MODERN WIRELESS

November

1/-

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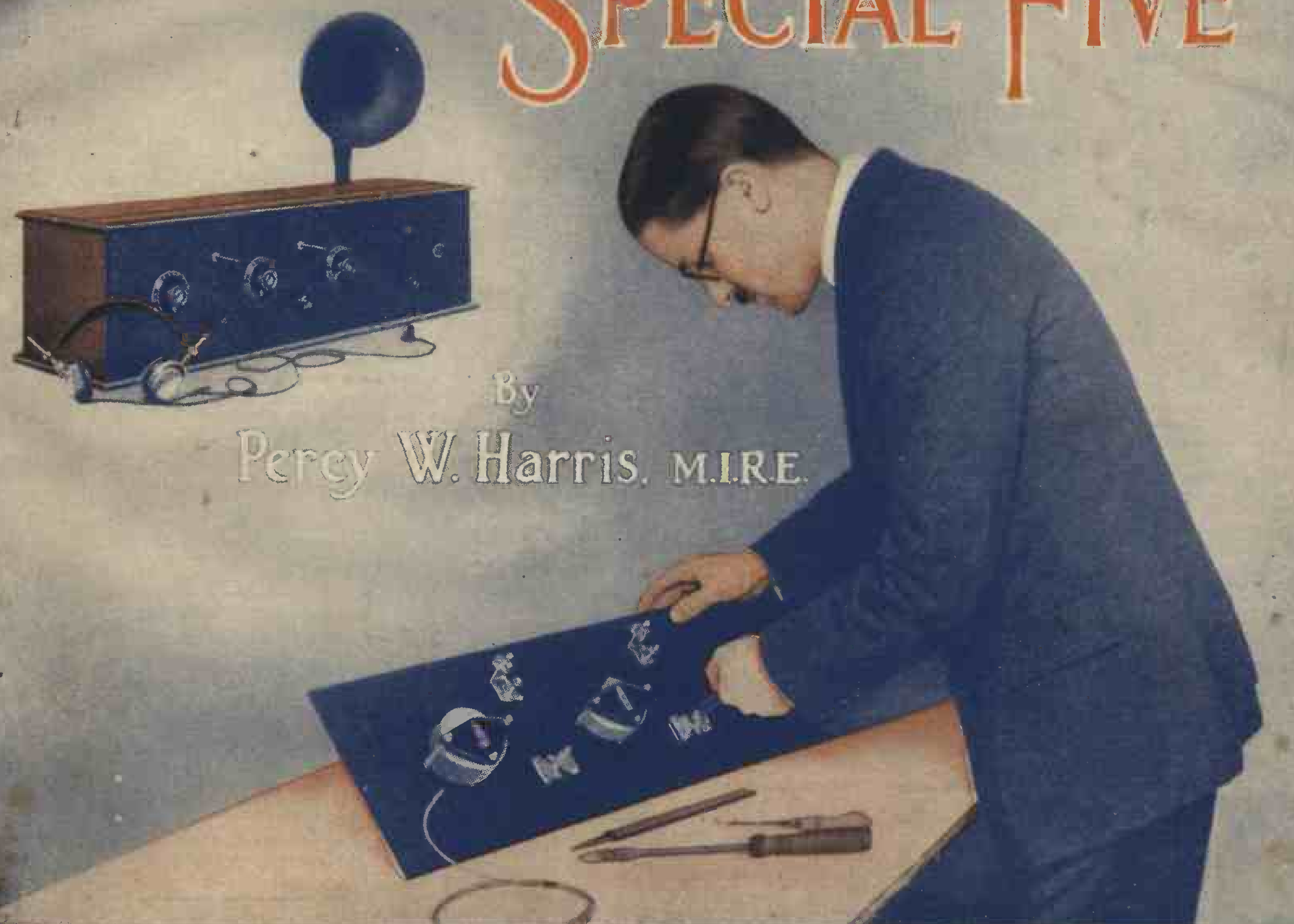
THE "SPECIAL FIVE"

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



HOW TO MAKE; A THREE-VALVE REFLEX SET. *By J. H. Reyner, B.Sc. (Hons.), A.C.G.I., D.I.C.*
A TWO-VALVE SET. *By E. J. Marriott.*
A TWO-VALVE POWER AMPLIFIER. *By C. P. Allinson.*
A SINGLE-VALVE SHORT WAVE SET. *By D. J. S. Hartt, B.Sc.*
A CRYSTAL RECEIVER. *By A. Johnson-Randall.*

A NOVEL METHOD OF SMOOTHING D.C. RIPPLES. *By Major James Robinson, D.Sc., Ph.D., F.Inst.P.*

CHOOSING A VALVE. *By Captain H. L. Crowther, M.Sc.*

THE TRUTH ABOUT APERIODIC AERIAL CIRCUITS. *By G. P. Kendall, B.Sc.*

CAN COIL CAPACITY BE NEGLECTED? *By H. J. Barton-Chapple, B.Sc. (Hons.), D.I.C., A.M.I.E.E.*

A handy reference book for the home constructor —the Burndept Components Catalogue

Copy of Latest Edition sent FREE on request

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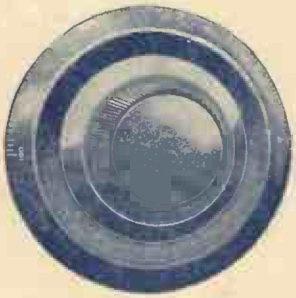

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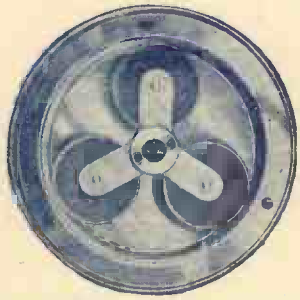

The simple mechanism of the Burndept Super-Vernier Dial. The ratio is about 7 to 1.

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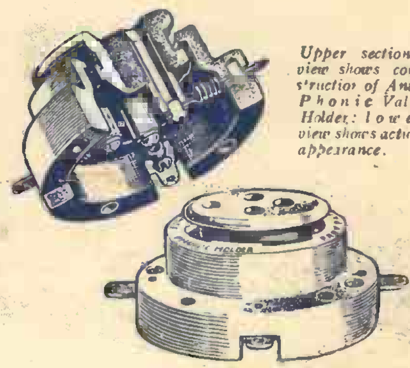

Upper sectional view shows construction of Anti-Phonic Valve Holder: lower view shows actual appearance.

being supported by four springs which absorb shocks and vibration. As the valve sockets are countersunk, the risk of accidental short-circuits is eliminated. The Anti-Phonic Valve Holder is fitted to most Burndept Receivers and is suitable for panel or base mounting.

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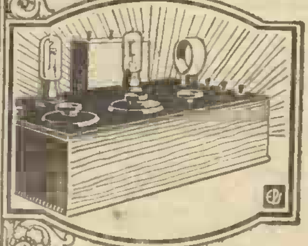

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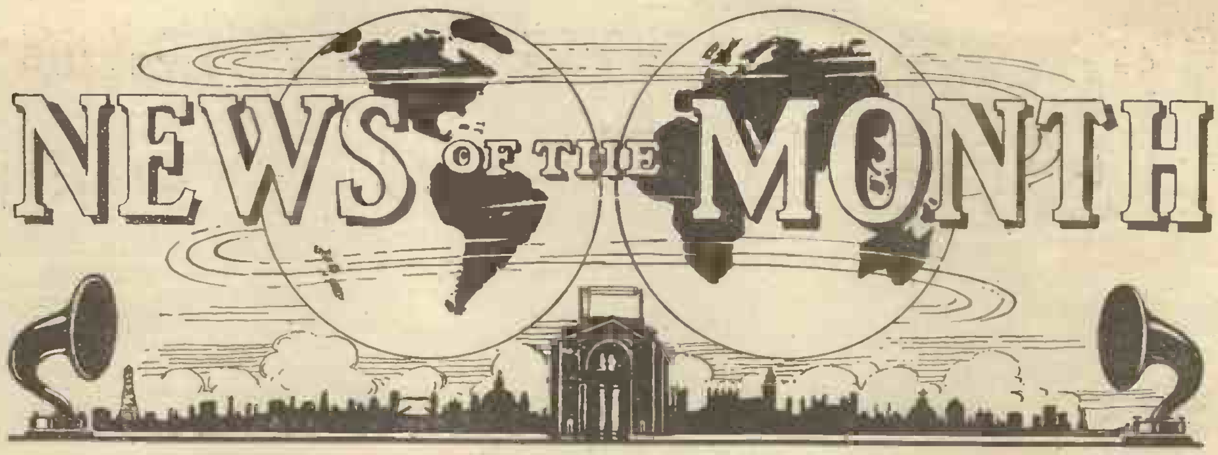


NOW that the winter is upon us the wireless enthusiast is commencing operations in earnest. Reception conditions are improving noticeably week by week, and in view of the developments which have been made during the past summer, we may look forward to a very interesting winter of experimenting.

Tendencies this Winter

Major Robinson outlined the tendencies in radio design in our September issue. There can be little doubt that this winter is going to be a selectivity winter. Super heterodynes will be experimented with to a considerable extent, but more straightforward types of circuits will not be neglected. The problem of short-wave reception must not be lost sight of, and, as is outlined in this issue, there is some very interesting matter to be received at these high frequencies. We wish our readers all success this winter, and they can rest assured that we shall keep them well posted with the latest details.

Features in This Issue

We have this month an attractive list of sets. Mr. Harris describes "The Special Five," which is to a large extent the outcome of his recent experiences in America. The circuit is remarkably selective, but goes one better than the average American set in that the low-frequency side is markedly superior, a very good quality of reproduction being maintained.

A somewhat different set is the Anode Input Reflex Set by Mr. Reyner. This set has been designed for those who want a simple loud-speaker set with a minimum of adjustment. There is only one tuning control and a very smooth reaction adjustment. It is primarily a set for the local station, but has given satisfactory reception on quite a number of the more distant stations.

For the benefit of those who prefer to use plug-in coils throughout their receiver, Mr. Marriott has designed a Two-valve Neutrodyne receiver. This set employs two plug-in coils for the neutrodyne stage, the coupling between the two being variable to obtain the maximum flexibility.

For the Short-Wave Enthusiast

A simple short-wave receiver is described by Mr. Hartt, and this, in conjunction with an article by Mr. Hort on "What to Listen for on Short Waves," will be of particular interest to those who have not yet explored this region of the ether. For the coast dweller or those who experience interference, Mr. Johnson-Randall has designed a two-circuit crystal set. This circuit employs a tuned aerial loosely coupled to a tuned low-loss secondary and is capable of giving very selective results. The tuning of the set is not unduly complicated, and this set will no doubt prove of use to those who are troubled by jamming.

A Power Amplifier

Many people think that a power amplifier is a difficult and costly piece of apparatus to construct. This, however, is not the case, and a particularly successful two-valve power amplifier has been designed and described by Mr. Allinson. This instrument gives excellent strength and quality. In fact, used with a crystal set within ten or twelve miles of the local station, the results are quite uncomfortably loud.

Articles

There is the usual quota of interesting articles. Major Robinson gives details of a novel arrangement for obtaining high-tension supply from D.C. mains without the use of the usual chokes and condensers for smoothing purposes. Capt. Crowther gives some useful advice on the choice of a valve for a particular purpose.

Those readers who have experienced difficulty in obtaining smooth control of reaction will find some interesting remarks in an article on Reaction Control Circuits, wherein the conditions for smooth reaction are laid down and a large number of suitable forms of circuit are given.

Other articles of interest follow, including several novel features.

Finally, we would particularly refer our readers to an article by Mr. Kendall, on the subject of the so-called "Aperiodic Aerial." Mr. Kendall shows that the aerial circuit in such cases is really tuned, but that the resonance curve is so broad that one coil serves to cover a wide band of frequencies.

THE "SPECIAL FIVE"

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

In this article Mr. Harris gives a pr ctical description of a receiver he has designed as a result of his recent visit to America. It is highly selective and is a big step forward in the improvement of receivers for the home constructor

IF I were asked what qualities the average experimenter desired most of all in his receivers, I should have no hesitation in answering selectivity and range. After the first novelty of receiving any wireless at all has worn off, the desire to reach out into space in search ot distant stations grows apace; but however sensitive the set may be, if it is not selective, the local station will make itself heard over a wide tuning range, completely swamping the distant stations.

Good Quality

Third in the list of desirable characteristics I would place quality. Increasing attention is being paid to this desirable feature of receiving sets, particularly as the broadcast programmes themselves are particularly well transmitted in this country. In audio-frequency amplifiers, and in loud-speakers to work with them, Great Britain unquestionably has the leading place, and our detector circuits are at least as good as anybody else's. Improvements in selectivity and sensitivity, as I have pointed out in previous articles, are largely dependent upon the development of the high frequency amplifying side of our apparatus, and since returning from the United States, I have devoted a good deal of thought and experiment to this question.

Sensitivity

The receiver described this month will, I hope, appeal to those home constructors who are in search of the desirable characteristics referred to above. It is by far the most selective receiver I have yet designed; its sensitivity is of a very high order (at Wimbledon I have received Birmingham at medium loud-speaker strength, without any aerial, but just the earth lead alone); it is economical to run, using a total filament current of 1¼ amperes, with the valves for which it is mainly intended, and considerably less if the ·06 type of valve is used; the quality of reproduction and silence of background are both remarkable, and finally, although it is large, the wiring and general construction are both very simple.

Special H.F. Transformers

The theoretical circuit which is given in Fig. 1 has several points of interest to the home builder. There are two stages of high frequency amplification, a detector, and two stages of note magnification, one of these being transformer and the other resistance coupled. The coupling of the high frequency stages is of special interest, and contains a form of neutralisation similar to that used in one of the best known and most efficient American sets. Although the method itself is not very well known, it is by no means new, and certainly deserves a wider popularity. The actual

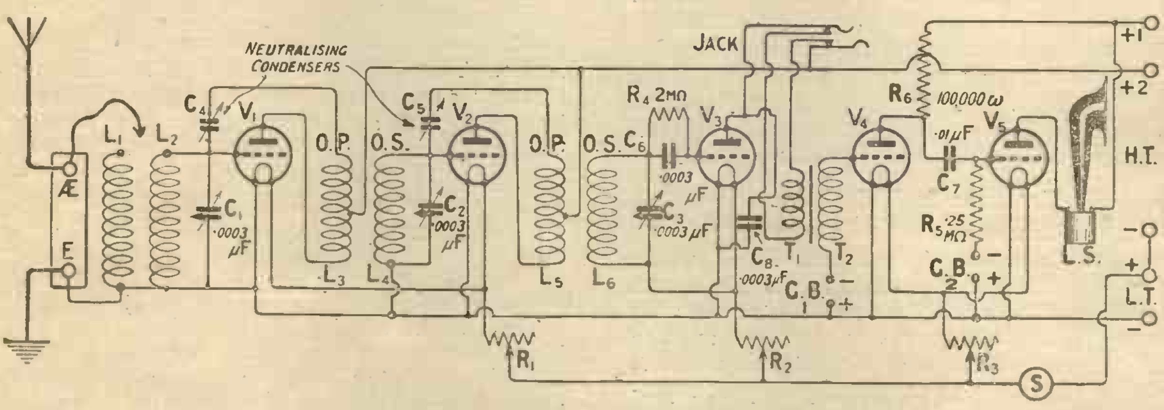


Fig. 1.—The circuit diagram is straightforward, the advantages of the set resulting from the special H.F. Transformers employed.

high frequency transformers used are of a design manufactured by Messrs. Peto Scott Co., Ltd., modified according to some suggestions I made to the firm. They are interchangeable, so that widely different wavelength ranges can be covered, and embody several of the points mentioned in my last month's article on "High Frequency Transformer Design."

The tuning of this set is so exceedingly sharp that at first the reader may have difficulty in picking up stations. To simplify pick-up I have designed a special aerial tuning coil arrangement which, as a matter of fact, can be very simply adapted to other receivers.

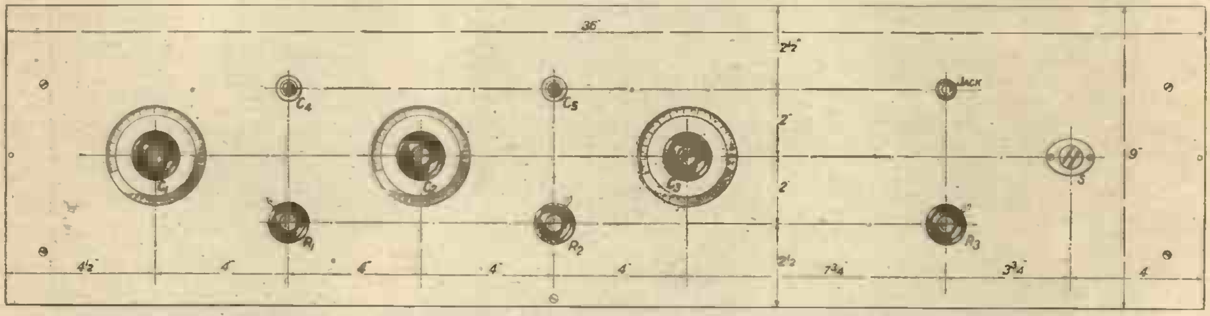


Fig. 2.—Simplicity is the keynote of the panel lay-out as shown in this figure. A full-size blue print (No. 136a) may be obtained on application, price 1/6 post free.

Aerial Coupling Arrangements

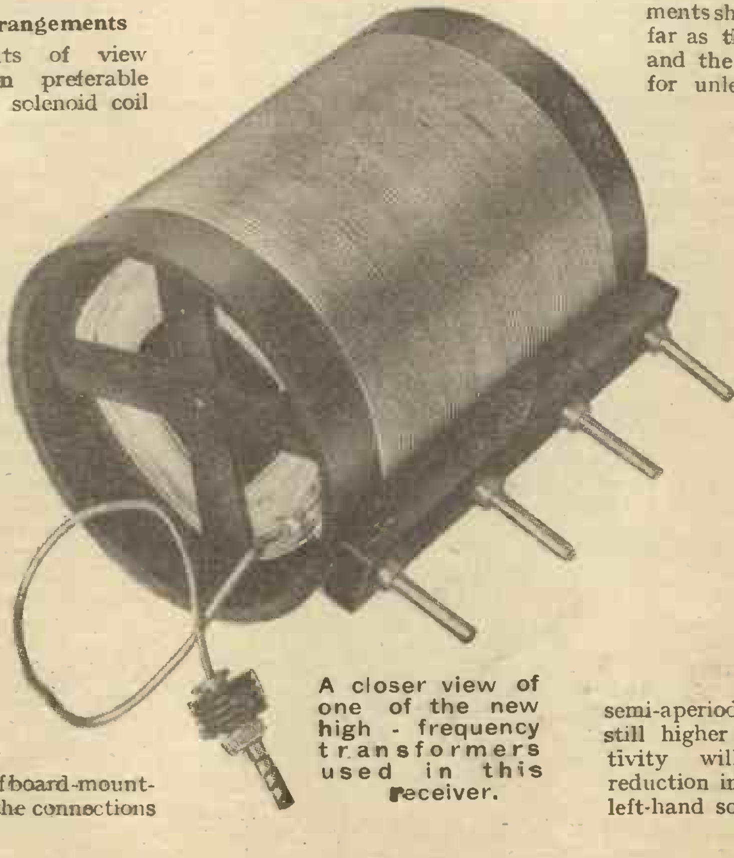
From some points of view it would have been preferable to use a single-layer solenoid coil in the first grid circuit, but in view of the many interesting combinations possible with plug-in coils of efficient design (by the way, plug-in coils vary widely in efficiency), and as, moreover, we want to be able to cover very wide bands of wavelengths when listening to broadcasting in Europe, I have thought it advisable to introduce the arrangement to be described.

Two Coil Socket

It consists of two board-mounting sockets for plug-in coils, placed side by side, and slightly separated. The type of board-mounting socket in which the connections are made by screwed terminals has been chosen for reasons which will be obvious on examining the receiver. On one side, the two sockets are bridged by a wire, and on the other side the left-hand terminal is left free, while the right hand is joined to the variable condenser and grid of the first valve. The other side of the variable condenser is joined to the earth wire.

Preliminary Tuning

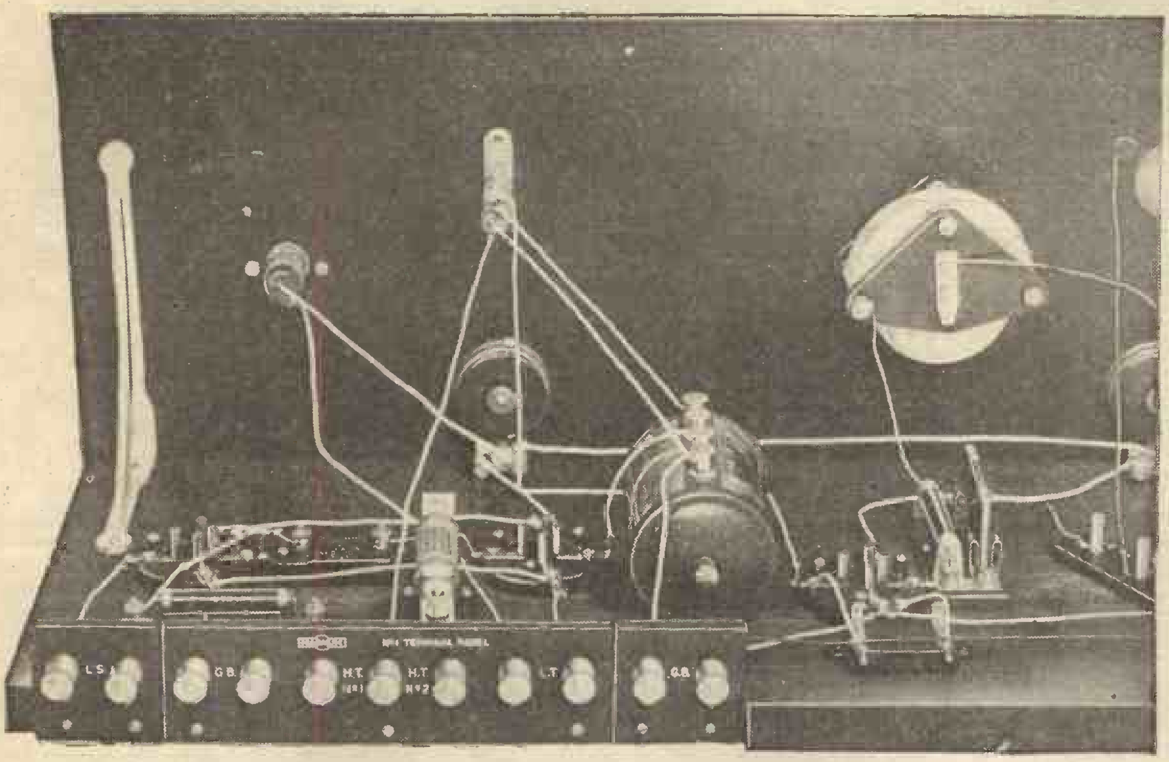
Examination of Fig. 4 will show that a flexible lead is connected to the aerial terminal A, and a permanent connection is taken from the earth terminal E to the bridging link on the other side of the two sockets. If now the flexible lead is connected to terminal No. 2, and a suitable coil plugged in to the right-hand socket, we have direct coupling of the aerial to the grid circuit. This gives fairly flat tuning, and is useful when picking up a distant station, to enable you to tune in the high frequency stages. When the other tuning has been adjusted for the best results, the flexible lead can be removed from terminal 2, and the plug-in coil changed for, say, a Lissen X coil, while the flexible lead is connected to one of the tappings on the X coil. In passing I should mention that it is essential to follow the exact arrangements shown in my drawing, as far as the position of the pin and the socket are concerned, for unless this is done, the tapping on the X coil will not come in the right position.



A closer view of one of the new high-frequency transformers used in this receiver.

Increasing Selectivity

This arrangement will give higher selectivity, but should it not prove sufficiently high, the flexible lead should be removed from the X coil tapping and inserted in terminal I, the X coil being left in the right-hand socket. Now in the left-hand socket plug a small coil, such as a 25 or 35, whereupon you will obtain semi-aperiodic aerial tuning, with still higher selectivity. The selectivity will increase with the reduction in size of the coil in the left-hand socket.



This view shows the low-frequency end of the receiver.

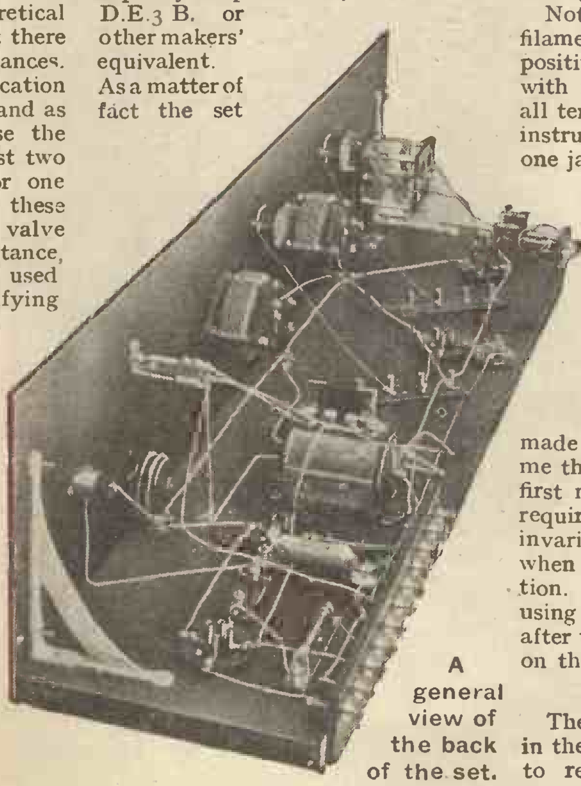
The tuning position of the first condenser will remain almost the same with any change in coil in the left-hand socket, provided that the left-hand coil is not too large. Gambrell coils also serve admirably for this form of coupling.

In examining the theoretical diagram it will be noted that there are but three filament resistances. I am all in favour of simplification of wireless receiver control; and as it is highly desirable to use the same type of valve in the first two sockets, I have arranged for one filament resistance to control these two valves. The detector valve has its own filament resistance, and one filament resistance is used to control the two note-magnifying valves.

Suitable Valves

My favourite valve for this type of receiver is the kind using about ¼ ampere, sometimes referred to as a small power valve. Valves of this type are made by a number of manufacturers. The first note magnifier valve should preferably be of the type designed for resistance capacity amplification. If ¼ ampere valves such as the D.E.5 are used in sockets 1, 2, 3 and 5, and if for the first L.F. stage a valve D.E.5 B. or equivalent is used, the total filament current will be only 1¼ amperes.

If it is essential to use the .06 ampere type of valve, then the first note magnifier valve should be of the kind used for resistance capacity amplification, such as the D.E.3 B. or other makers' equivalent. As a matter of fact the set will work quite well with any good valve, but if you wish to use bright emitters throughout, use separate filament resistances for each valve, as it is not desirable to pass the current for two bright emitters through one filament resistance.



A general view of the back of the set.

Notice, too, that in this receiver filament resistances are all in the positive L.T. Leads. In conformity with modern tendencies in design, all terminals are placed behind the instrument, and I have used but one jack to enable telephones to be plugged-in after the detector valve. In case some readers may wonder why I have not included three jacks to enable telephones to be plugged-in after the detector, the first note magnifier or the second note magnifier, I should explain that many months' experience with a receiver made up in this way has shown me that ability to plug-in after the first note magnifying valve is not required in practice, and that one invariably uses the loud-speaker when all five valves are in operation. My general rule is, when using the telephones, to plug-in after the detector and loud-speaker on the final valve.

Grid Bias Terminals

There are just two further points in the design to which I would like to refer before passing to con-

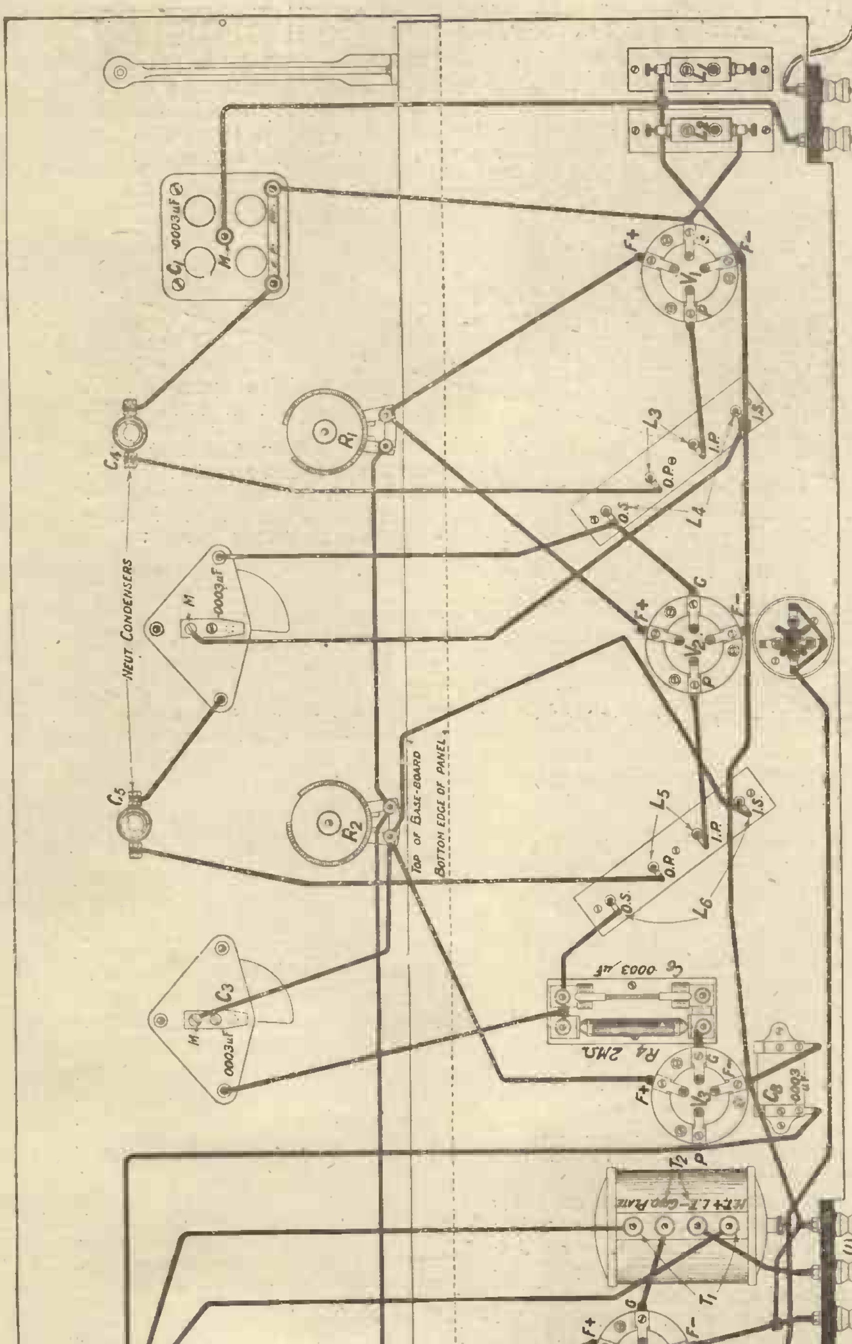


Fig. 3.—The wiring of the receiver is not complicated. Blue print No. 136b is obtainable, price 1/6, post free.

structional details. One is that I have not used a common positive terminal for the two grid bias arrangements. I have found in practice that quite frequently one uses separate grid bias batteries for the two last valves and indeed theoretically there are reasons for one doing so. It is always finnicky to place two different wires on the one terminal, and I think it will be found generally desirable to use four terminals instead of three, when grid bias is applied to two separate valves. Even if one grid bias battery is used, there is no difficulty, since both positive terminals are linked inside the instrument, so that either one can be the common terminal.

Separate Tuning Condensers

The final point refers to the question of the tuning controls. In many of my designs I have used a double condenser, requiring matched transformers. Some manufacturers of high frequency transformers have been very successful in their matching, as have some makers of variable condensers. But in many cases trouble has arisen through bad matching. We have by no means reached finality in high frequency transformer design, in view of which I have designed the present receiver, so that once it is made all kinds of high frequency transformers can be experimented with. For this reason separate condensers are used for each of the high frequency stages. There is then no possibility of trouble in regard to matching, and a wider flexibility is obtained.

Constructional Work

The wiring of the instrument is very simple, and is probably easier than that of any receiver I have previously described. The following components are needed:—

One Panel, measuring 36 in. by 9 in. by ¼ in. (this should be of first-class guaranteed ebonite of any of the reputable makes).

One Cabinet to suit (this is the same cabinet as used in the Anglo-American Six).

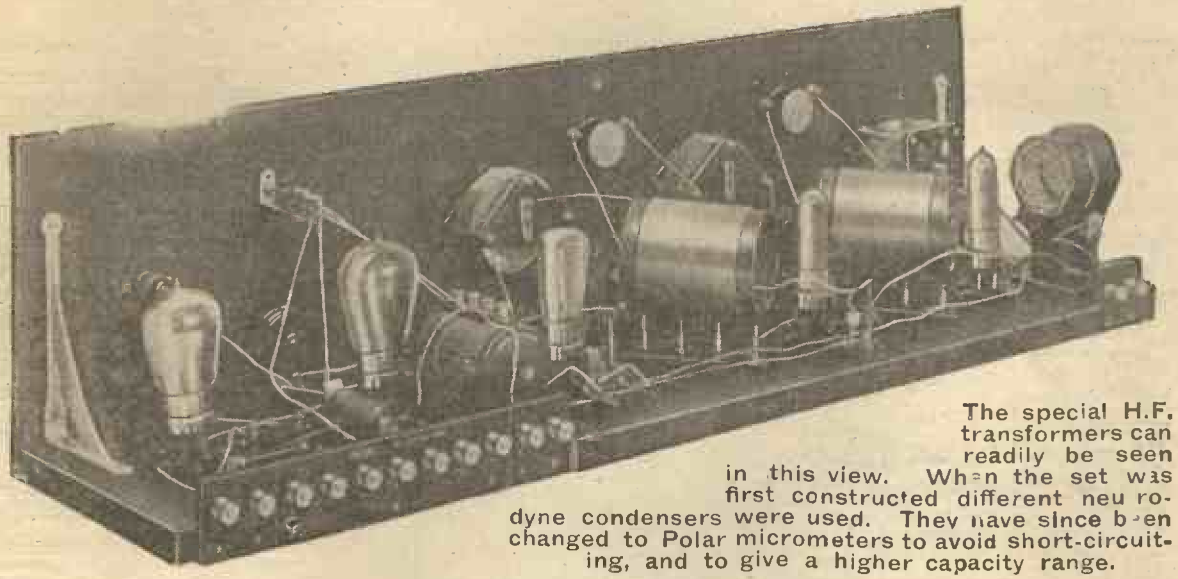
One Baseboard for same (this is usually supplied with the cabinet).

Two Board - mounting Coil Sockets, with side terminals (Peto Scott Co., Ltd.).

Three Square Law Variable Condensers, each of .0003 μF capacity (Bowyer-Lowe Co., Ltd.).

Three Filament Resistances to suit valves. For the ¼ ampere type of valve these can all be 5 ohms (Polar).

One Double circuit Jack with Plug (G.R.C. or equivalent make).



The special H.F. transformers can readily be seen in this view. When the set was first constructed different neutrodyne condensers were used. They have since been changed to Polar micrometers to avoid short-circuiting, and to give a higher capacity range.

One On and Off Switch (R. A. Rothermel Ltd.).

Two Neutralising Condensers (Polar Micrometer).

Five Board-mounting Valve Sockets (Antipong—Bowyer-Lowe Co., Ltd.).

Two Special High Frequency Transformers with tapped primaries (Peto Scott Co., Ltd.) (these are supplied with the board-mounting sockets).

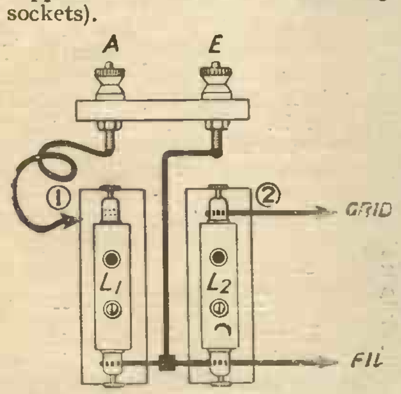


Fig. 4.—Illustrating the aerial coupling arrangements.

One Ordinary Board-mounting Valve Socket (this is used as a simple means of connecting the high tension leads to the transformers. It is not used to hold a valve).

One Grid Leak and Condenser combination. .0003 μF and 2 megohms (L. McMichael, Ltd.).

One L.F. Transformer (any good make will do. I have used the new pattern G.R.C., with considerable satisfaction here).

One 100,000 ohms Wire Wound Anode Resistance (Mullard Radio Valve Co., Ltd.)

One Fixed Condenser .0003 μF (Dubilier).

One Fixed Condenser ·01 μF (Dubilier).

One Grid Leak with mounting, ¼ megohm (L. McMichael, Ltd.).

Two Terminal Strips (one carrying aerial and earth terminals and the other the remaining terminals as shown (Magnum). (Burne Jones & Co., Ltd.).

Glazite Wire, for wiring up (about 20 feet will be ample)

Radio Press Panel Transfers.

Valves and Batteries

Notes on valves have been given at the beginning of the article. If dry batteries are used for high tension supply, it is suggested that one 60-volt unit with tappings be used for the first three valves, and a second battery up to 120-volts for the last two valves. If two such batteries are used, the negatives should be joined together and a wire taken to the H.T. negative terminal. High tension accumulators will give better results, in which case one high tension accumulator up to 120-volts can be used. In any case, whether high tension accumulators or dry batteries are used, a 1μF or 2μF condenser should be shunted across each tapping. I have not included these in the instrument as I consider fixed condensers as part of the high tension battery equipment.

The wiring is so straightforward that it needs no explanation other than that given in the drawings. Notice that three of the sockets of the valve holder used as distributor of the H.T. for the high frequency transformers are joined together. Flexible leads for the transformers are made to terminate with valve legs or other suitable plugs, and will then slip easily into the sockets. This facilitates change of transformers, when desired.

Operating Notes

The operation of this receiver will be learned very rapidly. The best way to start is to plug-in, say, a 60 or 75 coil (a 60 is advised, as this matches in inductance the high frequency transformers used). Disconnect aerial and earth and set all three condensers approximately at the same figure, say 20 degrees. If one of these condensers is swung backwards and forwards, it will be found that the set is oscillating. The two neutralising condensers should then be adjusted very carefully until the swinging of any of the condensers will not cause oscillation on the set. You will soon find how to do this.

Once this position has been found, the condenser can be locked by the ring provided, and the aerial and earth connected with one of the connections indicated in the beginning of the article. Stations will then be picked up with the greatest ease by rotating the three dials.

Since the above instrument was built, Messrs. Peto-Scott have brought out the transformer tapping to a separate pin, thus obviating the need of the flexible lead. With the new form the sockets marked "tap" are connected to the wire now shown as going to the valve socket used for the H.T. positive connections to the transformers. A test report and further notes on this set will appear next month.

OUR NEW GUARANTEE SCHEME.

The attention of readers is specially directed to the postcards enclosed, which give a further guarantee of satisfaction in their purchases from our advertisers.

In Passing

A Problem

"WHAT is worrying me," I remarked, "is whether switches are permissible and if so, which switches?"

"Eh?" said the Professor, looking up quite startled from his work. "My dear Listener, that sibilant sentence sounds like a spluttering soda siphon."

"Same to you and many of them," quoth I, at which the good man smiled, realising with some surprise that he himself was suffering similarly. . . No, this is terrible; this shushing business grows on one, and if I do not bring myself up short I shall run the compositor out of s's before he has got through more than the first paragraph. If that happened I suppose he would use f's, pretending that they were old fashioned long s's and then we should find the whole thing filled with fuch fentencef af "Fhould we ufe fwitchef?" or "Fwitchef are diftinctly liable to become an obfeffion." That of course would never

Whilst I fling ink over my left shoulder.

do, for probably you, reader, would get the habit, and instead of shushing you would go fuffing about all over the place.

Suppose One Lisped

Possibly if you happened to have a lisp you would find things still worse, for you might be called upon to read aloud what I have written and it would be very hard lines if you had to talk about "Thothe thwitthef that theem abtholutely nethethary." Thtill I dethire. . . Excufe me . . . Oh well, hang it, forgive me—that's a word you can't meff about anyhow. One moment please whilst I fling ink from my fountain pen over my left shoulder, turn the table round three times, and do the other things which ward off evil influences. What I am trying to say, if only I can manage to get it said without slipping into f's or th's, is that I want to tell you all about Professor Goop's opinion of switches and in doing so I will endeavour neither to shush nor to fuff nor to thuth more than I can help.

Switches

I think that at this point we had better have a fresh paragraph so that we may get a really fair start. It took the Professor and myself quite a little while to get our tongues straightened out. When he did answer my question he began "Such switches as are essential . . ." but I pulled him

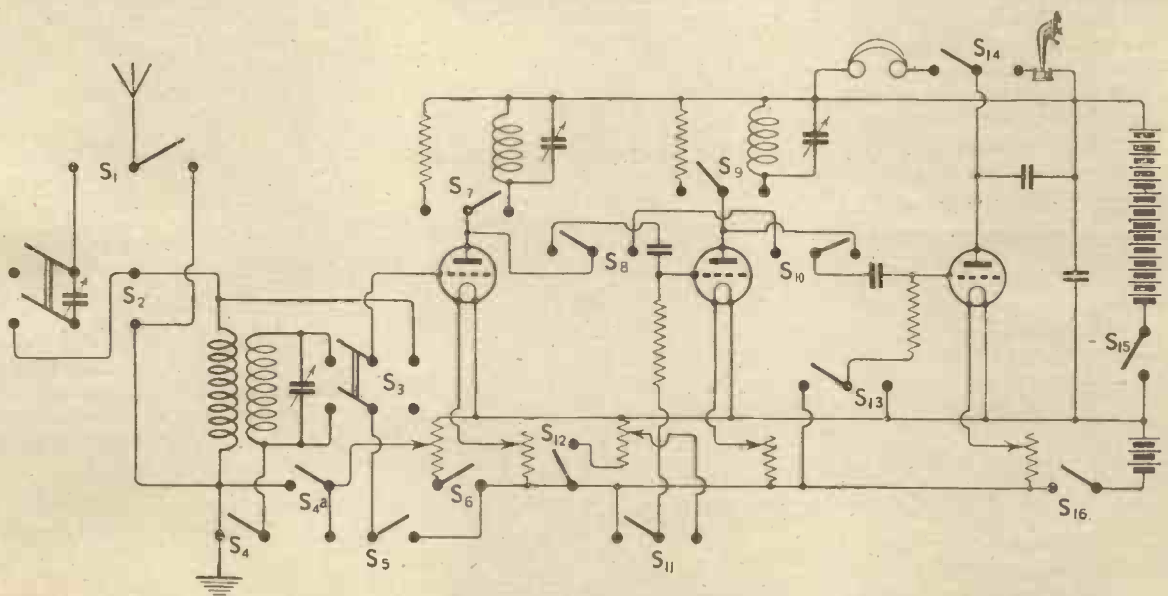


Fig. 1.—The thorough use of switches as suggested by Professor Goop.

up short. We agreed to abandon altogether words like such and essential and susceptible, feeling that we should be safer if they were taboo. Eventually we got under way and the Professor gave me his opinion on the subject, which I now set down in a somewhat abbreviated form for the benefit of an eagerly waiting world. Switches, the Professor went on to say, are exceedingly useful for a

Indispensable to the bobbed and shingled.

variety of purposes. Without them, properly applied, the young idea could never be taught to shoot as it should; without switches, shunting upon railway lines would become an impossibility and much unemployment would be caused; without switches the bobbed and the shingled would be unable to grow at a moment's notice long tresses should occasion demand it.

Switching and Pulling

The switch then is not be be condemned in any sweeping fashion. In the wireless set the thorough use of switches shown in Fig. 1, enables the proud owner practically to turn his set inside out at a moment's notice should he wish to do so. Perhaps I am a little rash in saying at a moment's notice, for in the case of the thoroughly switched set it is best to give at least half an hour's grace to allow the operator to disentangle the various switches and to arrive at the correct combination. Anyhow this is much quicker than pulling the set to pieces and resoldering all the connections necessary. As a matter of fact, though, thorough switching and pulling the set to pieces are almost synonymous terms since, if the switches run from S1 to S16, as they do in the diagram, there are about forty points to come unstuck, and if I know anything about wireless sets one of them always will. Unfortunately I have no room to show you more than the high frequency side of the circuit in question. If only the pages of MODERN WIRELESS were slightly wider I would draw you the low frequency department as well and we could have another dozen or so here quite comfortably.

Variety

You see the beauty of a circuit of this kind. The operator can earth his aerial in a flick, use a single or double circuit tuner, throw the A.T.C. into series or parallel, earth the secondary or not, connect the grid of the first valve to the potentiometer or to low tension negative, use tuned plate or resistance capacity coupling with his high frequency valves at will, connect the grid-leak of his rectifier to low tension positive or low tension negative, connect the ditto of the second high frequency valve to the potentiometer or low tension minus, cut out both potentiometers when they are not required, connect the telephones or loud-speaker and switch off both high and low tension batteries. In a word his set is thoroughly flexible, so flexible in fact that it will usually be caught bending. If he remembers to disconnect the aerial from earth the odds are a shade over 10 to 1 that he will omit to switch on his high tension battery. Should he do this it is Bush House to a busbar that he will omit to switch on the accumulator and will run round in

He goes on trying until it comes off.

circles grinning like a dog and wondering why and how all the filaments of his valves have burnt out unbeknownst since the last time he used the set.

Something to Play With

Still, he will have heaps to play with and that is what the average wireless enthusiast really wants. If you gave him a one-knob set he would be utterly miserable. The whole thing would be so dull. Most of us like the possibility of trouble. This is to be seen from our very earliest days. Give a baby (and do not forget that you and I were once things like that, smiling only when we had indigestion) a feeding bottle whose mouthpiece thing can be worked off if he tries hard enough and the child is perfectly happy. He goes on trying until it comes off and he is drenched from top to toe in a flood of warm milk. He then yells to attract attention and positively wriggles with joy as he watches his fond mamma's efforts to clean up the mess.

Uninteresting

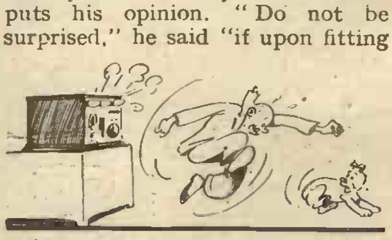
Present the same child with a perfect safety feeding bottle and see what happens. He makes one or two strenuous efforts to bring off the old jest, and then finding that there is nothing doing, he goes black in the face and does not laugh again until the doctor turns up. As fully fledged wireless men to-day we are precisely the same. Though being compelled to disembowel the set with screwdriver, pliers and a selection of other tools is no more pleasant than being wet to the skin with a bottlefull of milk, we still regard the set which does not make the process necessary at frequent intervals as something flat and totally uninteresting.

Examinations

An Athenian sage, who has probably bored more schoolboys than any other man alive or dead, once wrote that life without examinations would be a wearisome thing. As regards this sentiment I find that my young hopefuls are in complete disagreement with the philosopher when the end of the term approaches. They maintain that life without examinations would be a happy and a glorious thing. But there speaks the voice of inexperienced youth. The wireless man knows full well that unless he were called upon to make frequent examinations of his set he would soon chuck wireless altogether and take to knitting or spillikins as a hobby.

Shushing

Here I feel that I must quote Professor Goop's actual words, though I can take no responsibility for the way in which he puts his opinion. "Do not be surprised," he said "if upon fitting



He will run around in circles.

many switches swishing, swashing and swushing noises are heard in the receivers." There is, of course, a great deal of truth in this remark, though I hasten to point out that any of the noises which he mentions—I forbear from repeating them, for you know them quite well—can usually be brought to an end by the manipulation of S15 or S16 in the diagram, to say nothing of S1. A similar result may also be obtained by leaving S8, S10 or S14 in the open position.

We All Do It

Do not imagine from what I have said that Professor Goop throws cold water with both hands upon the switch in the wireless set. As you know he is one of the most broadminded of men and any such attitude would be completely foreign to his nature. Though in theory the Professor is opposed to switches, especially upon the high frequency side of the set, I can assure you that his own receiver bears a very marked resemblance as regards its wiring diagram to Fig. 1. So, if you will but admit the truth, reader, does yours—provided that you are a genuine experimenter—as naturally you are—and so does mine. It is so delightful, is it not, to be able to change from the short waves to the long by just flicking over a switch and so bringing in the resistance coupling instead of the tuned plate. Really it would be just as simple and far more effective to change the coils, but for some unknown reason the last thing that any really serious wireless man wishes to do is to change more than two coils. He can just manage the A.T.I. and the C.C.I., but when it comes to any more he goes cold all over at the very thought. It goes utterly against the grain to have to pull coils out of their sockets and to push in others to replace them. He will do almost anything else that you may suggest with the utmost cheerfulness, but when this question of changing coils crops up he goes on strike at once. Many of my friends have never heard Daventry or Radio-Paris simply because they cannot bring themselves to mount the necessary inductances, though all are lying ready to hand upon the wireless table.

The Single Switch

What I find happens to me as regards switches is this. Exercising the greatest self restraint, I proceed to construct a switchless set. Then some fellow writes an article showing how easy it is slightly to improve one or other of the circuits. To try out the new idea I fit up a neat little switch so that I can change over from the old circuit to the new and *vice-versa* in a second and so compare the two properly. That switch remains a permanent part of the receiver. The following week comes another new improvement and another switch. At the end of about six months the panel is positively bristling with switches, and though I know that their presence is responsible for many evil things I cannot bring myself to do away with them. This goes on until there comes a time when wishing to fit yet one more switch I cannot find room for it anywhere. At this point I cover my head with ashes and cry aloud that I will sin no more. I pull the set to pieces and make a new one purified from all taint of switching. If you want to continue the story you have only to go back to the beginning of this paragraph. Recently the Professor and I came to the conclusion that no set should contain more than a single switch and we have pacified our consciences by designing the Goop-Listener Single Switch Unit, which can be attached to any wireless set. I must admit that it is rather a bulky affair, looking rather like the control arrangement of a power station, still it is a *unit* and it enables you to do practically all the things that you can with the circuit in Fig. 1. As the Professor said, there is no doubt about its singleness, and you can always tell your friends perfectly truthfully that you have no switches *in* your wireless set, the Goop-Listener Single Switch Unit being quite outside it.

THE LISTENER-IN.

Radio Press, Ltd., Opens an American House

A. H. Morse, A.M.I.E.E.

A NEW era of Radio Press achievement has dawned with the inauguration of our new American House. Through these offices our readers will be kept in close touch with American ideas, developments being quickly reported by a competent expert, who, moreover, will view such progress through English eyes.

Mr. A. H. Morse, A.M.I.E.E., M.I.R.E., who has been appointed as manager of the new company, has been actively concerned with the technical aspects of radio communication for some years.

Varied Career

In 1897, Mr. Morse started in the Post Office Telegraph Service, which he left in 1900 to serve in the South African war. He subsequently supervised the erection of one of the first telegraph lines in West Africa.

From 1906–7 he served as consulting engineer to the De Forest Wireless Corporation, of which he later became Superintendent.

From 1909 to 1911 he was Superintendent of Construction and Maintenance to the United Wireless Telegraph Company, and in 1912 joined the Marconi Company in this country.

Three years later he was appointed adviser to the Indo-European Telegraph Co., but returned to Canada in 1919, when he became Managing Director of the Marconi Company in that country, an appointment which he held till 1923 when he resigned in order to enter business on his own account.

Radio Press, Ltd., will thus be admirably served and our readers will receive the latest information from the new offices, situate in the Bush Building, 42nd Street, New York, an excellent position in one of New York's most famous thoroughfares.

Appointment of H. J. Barton-Chapple

Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E., to the Staff of Radio Press, Ltd.

A recent portrait of Mr. Barton-Chapple.

IT is with great pleasure that we introduce to our many readers Mr. H. J. Barton-Chapple, who recently joined the senior technical staff of Radio Press, Ltd., as the outcome of our development policy in connection with the Research Laboratories at Elstree.

Qualifications

He is possessed of high qualifications, as a result of a particularly successful career. Before entering the City and Guilds (Engineering) College, Mr. Barton-Chapple secured a Whitworth Scholarship, which stands pre-eminent amongst open competitive scholarships in the United Kingdom, owing to the high standard of the examination and the rigid conditions for competing.

On entering College in 1919 he passed straight into the second year, and at the final examination of the third year secured the Associateship of the City and Guilds of London Institute (A.C.G.I.), heading the list of successful candidates and as a result securing the Siemens Memorial Medal. He also obtained the Henrici Medal for Mathematics, being the student of greatest merit in this subject. In the same year Mr. Barton-Chapple graduated at the University of London, obtaining the B.Sc. degree in Electrical Engineering with first-class honours.

This was followed by a fourth year Post-Graduate Course in Radio Telephony and Telegraphy under Professor Mallett, on the successful completion of which he was awarded the Diploma of Membership of the Imperial College of Science and Technology (D.I.C.).

Further Experience

On leaving College in 1922 Mr. Barton-Chapple was appointed Lecturer in Electrical Engineering (specialising in High-Frequency and Thermionic Valve work) at the Bradford Technical College. Since that time he has conducted classes in Electrical and Radio Engineering, being entirely responsible for the courses in the latter subject, and his efforts have met with particular success.

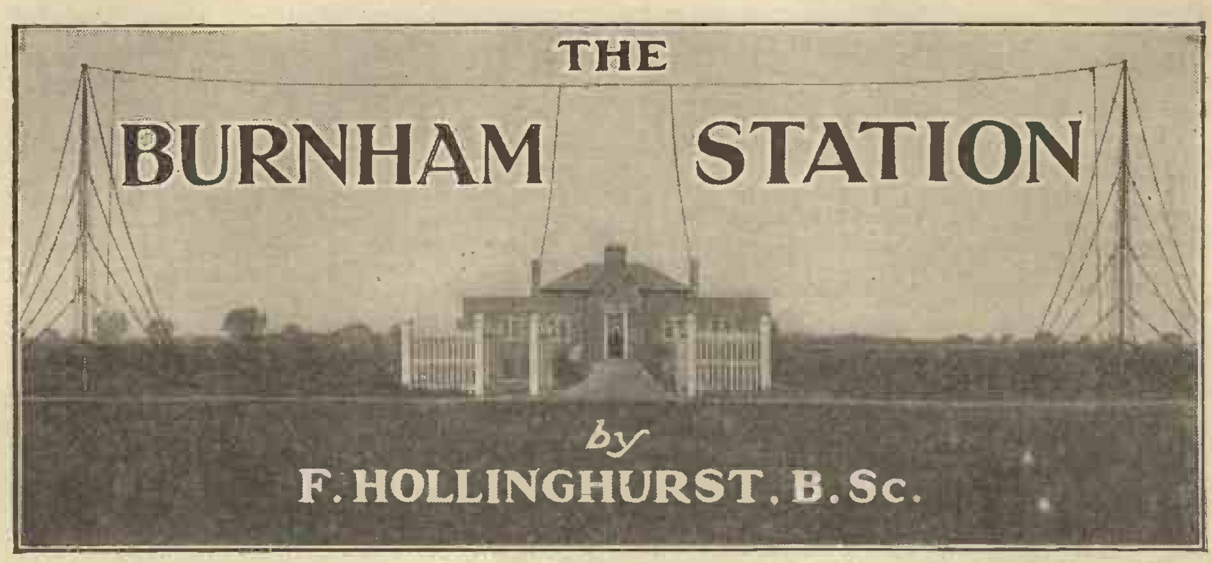
His duties brought him into immediate contact with every type of student. Thereby much experience was gained in elucidating problems in such a manner that students were able to secure a clear conception of the normally intricate points.

Practical Research

Mr. Barton-Chapple has had considerable opportunity for research work, and several articles on the results of such investigations have appeared from time to time in the technical Press.

While at Bradford Technical College he was elected an Associate Member of the Institution of Electrical Engineers (A.M.I.E.E.), a qualification which, as our readers know, is of a distinctly valuable character.

Our readers therefore may look forward to some very helpful articles from Mr. Barton-Chapple's pen, many of which will be the outcome of research work at our new laboratories which are now in full swing.



THE BURNHAM STATION

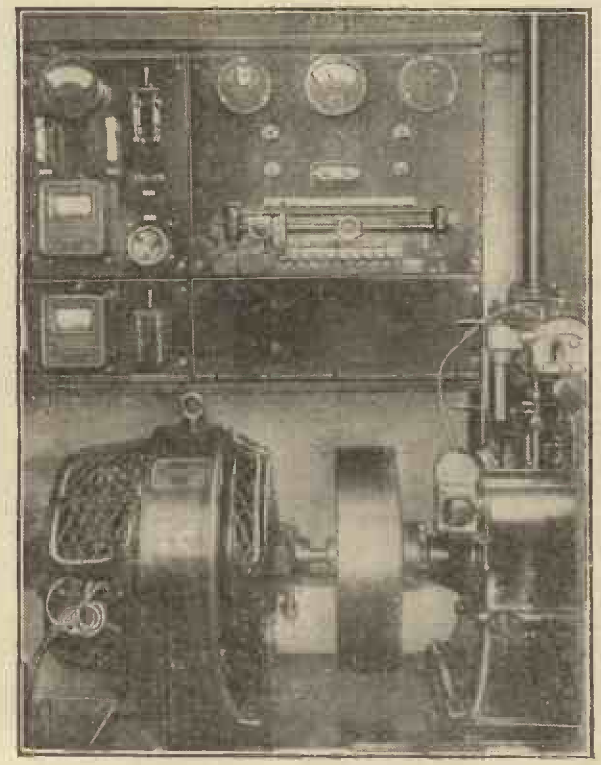
by F. HOLLINGHURST, B.Sc.

Some interesting details of the new station to augment the long distance CW traffic from and to ships, formerly handled by Devizes

IN August, 1920, the British Post Office opened a Wireless Station at Devizes, in Wiltshire, for maintaining communication with ships beyond the normal working range of the existing coast station system, which is not greater than about 150 miles. This station was equipped with a continuous wave transmitter and receiver working on two wavelengths of 2,100 and 2,400 metres to ships fitted with long range continuous wave receivers and 1½ kw. continuous wave transmitters to give a system having a maximum working range of from 1,500 to 2,000 miles.

Rapid Increase of Traffic

At the time of opening, only about 40 ships were so equipped, but by the beginning of 1923 this number had increased to 120, and as the facilities became known, the land station was rapidly outgrown. In order to cope with the increasing traffic, two possible courses were open. The first, to erect a new land station with transmitter and receiver some distance from Devizes, and the second, to build a new receiving station to house two or more receivers, and to install a second transmitter at Devizes. The second method was finally adopted, as being the more economical and workable, particularly from the point of view of future extension. Accordingly, work was commenced on the new receiving station near Burnham-on-Sea in Somerset, the station being completed and opened for traffic on February 2 of this year. The wave lengths of 2,100 metres and 2,400 metres were retained for the new service. The continuous wave transmitters with which the ships are equipped are capable of transmitting over a wave range of from 1,900 metres to 2,900 metres, so that more receivers can be added at Burnham as traffic requirements continue to grow. The site for the receiving station was chosen and laid out with a view to providing for such extension.

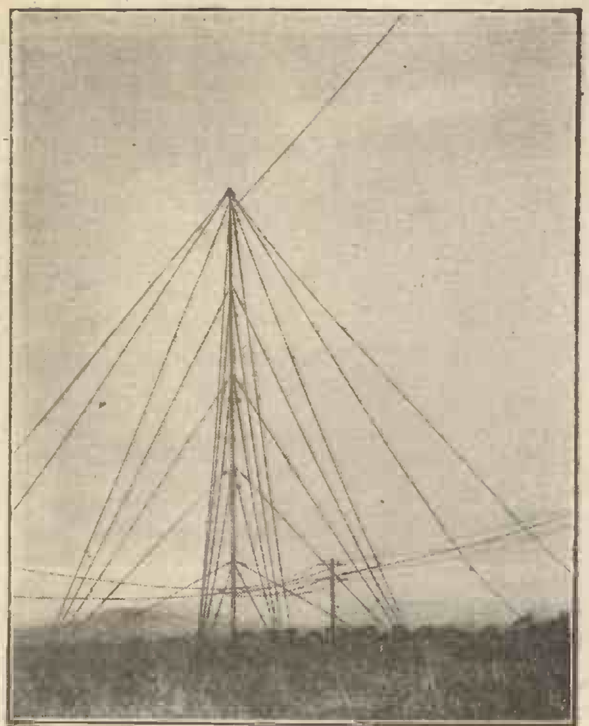


A view of one of the two 3 kw. generating sets. The automatic switchboard can be seen at the back.

Remote Control of Transmitter

With the adoption of the separate receiving and transmitting stations arose a necessity for some system of remote control whereby the operator at Burnham could listen to signals from ships, and could immediately reply by keying a transmitting set at Devizes. It was also desirable on grounds of economy that the same operator should be able to start and stop the transmitting set when he commenced or finished his outgoing traffic. The apparatus employed for this purpose is explained later.

The general appearance of the station can be seen from the photograph at the head of this article. The building itself is a single-storied brick structure, and contains a power room, battery room, two store-rooms, instrument room, land line room, office for the officer-in-charge, and retiring room



A view of one of the masts at Burnham showing the leads in from the loops.

for the staff. The instrument room is at the back of the building and overlooks the open site on three sides, thus allowing free access for leads from the aerials. Between the instrument room and the land line room is a communication hatch, through which messages received and written by the wireless operator can be passed for re-transmission by another operator over land lines to London, or through which messages received from London by land line can be passed to the wireless operator for transmission via Devizes to ships. The scheme is illustrated in Fig. 2.

Instrument Room

The receivers and other apparatus controlled by the operators are placed on benches which run round three sides of the instrument room, and are so arranged that the tuning, direction finding and filament controls of the receiver, the switch by which the transmitter at Devizes is started up and shut down, and the hand key which operates this transmitter are all within easy reach of the operator's chair.

A few feet away is the telegraph sounder by which land line signals from the engineer at Devizes are made audible. Power boards are fitted at intervals round the wall, and from these current at 52 volts for radio high tension circuits, 26 volts and 78 volts for land line circuits and 4 volts for radio low tension circuits is taken through fuses. These boards are also fitted with terminal connections to the radio and telegraph earths. A low tension switchboard for connecting to the three low tension batteries for charge or discharge is also fitted in this room.

The receiving equipment originally supplied by the Marconi Co. at Devizes is in use at Burnham. Directional reception is employed to minimise interference from the East, the majority of the reception being from West and South-West.

Facilities are provided whereby traffic may be received from ships at high speed and relayed direct to the Central Telegraph Office in London, where it is recorded telegraphically.

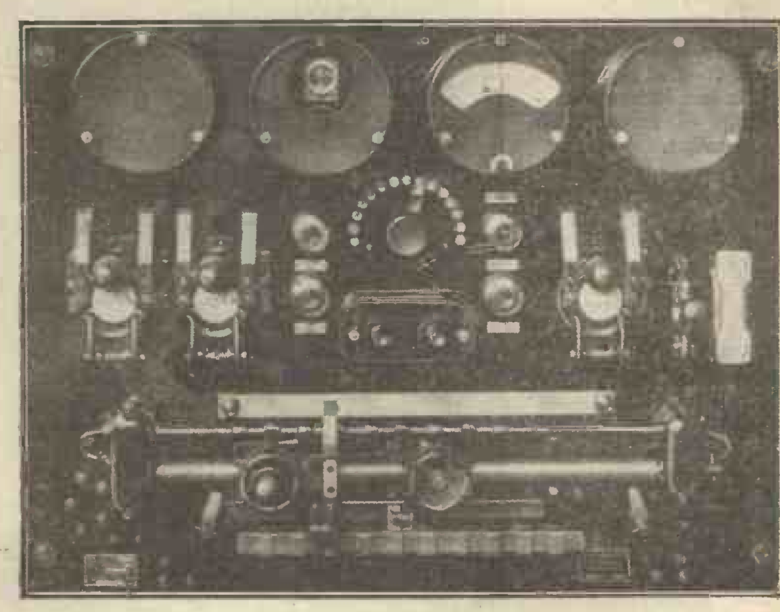
Power Supply

No power supply is available in the immediate vicinity of the station and an independent power supply is installed, comprising two similar engine generator sets, one of which can be seen in the foreground of the photograph of the power room. The prime movers are single cylinder petrol-paraffin four-stroke engines, driving 3 kW generators for charging the main 50-volt lighting batteries. The land line and H.T. voltages are also provided from small accumulators. They are of 8 amp-hour capacity and are the small cells seen in the photograph of the battery room. Part of the 50 volt lighting battery which consists of 27 cells of 200 amp-hour capacity can also be seen in this photograph. The battery room also contains six other cells forming the three 4-volt low tension batteries for lighting the filaments of the receivers. These cells are of the same capacity as those of the lighting battery and are connected in series with the main battery for charging.

An automatic switchboard is provided, which keeps the voltage on the mains constant between 52 and 55 volts. This is effected by means of an automatic switch, which cuts in or out certain cells at the end of the battery, so varying the total voltage within the limits specified.

Control Arrangements

It was stated earlier that the transmitters at Devizes were remote controlled from the receiving point at Burnham. This remote control apparatus at the receiving station consists essentially of a hand



A closer view of an automatic switchboard similar to that used at Burnham. The switch is operated by a motor at the back of the panel.

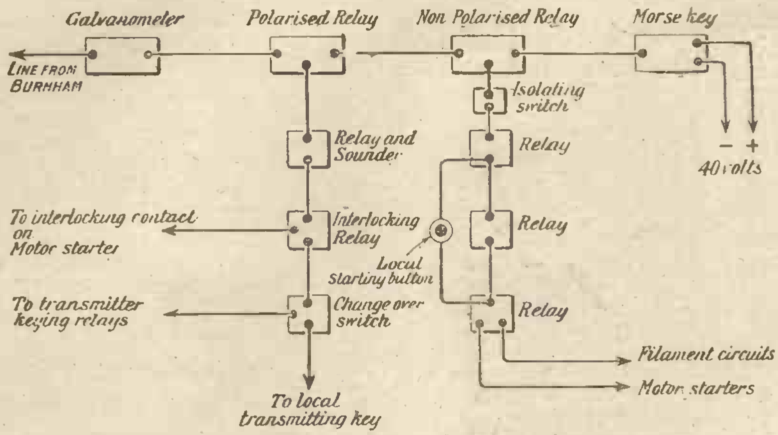


Fig. 1.—A diagram of the remote control arrangements at Devizes.

key and a switch key. The former is used for sending Morse signals to the engineer or for transmission through the sets to ships, and is arranged to reverse the connections between the battery and the line. The switch key is used for starting and stopping the transmitting sets, and in the "stop" position connects a 26 volt battery through the hand key to the line, while in the "start" position it changes over to a 78 volt battery.

Fig. 1 indicates the arrangement of the apparatus at the Devizes end of the control circuit. The operation of the polarised relay depends on the direction of the current passing through it. The reversals of current caused by the operation of the hand key at Burnham thus cause this relay to operate, and it is arranged to work on both 26 and 78 volts.

The non-polarised relay operates independently of the direction of the current, but will not work on the 26 volt battery.

Thus, when the switch at Burnham is in the "Off" position, the hand key can be used for "speaking" to Devizes, but will not operate the transmitter.

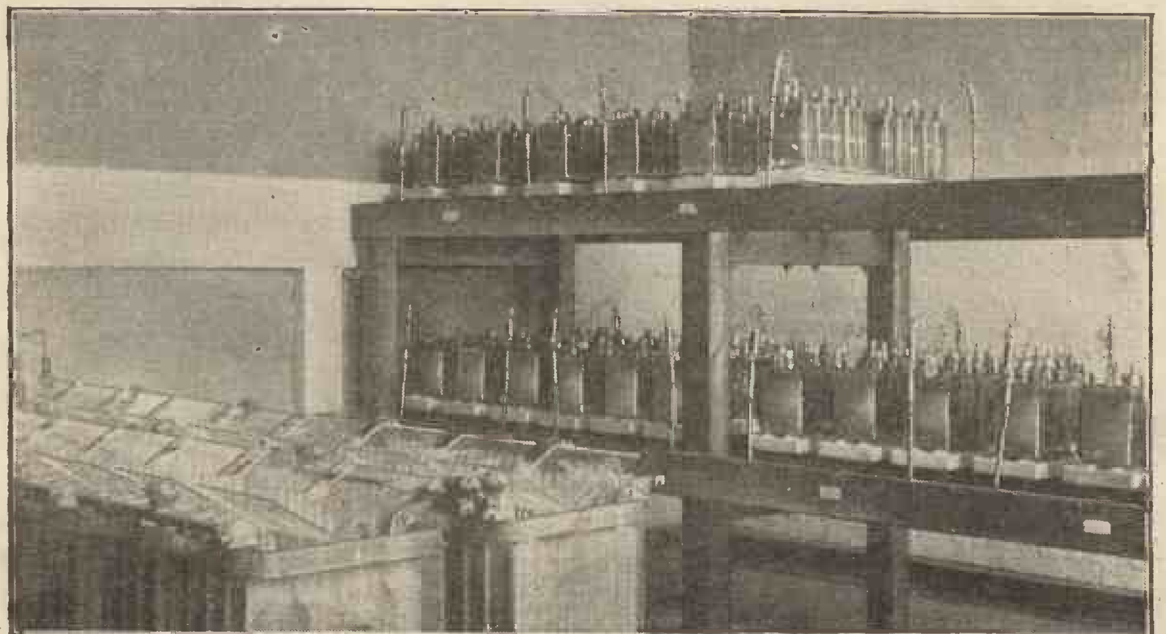
On placing the switch to "start," however, the non-polarised relay operates and starts up the transmitter. Operating the key at Burnham then causes the transmitter to function.

Safety Arrangements

An interlocking relay is incorporated at Devizes, which is a safety device preventing the operator from keying, and so taking a heavy current from the generators before they have had time to run up to full speed.

The control gear can be isolated or operated independently at the Devizes end if necessary.

The Devizes station is thus completely remote controlled by the operator at Burnham, the engineers at Devizes being concerned solely with the maintenance of the plant.



The lighting, the receivers and the land lines are run off accumulators all housed in one room. The main lighting batteries are in the foreground and the H.T. and land line batteries on the right.

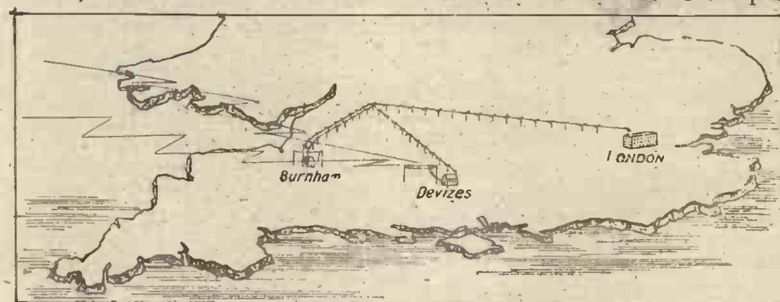


Fig. 2.—The station at Burnham controls the transmitters at Devizes by remote control and is also in telegraphic communication with London.

A SINGLE VALVE SHORT WAVE RECEIVER

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

MOST readers will remember that by last winter short-wave developments had reached such a stage that many enthusiastic amateurs were induced to make up receivers with the idea of receiving that popular station KDKA, of East Pittsburgh, Pennsylvania, then working on about 4410 kc. (68 metres. Those who did so no doubt experienced a certain amount of difficulty at first, and found that the conditions were not so straightforward as on the broadcast band. Later we saw further developments in short-wave reception and transmission, with the result that there is now a fair amount of activity down to about 20 metres and lower.

Larger Frequency Band

Thus we see that at the present time the enthusiastic amateur has to contend with a band of wavelengths of from twenty to about two hundred metres, if he wants to embrace the whole of the activities on the short waves. The main essentials for such a set are: First, a simple circuit which can be made to oscillate over the whole of the tuning range and which is at the same time easy to control as far as oscillation is concerned; that is to say, the oscillation control must be such as will allow one to bring the set into or out of oscillation easily without any backlash. No elaborate circuit is necessary, and that shown in Fig. 1 is probably the most satisfactory of the more simple circuits.

Design of Receivers

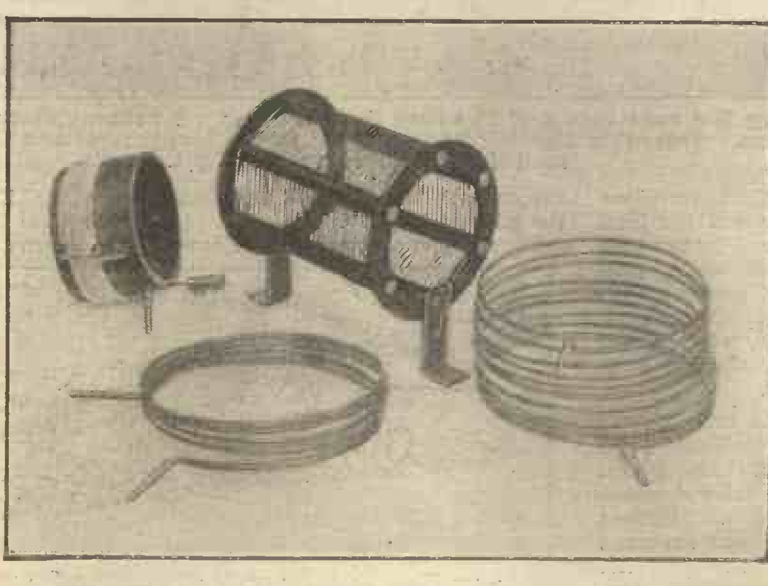
Further important factors to bear in mind in designing a wide wavelength-range short-wave receiver are the selection of components, particularly the variable condenser used for tuning, valve and valve holder, and the design of the coils to be used; in addition to these factors we must consider the question of casual capacities and endeavour to eliminate them as much as possible. Some further information on this subject will be found in my articles in *Wireless Weekly*, Vol. 6, Nos. 20 and 23, in which I discussed a number of characteristic cases.

It is, of course, an easy matter to make up a short-wave receiver from a given design, but it is somewhat more difficult to calibrate it.

There are, however, one or two methods of calibration on these high frequencies which the average amateur can use with success without much additional or more complicated apparatus. I refer here to the method of calibrating by harmonics and the Lecher wire method. This latter method is particularly suitable for calibrations on, say, 20,000 to 12,000 kc. (15–25 metres). I have described such a method of calibration in an article in *Wireless Weekly*, Vol. 7, No. 3, and have given some details on the "harmonics" method in *Wireless Weekly*, Vol. 7, No. 5.

Choice of Circuit

Now with regard to the present receiver, you will see from the circuit diagram that a simple oscillator circuit, using the form of reaction sometimes attributed to Reinartz, is used. A small aperiodic aerial coil is coupled to one end of the reaction coil. The local earth lead is made a tapping point upon the coil with the aid of a Burndept spring clip, or some similar device, so that the number of turns in the grid circuit and the number in the reaction coil can be adjusted. Reaction is con-



Some of the coils used by the author to tune from 15,000 kc. to 1,500 kc. (20 to 200 metres).

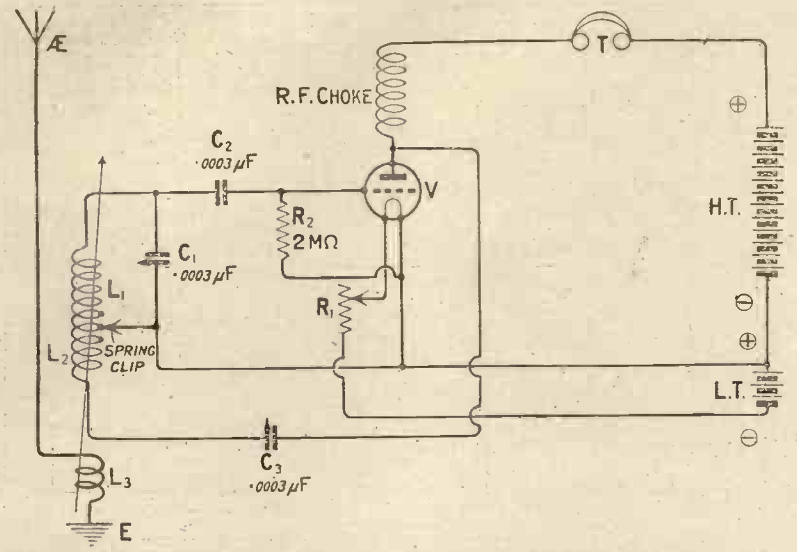


Fig.—The coils L_1 and L_2 are wound as one continuous coil. Note that the moving vanes of the variable condensers are represented by arrows.

trolled by the condenser C_3, otherwise the circuit is quite conventional.

Readers who have experimented even on 60 or 70 metres will be aware of the fact that as we go higher in frequency, the degree of sharpness of tuning increases, so that it is essential, if we are going to use the receiver up to 15,000 kc., to have some form of fine adjustment of the movement of the moving vanes of the condenser. There are several ways in which this can be achieved ; we may have a long extension handle rigidly secured to the condenser dial and in this way secure a reasonably fine movement and freedom from body or hand capacity effects.

Geared Dials

With the introduction of geared dials, however, we have another solution to the problem. There are now on the market several excellent forms of this type of dial. On the reaction condenser such a refinement is not absolutely necessary, but it would further simplify the handling of the receiver.

Reducing Stray Capacities

With the idea of reducing some of those casual capacities which affect the tuning range, I have made provision for the use of a V.24 type of valve. With care the ordinary type of 4-pin valves will be found suitable for use up to 15,000 kc., but low capacity valves of the type I have mentioned are more satisfactory and even necessary when we wish to go higher in frequency.

Choosing Components

I recommend intending constructors who have had only limited experience to adhere strictly to the specifications for the components given in the following list ; others who have had some experience of work on the high frequencies have a wide selection of components, if care and discrimination are used. The components embodied in the actual set seen in the photographs are :—

- One ·0005 μF square law variable condenser (Igranic).
- One ·0003 μF square law variable condenser (Collinson).
- One National Velvet vernier dial (R. A. Rothermel, Ltd.).
- One ebonite panel, 12 in. by 7 in. by ¼ in. (Paragon).
- One ebonite strip, 12 in. by 1 in, by ¼ in (Paragon).
- One ebonite strip, 5 in. by 1½ in. by ¼ in. (Paragon).
- One No. 1 terminal strip (Burne-Jones and Co., Ltd.). (Only six of the terminals are actually used.)
- One high-frequency choke (Lissen, Ltd.).
- One bright emitter filament resistance (L. McMichael, Ltd.).
- One ·0003 μF fixed condenser and gridleak mounting (Dorwood).
- One 2-megohm gridleak (Dubilier).
- One set of clips for V.24 type valve.
- Two large terminals, three valve sockets, 4 B.A. screws and nuts, wood screws, Burndept spring clip, square wire, six suitable brass brackets, and Radio Press panel transfers.
- No. 20 enamel covered wire (about ¼lb.).
- No. 18 D.C.C.

A general view of the receiver with the 30 turn coil in position. The geared dial on the left has the appearance of an ordinary dial.

Two low-loss formers, 3½ in. diam. and 4 in. long, with glass discs, and brass angle brackets (Collinson Precision Screw Co.).
One 10-turn bare wire coil of No. 12 bare copper wire, and 4 in. diam. with valve pins soldered on ends (Scientific Appliances, Ltd.).
One piece thin ebonite tube, 2¾ in. diam. and 1¾ in. long (Burne-Jones and Co., Ltd.).

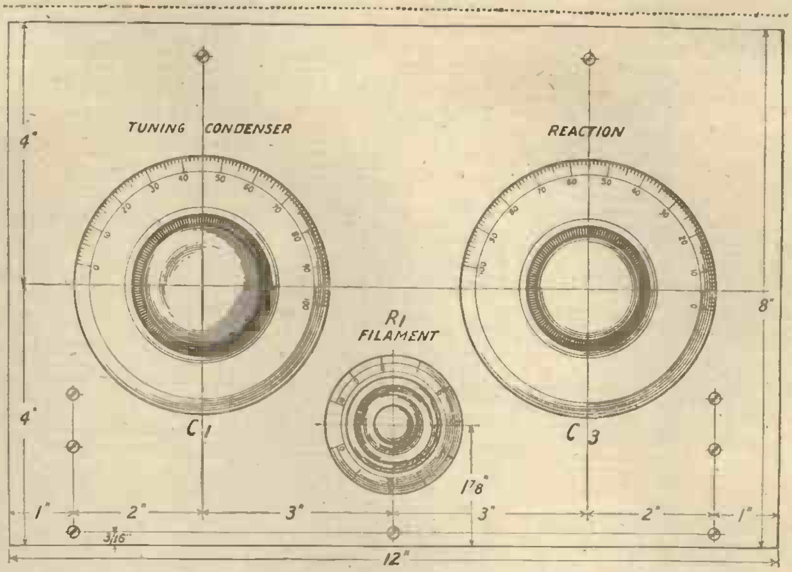


Fig. 2.—The panel-layout is extremely simple. Full details of the method of securing the vernier dial are given in the text.

Making the Receiver

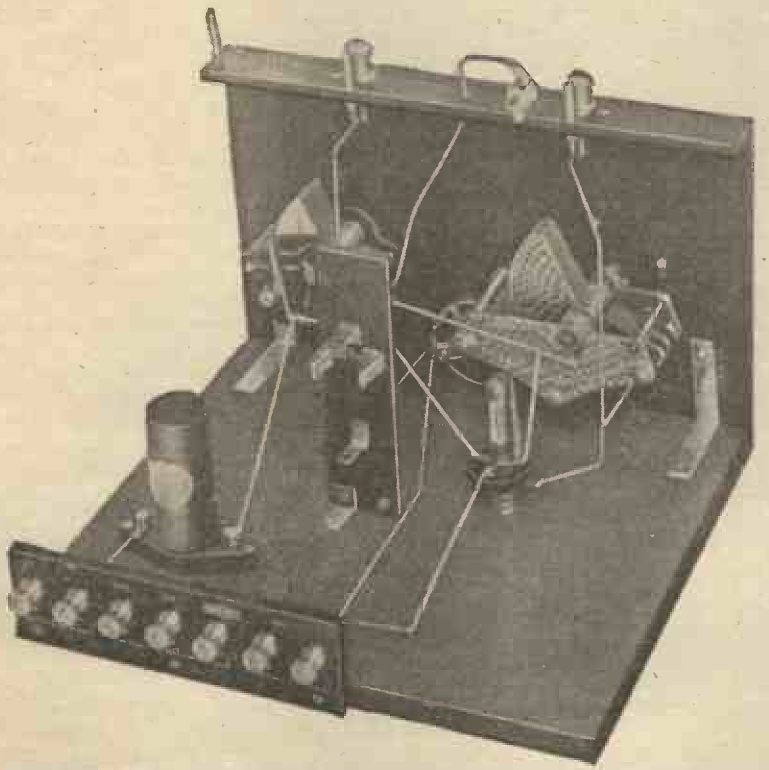
With the exception of one or two small points, the construction of the receiver will be found to present no great difficulty. You may have a little difficulty in marking out and drilling the holes for fixing the tuning condenser and the geared dial. There are three holes for the securing screws of the condenser; one for the condenser spindle and four for the geared dial. The hole for the condenser spindle should be drilled ½ in. or more in diameter (the reason for this will be apparent later). It will be necessary, too, if you are using the particular dial I have specified to cut off ⅞ in. from the condenser spindle and to remove the stop on the spindle; the latter operation can easily be done by merely unscrewing the set screw. The shortening of the spindle should be done with care, using a good hacksaw blade, otherwise the condenser is likely to be damaged. If you are averse to a procedure of this sort, I would advise you to use some other type of vernier dial which can be fixed without shortening the spindle.

Other Geared Dials

Such makes as the Burndept, Jewett Micro-Dial, and E-Z-Toon Vernier Dial will be found suitable for this purpose.

Fixing the Geared Dial

Having drilled the holes for securing the condenser, take the geared dial to pieces by first of all removing the knob by loosening the set screw and then removing the dial portion by unscrewing the three small brass screws which secure it to the circular metal part which contains the gearing mechanism. Then fix the condenser temporarily in its correct position on the panel, and place this circular metal part just referred to on to the shortened condenser spindle, securing it with the set screw provided. A large ½ in. hole in the panel is necessary to allow for this. Having secured the gearing mechanism in its correct position on the condenser spindle, use this as a template to drill the four holes for the securing screws which are used to fix it to the panel. 6 B.A. screws are perhaps best for fixing the gearing mechanism to the panel. The dial is then put on with the aid of the three small brass screws and the knob finally secured in position, care being taken that it does not scrape against the dial.


Greater attention should be paid to the spacing of the wires than to their actual length. To reduce the capacity of the valve mounting holes are drilled in the ebonite strip between the three upper clips.

Points to observe in Wiring

The wiring is best carried out with some rigid wire, all connections being carefully soldered and special attention paid to the spacing of the various wires, particularly those in the grid circuit of the valve. These should be kept well spaced from all neighbouring wires and those in the plate circuit. I do not think that great attention need be paid to the length of the wires, since the more important factor seems to be their adequate spacing.

Design of Coils

It is quite possible to cover the range of 15,000 to 1,500 kc. with the aid of only two coils. This is a matter of great convenience, but whether we are working efficiently on any frequency in this range, when using only two coils, is a doubtful point, for we may not possibly be preserving a reasonable inductance to capacity ratio on every frequency. I will, however, give you the design for two such coils, and also indicate the turn numbers and dimensions for an intermediate coil.

Coil Sizes and Turn Numbers.

The 10-turn coil is fairly springy but can be used down to 20 metres, if care is taken not to allow it to vibrate. If any difficulty is experienced owing to this vibration I would advise you to obtain two strips of ebonite and clamp the turns of the coil between them at the top.

The second coil consists of 30 turns of No. 20 gauge enamelled wire, wound with double spacing on a standard Collinson low-loss former, 3½ in. in diameter and 4 in. long, with the usual glass disc in the centre. The ends of the coil are soldered to the brass angle brackets provided with the coil, and a short length of wire is soldered to the 15th turn to act as a tapping point. This coil is mounted by securing the lower end of the angle bracket under the large terminals.

Intermediate Coil

For the intermediate coil I suggest one of 20 turns, with a centre tap. This is wound and mounted in the same way as the 30-turn coil.

The "aperiodic" aerial coil consists of 10 turns of No. 18 D.C.C. wire on the length of 2¾ in. diameter tube. Two connecting rods are put on the ends of this coil to enable the aerial and the earth connections to be made. The coil is mounted with the aid of a valve-pin and socket.

Various sizes of this coil can be tried for different parts of the desired tuning range and I suggest 2-turn and 5-turn coils in addition to the 10-turn coil.

Operation and Adjustment

For the preliminary test adjust the filament temperature and H.T. voltage to such a value that oscillation takes place over the entire tuning range. Try this out with all of the coils, with the local earth tap on the centre tapping. The set should go into and out of oscillation without any backlash. The correct adjustment of the H.T. voltage and the filament temperature will ensure that this is so. Finally, the aerial and the earth may be connected up and searching for signals commenced. The 10-turn coil tunes to about 5,660 kc. (about 53 metres), while the 30-turn coil tunes from above this figure to about 1,500 kc. (200 metres). This is with the local earth tap on the centre tapping in each case.

With the 10-turn coil and the tapping point taken so that there are four turns in the grid circuit, I have been able to tune up to 20,000 kc. (15 metres). A description of what to listen for on these high frequencies is given in another article in this issue.

In conclusion, I may say that the construction of a receiver such as this should provide anyone with a fascinating contrast to the usual broadcast reception and give a good insight into the peculiarities of short waves.

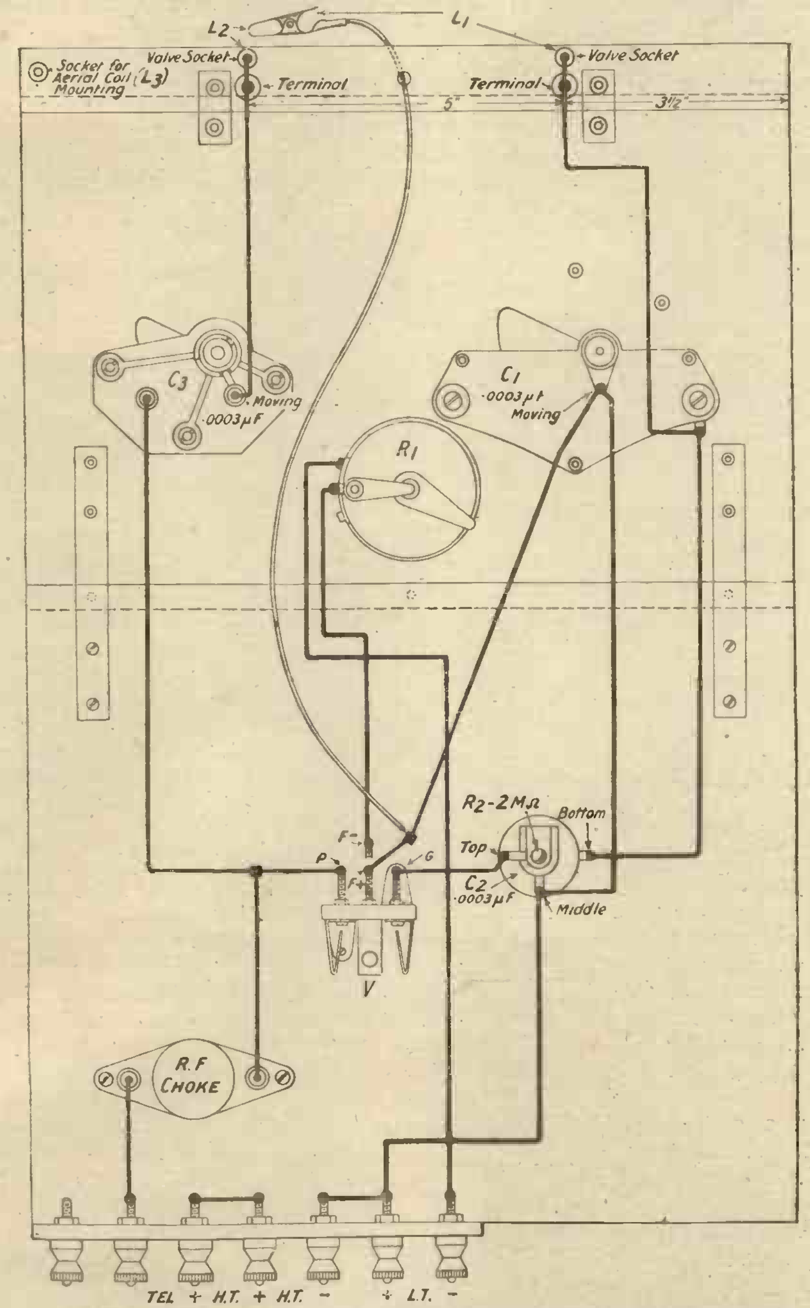


Fig. 3.—Keep all your wires well spaced and reasonably short, and preferably solder all connections firmly.

How to Run Your Receiver Direct from D.C. Mains

By MAJOR JAMES ROBINSON, D.Sc., Ph.D., F.Inst.P.
Director of Research

The voltage from D.C. mains is unsuitable for H.T. supply, unless special precautions are taken, owing to small variations which give rise to a hum. This article describes a novel method of overcoming this defect.

ANY device which will enable listeners to use their valve receivers and amplifiers direct off the electric supply mains, and thus to abolish the troubles of accumulator charging and of replacing high-tension batteries, will be welcome. After all, accumulators and high-tension batteries are merely for the purpose of providing voltage and current for the amplifier, and if in any house a supply of voltage is already there, it is highly desirable to make use of it, if a practicable scheme can be evolved.

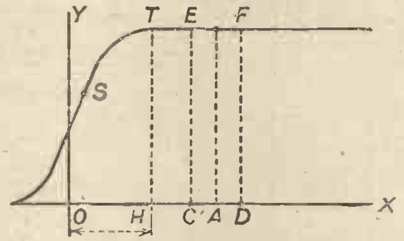


Fig. 1.—The method described employs a valve working beyond the saturation point.

In this country, for some reason or other, very little use appears to have been made of the electric mains for the direct supply of voltage and current to amplifiers, although a considerable use is being made of such mains in some other countries. The problem is comparatively straight-forward. This is particularly so in the case of direct current supplies, which are usually of 200 to 240 volts, although certain supplies are of the order of 100 volts.

In the case of alternating currents, a certain amount of trouble exists owing to the different frequencies of the various supplies, the frequency varying from 25 to 60. These troubles, however, are not serious, and could be overcome without serious trouble in attempting to apply the voltage of the mains direct to amplifiers.

D.C. Mains

In the case of D.C. mains, the straightforward plan would thus appear to be to bring down the voltage to what is required by means of a resistance, and thus to apply the voltage as required to the amplifier. However, the problem is not quite so simple, because there is another trouble, which is that the so-called direct current supply is not quite constant enough. Usually there is a variation of voltage of the order of about half a volt, although in some cases the variation may be even more than this.

This variation takes place at a considerable frequency, which is very often not uniform, so that we have to arrange to eliminate this ripple, and to obtain an absolutely smooth supply of voltage. As the actual voltage induced in an aerial from wireless waves is very small, of the order of a few millivolts only, whereas the variation of voltage on the direct current mains may be 500 millivolts or more, it is quite obvious that it will be impossible to receive wireless signals unless something is done to eliminate the variation of voltage due to these D.C. mains.

Use of Chokes and Condensers

The usual method suggested for eliminating the ripple of D.C. mains is to employ large inductances which are called "chokes" and large condensers. A method for using chokes and condensers for eliminating the ripple is described in MODERN WIRELESS for October.

There is, however, another method which may be employed, utilising a thermionic valve to eliminate the ripple, and by means of such a valve a constant voltage may be obtained. The principle underlying the method will be understood from Figs. 1 and 2. A two-electrode valve is all that is required, although it is possible to use an ordinary three electrode valve by joining the grid and anode together.

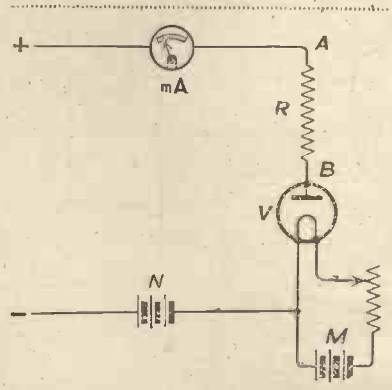


Fig. 2. Using a circuit of this description all the voltage variations may be absorbed in the valve.

Saturation Current

In Fig. 1, the characteristic of a two-electrode valve is shown, the current being plotted for different voltages. Volts are plotted along OX and the current is plotted along OY, the voltage being applied between the filament and the anode. This curve is well known, the general characteristics being that when the voltage on the anode is negative no current flows, and as this negative voltage is diminished the current begins to flow, until there is no potential between the anode and filament, when a small amount of current flows to the anode. When the anode is made positive, the current increases up to a maximum value, and on reaching this point, no matter how much the voltage is increased, the anode current never increases. This maximum current is called the "Saturation Current." In Fig. 1 the maximum current is obtained when the voltage on the anode is given by OH, the current then being given by HT.

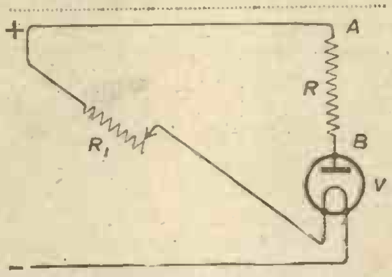


Fig. 3. In this circuit the filament is also supplied with current from the mains.

This principle is, of course, very old, being the principle of the Fleming valve. It is immediately obvious, however, that if we apply a variable voltage to such a valve with the mean value at a point such as A, and allow the voltage to vary between C and D, the anode current is absolutely constant, being of the value of CE or DF the whole time. We must now examine how this principle can be applied actually to the direct current mains in order to keep the variable voltage, and thus variable current away from the amplifier.

In Fig. 2 a method of connecting the valve in series with the direct current mains is shown. The filament of the valve is supplied in this case by a separate battery M. The filament is joined to the negative pole of the electric supply. The anode of the valve is joined to a resistance R, the other end of which resistance is joined to the positive pole of the supply. We thus have the valve joined in series with the resistance and both together put across the main terminals.

All we have to do now is to adjust conditions so that the voltage across the valve is of such a value that the current through the valve is absolutely constant, irrespective of any slight fluctuations of voltage. We must so arrange the resistance R and the magnitude of the current through the valve, so that the potential at which the valve is working is well to the right of the point H in Fig. 1. It is advisable to arrange that it is some considerable distance to the right of H, *e.g.*, at A.

Adjustment of Valve

The points which require attention in order to obtain this condition are the resistance R and the emission from the filament which is controlled from the filament battery M. Very little calculation is required in order to find the actual conditions, that is, the emission and the actual resistance R which are required. The current through the resistance is equal to the voltage across it divided by the value of the resistance in ohms. This is a statement of the well-known Ohm's law.

It is usually possible to obtain a valve which will produce the saturation current for a voltage of 60 to 80 volts. If we allow such a valve to have about 100 volts across it, we have left available for the resistance R also 100 volts, assuming the voltage of the mains to be 200 volts. Suppose that the saturation current is one-tenth of an ampere, then this current will also flow through the resistance. The voltage across the resistance R is to be 100 volts, and as the current is one-tenth of an ampere, the resistance of R, by Ohm's law, must be 1,000 ohms.

In these circumstances we have the voltage from the mains, of 200 volts, divided into two parts, that across the resistance R and that across the valve V. As the current which passes through the valve is constant, if the valve is working at the saturation point as described, the current through the resistance R is constant, and thus the potential across R is also constant. All the voltage variations of the mains, therefore, are absorbed by the valve V. If the main voltage rises to 201 volts, the valve cannot pass any more current owing to the saturation effect, so that the voltage developed across the resistance still remains the same, that is, 100 volts.

Effect of Altering the Resistance

Consider for a moment the effect of altering the value of the resistance R by some large amount. Suppose that the resistance of R is reduced to 100 ohms. As the current is 1/10th of an ampere, the voltage across R is 10 volts, and thus the voltage across the valve becomes 190 volts without changing the current through the valve.

On the other hand, suppose that we make the resistance of R much greater, say, 4,000 ohms. It will be obvious that the current in the valve must now change, for the following reason. Let us assume that it does not change, but remains constant at the value of 1/10th of an ampere. By Ohm's law we have a resistance of 4,000 ohms which has a current of 1/10th of an ampere flowing through it, and thus we require a total voltage of 400 volts, which is impossible, as we have only 200 altogether.

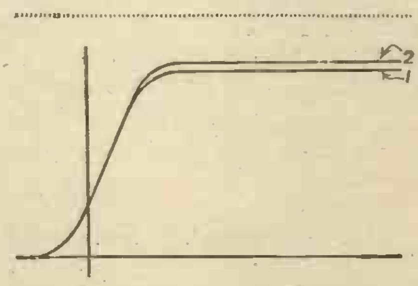


Fig. 4.—A variation of filament current will cause a corresponding variation of the saturation current.

Thus it is obvious that if we increase the resistance of R above 1,000 ohms, the current will remain at 1/10th of an ampere until the distribution of the voltage between the resistance and the valve is of such a nature that the voltage across the valve is equal to the value OH in Fig. 2. This voltage for most ordinary valves is of the order of 60 to 80 volts. As soon as the conditions are such that the voltage allowed for the valve becomes less than OH, then the current through the valve will diminish. At this stage, of course, the valve is not in the condition that we require for smoothing purposes.

Practical Manipulation

We have discussed some theoretical reasons for the distribution of voltage between the resistance and the valve, and have shown how it is possible to obtain the correct relations. In practice the method to be employed is as follows: In series with the valve and the resistance it is advisable to use a milliammeter. This is shown as MA in Fig. 2. Also in series with the resistance and amplifier a small battery should be employed for test purposes, which is shown as N in Fig. 2.

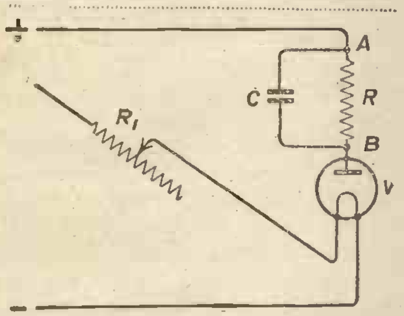


Fig. 5. — A large condenser shunted across R will smooth out any variations which remain.

The object of this battery is to produce artificial variations of the voltage on the mains. Conditions should finally be obtained so that no matter what the voltage of this battery, within limits, or which way round it is connected, the current through the milliammeter is constant. The resistance R should be varied, and also the emission from the filament should be varied by means of the battery M and its filament rheostat.

Elimination of Filament Battery

So far we have supplied the current for the filament of the valve V by a separate accumulator M. But as we have already plenty of electrical power, it is advisable to use this electrical supply to heat the filament of the smoothing valve V. The way to do this is shown in Fig. 3, where the filament is joined in series with another resistance R. This resistance should be so adjusted as to give the correct filament current for the valve V.

A suitable resistance for this purpose is an electric lamp, which should be chosen of the correct wattage to give the correct current to the filament. In addition, a small variable resistance should be used with this electric lamp in order to allow of the finer variations of the filament current and thus of the emission.

Temperature Lag

By using the electric supply to heat the filament of the smoothing valve V we introduce the possibility that we may not obtain the maximum amount of smoothing, because the variations of voltage on the mains are now introduced to the filament of the smoothing valve and thus we get the temperature of the filament of this valve altering in harmony with the voltage variations on the mains. Changing the filament current, and thus the emission, is equivalent to changing the saturation current. This is shown in Fig. 4, where we get curves 1 and 2 corresponding to the smaller and larger filament currents.

In actual practice, however, this effect is not serious, if appreciable at all. The variations of electric voltage are followed only very slowly by change of temperature of the filament. Temperature effects are by no means instantaneous, and time is required to change the temperature of the filament when the voltage is altered. Owing to this lag of temperature effects, the difference between the saturation currents 1 and 2 is usually extremely small. This is particularly so, because the frequency of the variation of voltage is usually comparatively high, being anything from 60 to 1,000 cycles per second.

A Suitable Single Valve Circuit

There is no doubt, therefore, that a valve used in this manner cuts down the variations of voltage obtained on the direct current mains to a very large extent, actually to about 1 per cent. of the original variation. The final clearing up of this variation can be obtained by using a condenser of a few μF across the resistance R as shown in Fig. 5. We thus have at the points A and B, a source of potential or voltage of the order of 100 to 120 volts, which is absolutely constant, and we can now make use of this source of supply for our amplifiers and receivers for both the anode supply and the filament supply.

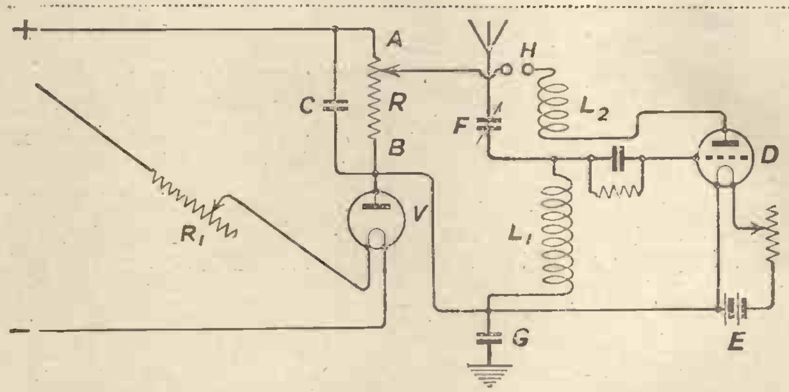


Fig. 6.—A practical single valve circuit using the method described.

We shall consider in this article only the case of a single valve receiver. In Fig. 6 a scheme is shown whereby the anode supply is fed from the mains by means of this smoothing valve. In this case it is necessary to use a special battery to heat the filament of the receiving valve D. The smoothing arrangement, including the smoothing valve V is shown to the left of the figure, including the series resistance R for the anode of the smoothing valve, and the series resistance R_1 for the filament of the smoothing valve.

Our source of supply for anode voltage is now the two terminals A and B. A is obviously the terminal to join to the anode of the receiving valve. The point B should be connected to the filament of the receiving valve. A very simple form of receiving circuit is shown, with a direct coupled aerial. Reaction is used in this circuit, as shown at L_1 and L_2.

Aerial and Earth Both Insulated

The first point of interest is that the aerial must be insulated from the receiver, and this is done by using a series condenser, F, which is shown as a variable condenser. The aerial must not be connected direct to earth as if this is done it will result in earthing the receiving circuit DHG, and thus in earthing the mains at some particular point corresponding to B. This must be avoided at all costs for there is usually an earth already in the mains which will most certainly be at some other point, so that the aerial must be earthed through a condenser G which should have a value of the order .01 μF. Again the telephones are at a somewhat high potential, and these should also be well insulated, or else a telephone transformer should be used.

The high tension voltage may be varied if desired by arranging a tapping point on the resistance R.

In this case, where we only supply the anode current of the receiving valve from the smoothing circuit, a comparatively small current is required, so that there is no necessity to use a large smoothing valve V. A valve which will give an emission current of 20 milliamperes is quite sufficient, and quite a number of receiving valves will do this.

Filament of Receiving Valve

In Fig. 7 a diagram is shown for the case where both the filament supply of the receiving valve V and the anode supply are provided by the smoothing circuit. The filament of the valve D is now joined in series with the resistance R, the anode supply being obtained from the positive end of the resistance R as before. A variable tapping might be used at A. It is, however, very often convenient to use a lamp in place of the resistance R_1, and in this case it will not be easy to provide a variable tapping-point at A.

The magnitude of the filament current in the valve D is controlled by the emission of the valve V. This controls the current through the rectifying valve V as is required, and for convenience and economy it is recommended that a 60 milliampere valve be used as the receiving valve D. In this case we need not provide for too great an emission current in the valve V.

An emission of about 65 milliamperes is required and, therefore, it is necessary for us to use a valve V which is capable of giving a saturation current of more than this value A number of valves are available which will do this. The LS 5 valve is capable of giving 70 or 80 milliamperes. Two B4 valves in parallel will also provide sufficient emission. In these cases, of course, we are using three electrode valves, whereas two electrode valves are all that is required. With three electrode valves it is necessary to connect the grid and anode together.

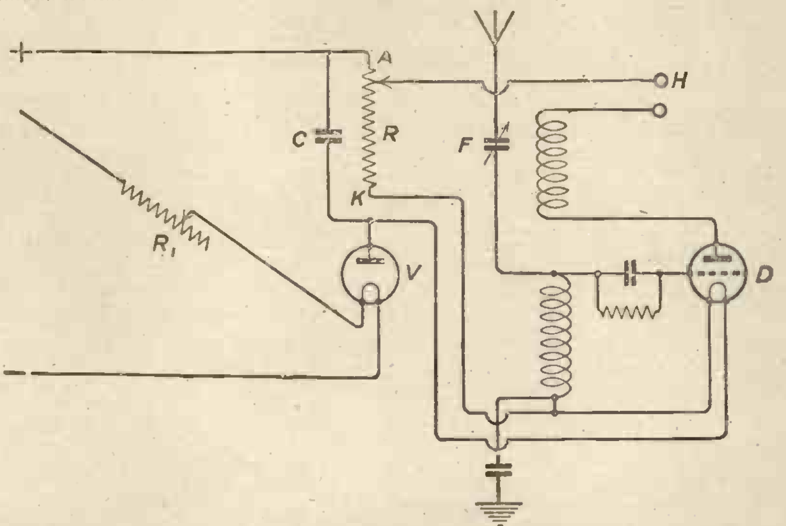


Fig. 7.—In this case the filament of the receiving valve is also supplied with current from the mains.

Cost of Running

As regards the question of cost of running such a circuit this should not be too high, particularly if we use a valve as rectifier which has a dull emitter filament. If we use a bright emitter such as the LS 5, the filament current is three-quarters of an ampere, which requires a power of 150 to 160 watts. This means that in six hours we have used 1 unit of electric power, so that the cost will be of the order of 1d. per hour. It is possible to have cheaper running by using other valves. It should be possible for valve manufacturers to design a valve which can operate on very little filament current and yet give the required emission.

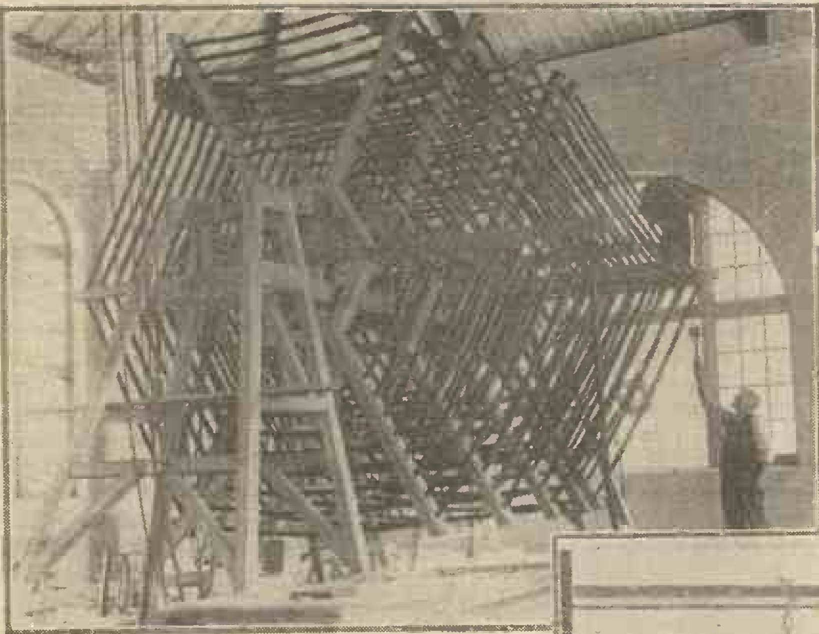
Special Forms of Valve

One method of doing this is to have a valve designed which has a very long filament, as the emission from a filament is proportional to its length.

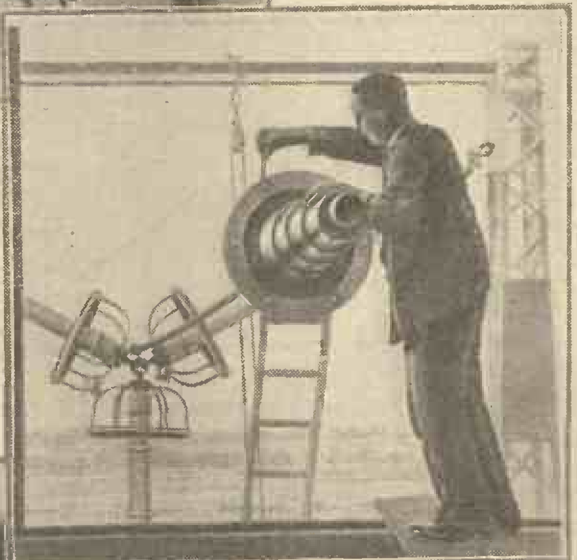
In this way it should be possible to obtain an emission of 60 milliamperes for a filament current of about 200 milliamperes. In the circumstances the running of such a smoothing circuit should be very economical.

Examples have been shown for single valve receivers, but the method may be applied equally to multivalve sets, and further details will be given in a future issue.

Developments at the Rugby Station

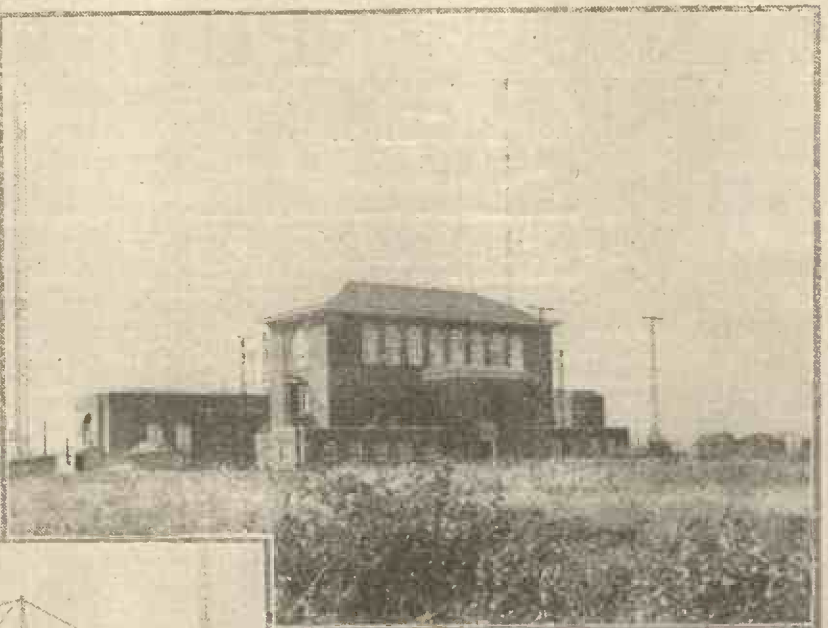


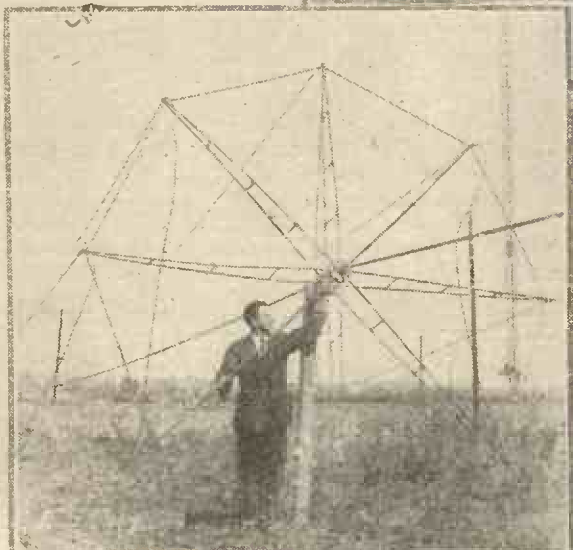
The photo above shows the main aerial tuning inductance in process of construction. It is wound with heavy cable made up of a large number of strands of fine wire to reduce the high frequency resistance.
The photo on the right shows the large glass panel carrying the lead-in insulator for the aerial. The actual strain on the lead-in is taken by the three balanced insulators outside.



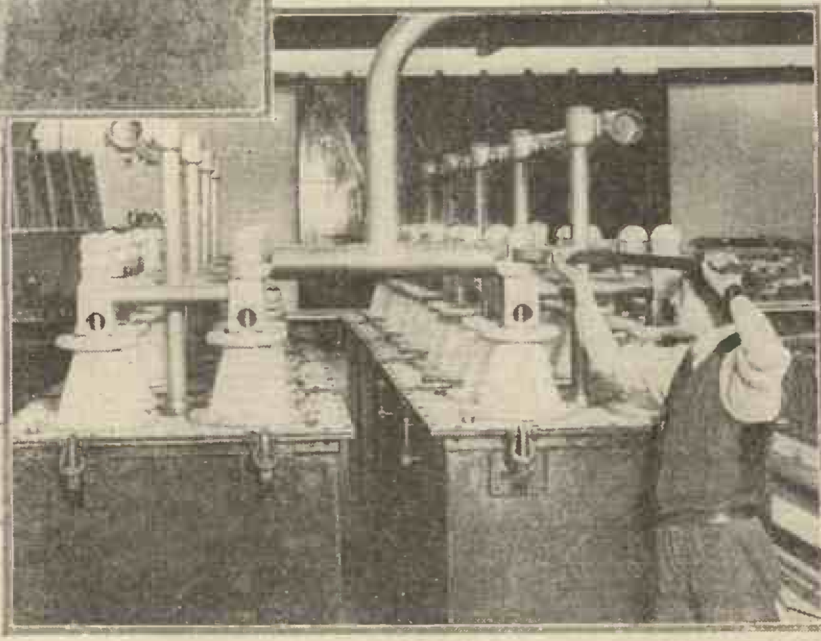
When using stranded wire cable the ends of the wires have to be connected to the rest of the circuit by soldering round the edge of a large diameter copper tube. This photo shows this operation, which takes a considerable time, actually in progress.

Some of the Latest Photographs





The station building itself is of imposing appearance, as can be seen from the above photograph. The 820 ft. masts can clearly be seen, while some idea of the size of the aerial is obtained from the left-hand photo which shows one of the huge spreaders.



Coupled circuit valve transmitters will be employed. and this photograph shows some of the large oil-filled condensers for the closed circuits. Note the heavy insulators required to withstand the high voltage.

AN ANODE-INPUT REFLEX SET

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

A simple set for the nearer stations.

THE set which is described in this article was designed primarily with the object of providing a simple set having a minimum number of adjustments which would be capable of giving loud-speaker results on the local station up to a distance of 30 to 40 miles, and telephone reception, with possible loud-speaker results, on some of the more distant stations. As will be seen this result was more than achieved.

Simplicity of Operation

The reflex principle was employed because in a set of this character, where extreme efficiency is not desired, one of the valves can quite satisfactorily be used at both high and low frequency. One of the disadvantages of the reflex principle, however, lies in the fact that it does not lend itself very well to long distance reception. A second disadvantage lies in the fact that in the usual form of reflex arrangement several adjustments are required in the process of tuning in.

These disadvantages have been overcome to a large extent in the present set. There is only one tuning control, and associated with it a reaction control which is particularly smooth in operation. The only other adjustments which are required in the set are the three filament rheostats, which remain adjusted once they have been set approximately to the correct position.

Single Tuning Control

The idea of utilising only one tuning control resulted from the necessity for keeping the set as simple as possible. Now in the ordinary reflex circuit it is necessary to tune the grid circuit, and also to tune the anode circuit of the reflex valve. The detector, which may be either crystal or valve, is then placed across the tuned circuit in the anode of the valve. This, of course, necessitates two tuned circuits, and if the tuning control is to be simple one of these should be eliminated.

Various circuits have been devised from time to time in which the tuned anode circuit was eliminated by some means, but such circuits have not always been satisfactory owing to the difficulty of producing an adequate voltage across the detector. In the particular circuit under consideration it is the grid circuit which has been eliminated, leaving the only tuned circuit in the anode of the reflex valve. It thus becomes a species of anode input circuit, the principle of which was dealt with in some detail in an article by Mr. John Scott-Taggart, F.Inst.P., A.M.I.E.E., in the September issue of MODERN WIRELESS.

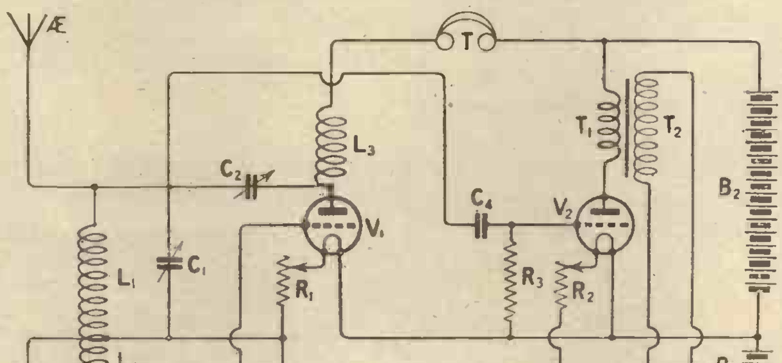


Fig 1.—The original form of circuit. L_1C_1, is the tuned anode circuit, reaction being introduced by means of the grid coil L_2.

The Original Circuit

The essence of the circuit as originally tried is shown in Fig. 1. Here the tuned circuit is connected across the anode and filament of the valve V_1, and coupled to this circuit is a small coil L_2, which is applied across the grid and filament. The high-tension supply to the valves is obtained through the high-frequency choke L_3, and the condenser, C_2, is inserted in the anode circuit of the valve to prevent the high tension from short circuiting through L_1.

The currents set up in the aerial induce voltages in L_2 which are applied across the grid and filament of the valve and are amplified in the ordinary way. These currents then flow through the circuit C_2-L_1 back to the filament, and if the coils are in the correct direction this will produce a reaction effect which will ultimately cause the valve to oscillate. The reaction can be controlled by varying the value of the condenser C_2.

The voltage developed across the tuned circuit L_1-C_1 is then applied across the grid and filament of the detector valve V_2 in the anode circuit of which is an intervalve transformer. The secondary of this intervalve transformer is connected in the grid circuit of V_1, so reintroducing low-frequency variations into this valve so that the valve amplifies the current both at high-frequency and low-frequency.

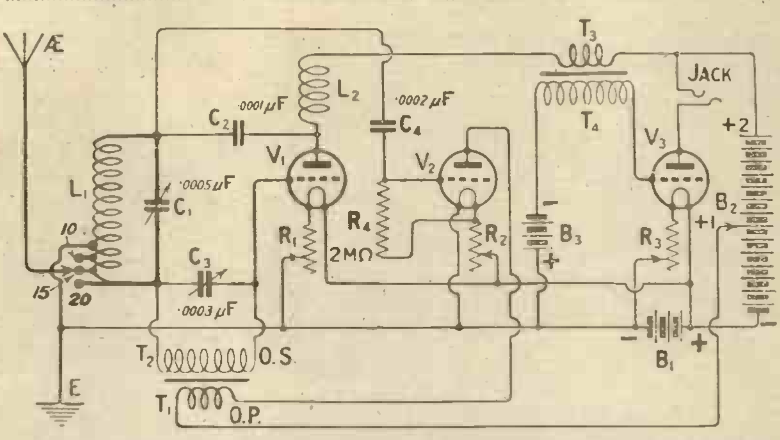


Fig. 2.—The circuit ultimately adopted, which gave much superior results. An extra L.F. valve has also been added.

Final Form of Circuit

This simple form of circuit has been shown in order to enable the reader to appreciate the real functioning of the final form of circuit adopted. It was found for several reasons that this circuit did not give the results that were expected of it, and several minor modifications were made before the circuit was finally made up into the form of a set. The final form of circuit is shown in Fig. 2.

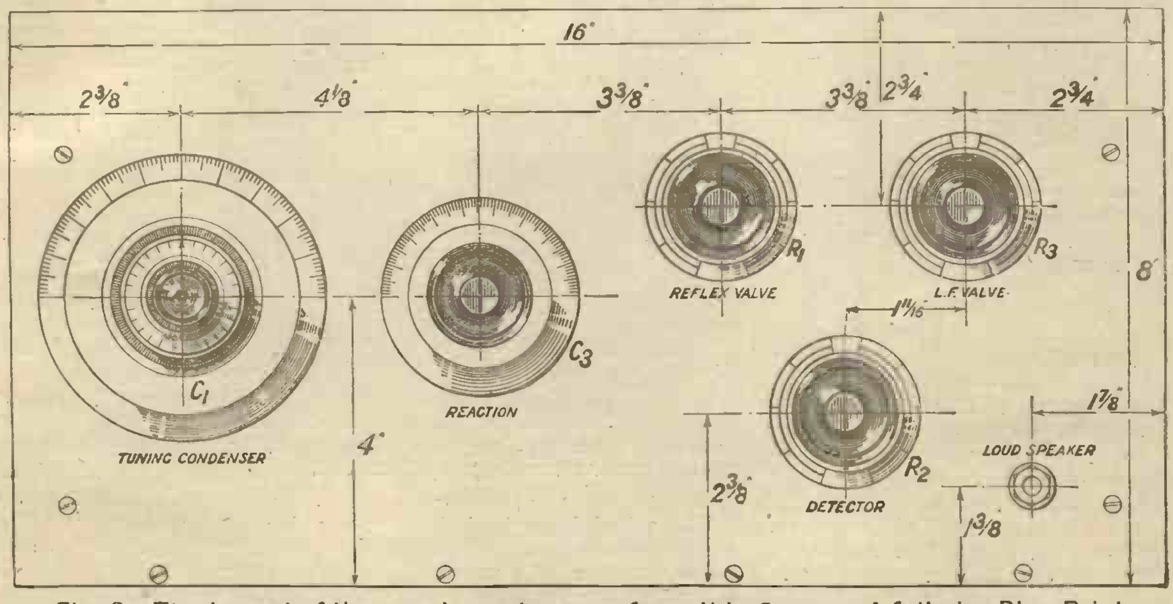


Fig. 3.—The lay-out of the panel may be seen from this figure. A full-size Blue Print, No. 135a, may be obtained, price 1s. 6d. post free.

The modifications are as follows. The condenser C_1 instead of being connected simply across the coil L_1 is connected across both L_1 and L_2, which are wound both on the same former. This was found to give very much better signals, particularly in the reception of distant stations. Secondly, in order to increase the selectivity the aerial was not connected across the whole coil but across a portion only.

Furthermore, better results were obtained by making the tappings at the grid end of the coil as shown, in accordance with the usual Reinartz practice.

Finally, instead of controlling the reaction effect by varying the value of the condenser C_2, the condenser across the secondary of the intervalve transformer T_1-T_2 was made variable. It was found that the varying of the condenser C_2 caused slight variations in the tuning of the circuit which were not very desirable. By making C_2 fixed, however, and varying the shunt capacity across T_2 an equally good reaction effect was obtained without the slightest effect on the tuning of the main oscillating circuit.

It will be seen that a third (low-frequency) valve has been added in this circuit in order to obtain loud-speaker results. We may now consider the design of the set.

Components Required

The components required are as follows (the names of the makers of the various components have been given in brackets after each item, although similar components by other manufacturers may equally well be used) :—

1 Ebonite Panel, 16 in. by 8 in. by ¼ in. (Paragon).

1 Mahogany Cabinet, 9½ in. deep take panel with baseboard 9 in. deep. The back of the case must be cut away to allow for the two terminal panels.

1 ·0003 μF Condenser (Jackson Bros. low-loss).

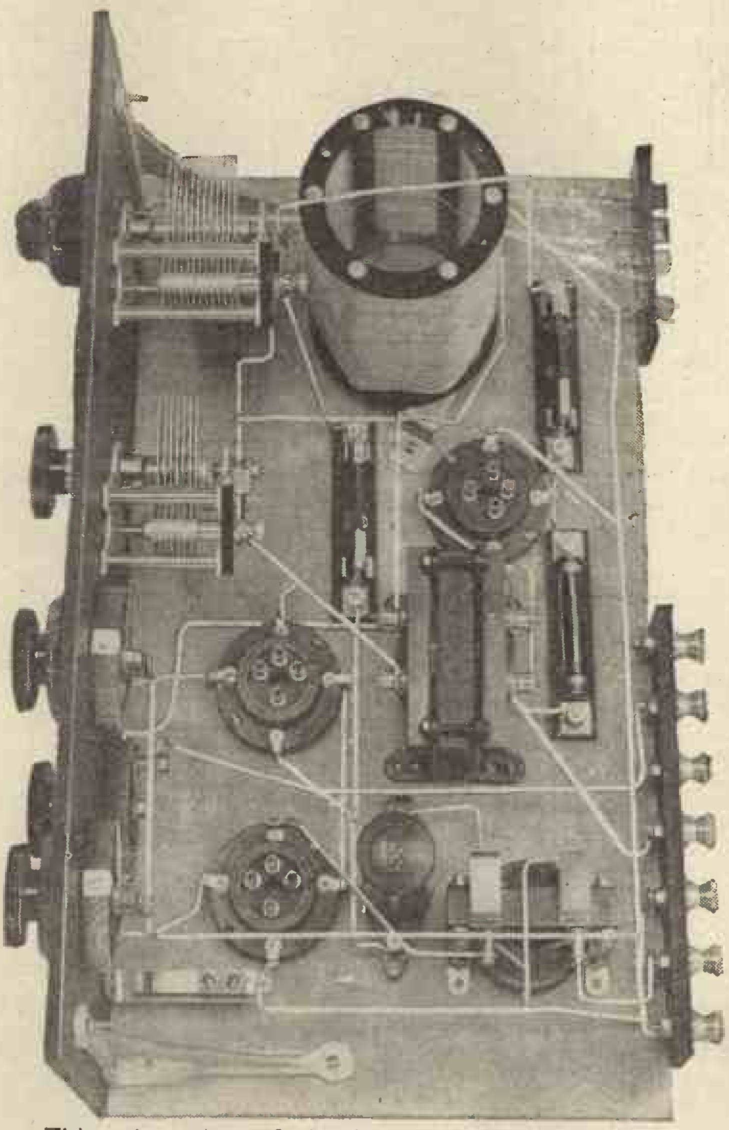
1 ·0005 μF Condenser (Jackson Bros. low-loss).

1 Low-Loss Coil Former (6 in. long, 3 in. diameter (Collinson Precision Screw Co., Ltd.).
3 Filament Rheostats, dual type (L. McMichael, Ltd.).
3 Anti-vibration Valve Holders (Burne-Jones & Co., Ltd.).
1 Radio Frequency Choke (Lissen, Ltd.).
1 ·0001 μF Fixed Condenser (L. McMichael, Ltd.).
1 ·0002 μF Fixed Condenser (L. McMichael, Ltd.).
1 Grid Leak, 2 megohms (L. McMichael, Ltd.).
2 Angle Brackets (Burne-Jones & Co., Ltd.).
1 Terminal Panel, 7 in. by 2 in. with 7 terminals (Burne-Jones & Co., Ltd.).
1 Terminal Panel, $3\frac{1}{2}$ in. by 2 in., with 4 terminals or plug sockets.
1 E Z Toon vernier condenser dial.
1 Packet Radio Press panel transfers.
1 Jack, single open type.
1 Intervalve Transformer (Radio Instruments, Ltd.).
1 L.F. Intervalve Transformer (L. McMichael, Ltd.).

These latter items are important, as the set is of the reflex variety. The transformers employed were an R.I. transformer for the reflex stage and a McMichael for the second stage. Other makes of transformer may be employed, but in some cases there is more tendency to oscillation in the reflex valve than in others. This point, however, is dealt with in some detail later.

Lay-Out

The lay-out of the components may be seen from Fig. 3 and Fig. 4, which illustrate the front and back of panel arrangements. The coil should be wound with 90 turns of No. 22 wire, tappings being taken at the 5th, 10th and 20th turns. The tapping at the 20th turn is taken to the earth terminal, the remaining tappings being connected to the aerial terminals. As has been remarked, the selectivity of the set is obtained by only tapping the aerial across a very small portion of the coil. Plug sockets have been used, therefore, to enable the best tapping to be found under varying conditions.



This plan view of the lay-out and wiring will be of assistance in making up the set.

The actual lay-out of the components on the baseboard should be adhered to as closely as possible, in order that any tendency to oscillation may be under control. It will be noticed that the two transformers have been placed reasonably far apart to minimise any tendency to low-frequency howling. The front of panel lay-out, of course, can if desired be altered, providing the tuning and reaction condensers are maintained approximately in the position shown. The position of the three rheostats on the right of the set is not important.

The vernier dial is almost essential. The particular dial employed is drilled to take a $\frac{1}{4}$ in. spindle, but a small strip of metal was inserted to adapt it to the 3/16 in. spindle. Dials to fit 3/16 in. spindles may now be purchased.

Wiring Up

Having laid out the components upon the baseboard as indicated in Fig. 4, and fixed the condensers and rheostats and the telephone jack to the panel, the process of wiring may be commenced. It will be noticed that the various connections have been made as direct as possible. With the particular arrangement of components, the wiring is fairly well spaced and care should be taken to see that this spacing of the wiring is followed in making up the receiver. If this is not done there may be some difficulty when the set is finally tested out. Beyond this precaution there is little else that calls for any comment.

Operation of Set

The operation of the set, when completed, is particularly simple. The reaction condenser should be placed in the zero position (*i.e.*, "All out"). Having inserted the valves in their sockets and adjusted the filament currents to suitable value, the local station is tuned in by suitable adjustment of the tuning condenser. It will then be found that an increase in the capacity of the reaction condenser will cause the set gradually to come up to the oscillation point until a limit is reached, when it quietly commences to oscillate.

For the local station the reaction condenser is not as a rule required.

The condenser may be set in the zero position and the tuning control turned round until the station is heard. Having tuned the station in, an increase of strength may be obtained, if required, by bringing the set up to the point of oscillation quency of the oscillation increases so the reaction condenser has also to be increased. This means that as the tuning capacity is *decreased* so the reaction condenser has to be *increased*. Once this peculiarity has been mastered, it is possible to

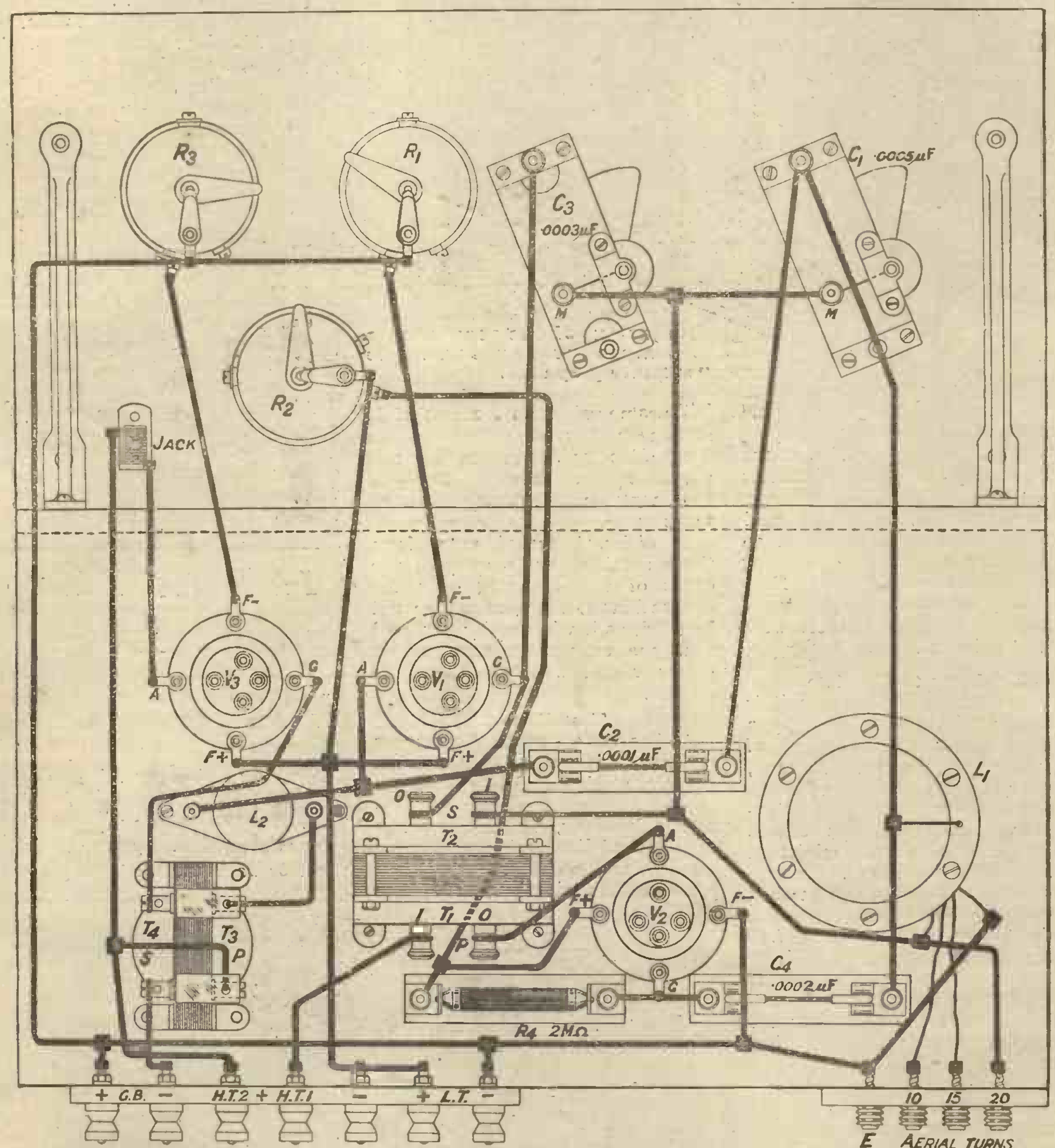


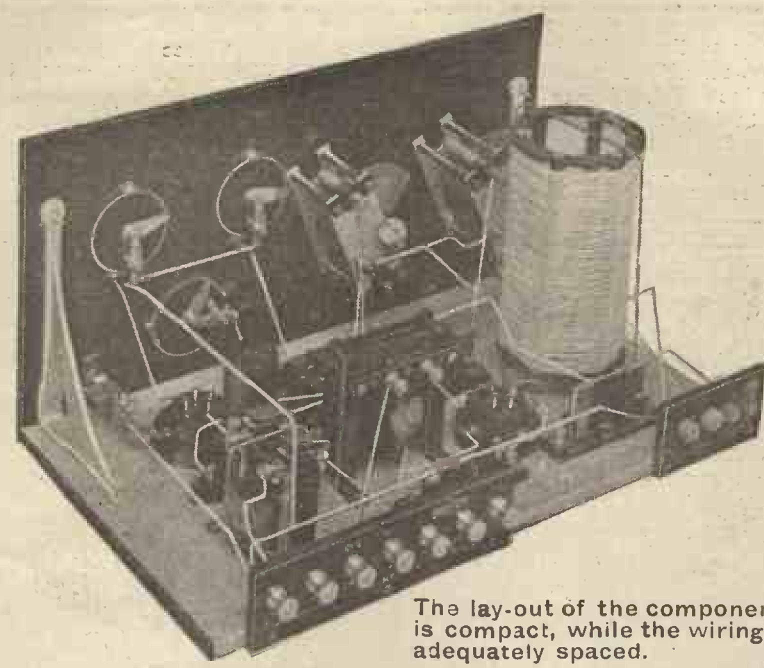
Fig. 4.—The wiring of the receiver is straightforward. Various values of C_2 may be tried when testing out. A Blue Print of the wiring (No. 135b) is available on application, price 1s. 6d. post free.

with the reaction condenser, as has been described.

The testing for more distant stations may be accomplished by the simultaneous adjustment of the tuning and reaction condensers. It will be found that as the fre-search over the whole of the dial and keep the set on the point of oscillation with the reaction condenser in the manner just described, and by this means several other stations may be brought in satisfactorily at loud-speaker strength.

Valves

The liability of the set to oscillate depends upon the type of valves employed, although, with the details given, the set will be well under control with the majority of valves. The last valve should, of course, be a power valve, but, if desired, an ordinary L.F. valve may be used. The detector should be a valve having a high impedance and a high amplification factor, such as a D.E5.B, but an ordinary G.P. valve is quite satisfactory.



The lay-out of the components is compact, while the wiring is adequately spaced.

For the reflex valve any general purpose valve may be employed, such as a D.E.3 or a D.E.R, or one of the corresponding bright emitter type.

The detector H.T. ($H.T._1$) should be comparatively small, about 30 to 36 volts, as otherwise the detector valve tends to oscillate. The H.T. for the other valves ($H.T._2$) should be as large as is permissible with the valves in use.

Tendency to Oscillate

The oscillation in this circuit is controlled, as has been seen, by a capacity across the secondary of the reflex transformer. It may, however, be found that with the particular transformer and particular valves employed, the circuit still oscillates even at the minimum of the reaction condenser. In such a case the trouble may be remedied very simply by moving the earth tapping down a few turns, *i.e.*, making the tapping at the 18th or 19th turn instead of the 20th. It is simpler to try different valve combinations first, however, as with the majority of valves reaction control comes well in the middle of the condenser.

Conversely, if the reaction is insufficient at the high frequencies (low wavelengths), the earth tapping should be moved upwards a few turns.

With suitable adjustment the reaction control is smooth and free from backlash. It also remains near the oscillation point over a reasonable range.

Variations of H.T. voltage and filament current should be tried till this ease of control is obtained.

With some valves an increase of C_2 is beneficial, and values up to ·0003 μF may sometimes be employed with advantage. If C_2 is too large, low-frequency buzzing takes place.

If different transformers from those specified are employed, the effect of the changing over the connections to the terminals should be tried, as it will usually be found that one connection gives rather better signal strength than the reverse.

Test Report

As has been stated, the set was primarily designed to operate upon the local station, and to give simple control with good selectivity. Actually, however, the receiver has been tested in various parts of London, and no difficulty was experienced in tuning in several other stations on the loud-speaker, as will be seen from the accompanying test report.

Valves in use : All D.E.3 type.
$H.T._1$: 30 volts. $H.T._2$: 66 volts.
Aerial on smallest tap (10 turns).

Dial reading.	Station.	Remarks.
33	Unidentified ...	Dance music.
34	Aberdeen	
36	Radio Toulouse	
39	Birmingham	
46	French station	
48	Glasgow	
51	German station	London in background.
52	Newcastle	
55	Bournemouth	Interference from London.
63	London	
76	Dortmund	
78	Brussels ...	Dance music.

All the above on the loud-speaker.

NOTE.—The dial used is a frequency dial, so that the higher wavelengths (lower frequencies) tune in at the lower readings.

IMPORTANT NOTICE.

Owing to the numerous applications from our readers for Back Numbers of our publications, we have decided to make no extra charge on any of our periodicals for issues published within six months. The charges for back issues more than six months old will be as in the past.

The finished set has an attractive appearance.

Opinions of Famous Amateurs

GECoPHONE
LOW LOSS-SLOW MOTION VARIABLE CONDENSER

Extract from report from
Mr. E. J. SIMMONDS, M.I.R.E., F.R.S.A.

"I have now had an opportunity of testing the condenser and frankly have nothing but praise for its performance. The slow-motion is particularly good, and the absence of backlash allows of an accurate calibration of the short-waves. I have been using geared vernier knobs for some time, but shall replace them by your new condenser at once.

"I shall be pleased to bring this to the notice of all my W/T. friends.

(*Signed*) *E. J. Simmonds.*

Station G.2OD.

THIS advertisment is written not by us, but by some of the most prominent amateurs in Great Britain who have conducted independent tests of the GECOPHONE Low-Loss Slow-Motion Variable Condenser.

Extract from report from
Mr. J. C. READ, Vice-President of the Hounslow and District Wireless Society.

"When the condenser was placed in circuit there was a marked increase in signal strength and and the receiver much more sensitive. The hand-capacity effect is almost entirely eliminated and working on 30 metres it could be regarded as negligible. The micrometer adjustment is of a very convenient ratio, i.e., a large wave-length band can be covered quite conveniently and the most minute adjustments can be easily made. There is absolutely no backlash."

(*Signed*) *J. C. Read.*

GECoPHONE
LOW LOSS-SLOW MOTION VARIABLE CONDENSER

Extract from report from
Mr. H. LITTLEWOOD.

"On the broadcasting band of wave-lengths tuning is greatly improved, and stations are now received with the greatest of ease which, in the case of the ordinary condenser, were most difficult to tune in. Hand-capacity, the principal fault of many condensers, is entirely absent.

"When used as closed circuit condenser in a short wave-length receiver the results were astounding . . . tuning was simply child's play. You have undoubtedly set a new-standard in variable condensers which, in my opinion, will take a great deal of beating."

(*Signed*) *H. Littlewood*

Station G.2XY.

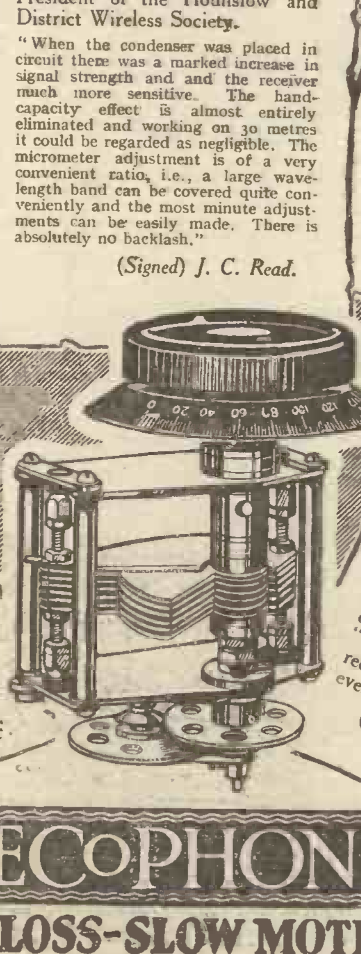
GECoPHONE
LOW LOSS-SLOW MOTION VARIABLE CONDENSER

Extract from report from
Mr. C. G. WILLIAMS. Wallasey.

"I feel impelled to write you regarding the outstanding qualities of your new GECOPHONE Low-Loss Slow-Motion Variable Condenser. The points that to my mind call for special note are: (1) Dial revolves in same direction as rotor plates; (2) accurate arrangement for centring of dial; (3) bearing surfaces of dissimilar metals; (4) stout bush for panel fixing.

"I could write at much greater length on this splendid component, but think it will be amply sufficient to describe it as—The Best."

(*Signed*) *C. G. Williams.* Station G.2JF.



GECoPHONE
LOW LOSS-SLOW MOTION VARIABLE CONDENSER

Extract from report from
Mr. S. MACDONALD ASH. Rathmines, Dublin.

"I consider it to be a masterpiece of design and workmanship, and have already realised its great advantage on long-distance reception. The beautiful slow adjustment, which is perfectly smooth and without the slightest backlash, far surpasses that of any variable condenser I have yet tested.

"I shall have no hesitation in recommending this condenser on every possible occasion."

(*Signed*) *S. Macdonald Ash.*

Sold by all GECOPHONE Service Depots— *—Wireless Dealers and Stores.*

GECoPHONE
LOW LOSS-SLOW MOTION VARIABLE CONDENSER

Advt. of The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C. 2.

experts in radio acoustics since 1908

Brandes

The Table-Talker

designed with expert knowledge of acoustics

NOTE: Acoustics: the science of sound. Radio Acoustics: transforming the electrical impulse into audible sound.

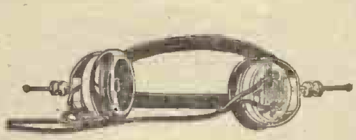
The ultimate excellence of the Brandes instrument does not lie solely in the hands of the master craftsman. True, his care and ingenuity must be exercised during construction, but the basic principles are laid down for him by technical experts in the Brandes laboratories. There the secrets of acoustics are thoroughly investigated and finally built into our plans. The electrical impulse is captured by your set. Transformed to audible sound by a Brandes loudspeaker that transmitted sound is perfectly reproduced.

Ask your Dealer for the Table-Talker.

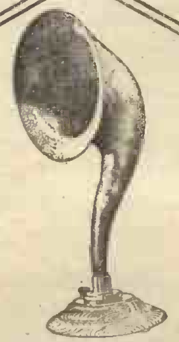
The new goose-neck design is the result of research in radio acoustics, which definitely establish its value in relation to the diaphragm fitted. One feature remaining unchanged is the patent material used in the construction of the horn which eliminates any suggestion of harshness. It is now possible to control volume and selectivity with the small lever located at the rear of the base and to tune-in to a finer degree. Elegantly shaped, it still has that tasteful neutral brown finish and felt-padded base. Height 18 ins., bell 10 ins.

30/-

Audio Transformer
Ratio: 1 to 5
17/6



Matched Tone Headphones
20/-



The Brandola
90/-

Brandes Limited *296 Regent Street, W.1*

WHAT VALVE SHALL I USE?

By
Capt. H. L. CROWTHER, M.Sc.
Deputy Director of Research

WITH so many different types and makes of valves on the market at the present time it is sometimes very difficult to make a decision as to what kind to use in any particular receiver or amplifier. It is proposed, in this article, to give some idea of the fundamental valve characteristics and constants required for the performance of different functions, and so to assist one in making a decision as to what valve to buy.

Valve Constants

Most manufacturers now supply data for each of their different types of valves, from which one is able to judge their capabilities and their limitations, having regard to the set in which they are to be used. The following are the more important constants of a valve which should be considered:

Filament current and voltage.
Voltage amplification ratio.
Impedance.
Grid bias required under working conditions.
Maximum or total emission.

The Filament

Let us consider these various points in turn. If economy in filament battery power is of no importance, then probably the only advantage in choosing a dull emitter valve is that it has a considerably longer life than that of the bright emitter. In other respects there is nothing to be gained. As economy in accumulators, however, is generally of very great importance it is usual for the choice to fall to the dull emitter, especially in cases where the number of valves exceeds two or three.

With regard to dull emitters, it is as well to remember that there are two distinct types of filament on the market, namely, the coated filament and the thoriated tungsten filament. If a valve with a coated filament is obtained great care must be taken not to over-run it, as this is easily done if the filament voltage is increased by more than about ten or twenty per cent. above its specified value. The thoriated tungsten filament is not nearly so susceptible to excessive voltage and is not easily burnt out.

What is Voltage Amplification Ratio?

We now come to the voltage amplification ratio, which is the theoretical voltage amplification of a valve. For instance, if this ratio for any particular valve is 10, then by applying an alternating current potential of 0.1 of a volt between the grid and the filament, it should be possible to obtain an alternating potential of 1 volt across the anode circuit. In practice, however, this actual "step up" in voltage cannot be obtained owing to the high impedance of the valve itself, which cannot be neglected in comparison with the practical values of external impedance in the anode circuit. For example, if the external impedance in the anode circuit is only equal to the impedance of the valve itself, then the actual voltage amplification is only half the theoretical value.

The higher the external impedance in the anode circuit compared with that of the valve itself, the nearer will the amplification factor under working conditions approach that of the theoretical amplification ratio. In practice, for voltage amplification it is usual to make the external impedance of the anode circuit if possible at least 3 to 4 times that of the valve itself.

In cases where a load is taken from the anode circuit to operate a loud-speaker, for instance, the conditions are somewhat different, and these will be discussed below.

Valve Impedance

We have also to consider the internal impedance of the valve. This is not simply the resistance of the valve as obtained by dividing the value of the high-tension voltage applied to the anode by the anode current. It is obtained by finding the change in anode current produced by a small change in the anode potential and dividing the change of anode volts by the change in anode current. For example, if a valve, at zero grid potential, gives 10 milliamps anode current at 90 volts, and 12 milliamps at 110 volts, then the impedance of the valve at zero grid volts, and a mean anode voltage of 100 is equal to $\frac{110-90}{\cdot 002}$ =10,000 ohms. The impedance and amplification ratio of a valve depend on the size and spacing of the electrodes. A valve with a high amplification ratio usually has a high impedance and a valve designed for a low impedance has a comparatively low amplification ratio.

Classification of Valves

Let us now consider the effect of these various characteristics in different types of circuits. Receiving and amplifying valves can at present be divided into the following types according to their uses :

(*a*) High-frequency amplifiers and detectors.
(*b*) Low-frequency amplifiers.
(*c*) Power or loud speaker valves.
(*d*) General purpose valves.

We will consider these requirements in turn.

High-frequency Amplification and Rectification

As the voltages and power dealt with in high-frequency amplification and rectification are very small the maximum emission required from the valve is comparatively small and need not exceed 5 to 10 milliamps. The chief requirements of a detector valve is a high voltage-amplification factor. Although this means a high impedance, it is not of serious consequence. The valve should be designed for a comparatively low anode voltage, and should be such that the characteristic is fairly symmetrical about the zero grid volts line. The requirements are thus an impedance of 30,000 to 60,000 ohms with an amplification factor of 10 or more.

For high frequency work the external impedance in the anode circuit is usually very high, particularly if tuned circuits are employed. This has led to the use of valves having a high impedance and consequently a high amlpification factor.

Low-frequency Amplification

For low-frequency work the external impedance is usually fairly low, so that a low impedance valve is preferable. For power amplifier work, using transformer coupling, the valve should be designed so that the mid point of the working straight part of the anode current-grid voltage characteristic is obtained with about –5 volts on the grid.

This allows of a fairly large sweep in the grid potential without the liability of the grid becoming positive. To obtain these conditions without the necessity of excessive high-tension voltage, the valve should have an amplification ratio of, say, between 5 and 10 with an impedance of from 10,000 to 25,000 ohms.

Resistance Amplifiers

The valve required for use in a resistance amplifier depends on the value of the anode resistances. If these are of the order of 50,000 to 100,000 ohms the impedance of the valves can be as much as 30,000 to 50,000 ohms. This allows a valve of a high amplification ratio to be used. The high tension supply in all cases should be sufficient to enable the valve to be operated with a negative grid bias of one or more volts, depending on the amplitude of the signal.

With resistance amplifiers it must be remembered that the high-tension voltage must always be considerably greater than that normally required with transformer coupled amplifiers, owing to the voltage drop across the resistance itself. In a resistance amplifier in which a valve is used with an impedance equal to half that of the anode resistance, the voltage required on the amplifier will be three times that normally used with the valve in a transformer coupled amplifier.

Power or Loud-Speaker Valves

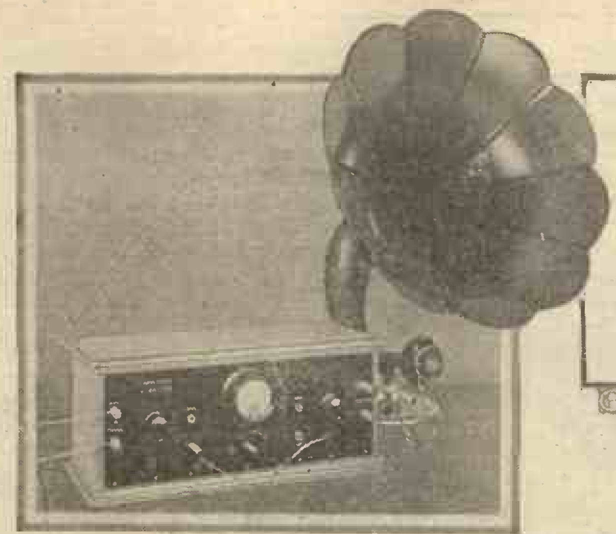
Up to the present we have been dealing with valves whose chief function has been voltage amplification. Practically no power has been required from the anode circuit. As the power taken by a loud speaker may be considerable, it is essential to select a special valve for this purpose. The power that can be obtained from a valve naturally depends on the high tension voltage, but as this is limited in most cases to about 200 volts at a maximum, the valve used should be capable of supplying the power required at this voltage and of course supplying it without distortion.

To obtain power under these conditions it is essential that the impedance of the valve should be very low. The amplification ratio is of secondary importance, but this of course should be as high as possible for any given impedance. For instance, a valve with an impedance of 5,000 ohms and an amplification factor of 3 is capable of giving much more volume of sound without distortion than a valve having an amplification ratio of, say, 15 and an impedance of 25,000 ohms.

In addition to a low impedance, a loud-speaker valve must have a very considerable emission, which should not be less than 20 milliamps. It should also be designed for operation at a negative grid bias of at least 10 volts.

A General Purpose Valve

For general purpose work, a valve with an amplification ratio of 10, an impedance of 30,000 ohms and a total emission of 10 milliamps is required. For low-frequency work the anode voltage should be about 100 volts with a grid bias of from –3 to –5. For high-frequency amplification and rectification an anode voltage of about 30 to 40 would probably be sufficient. Such a valve is not suitable, however, for operating a loud-speaker of any size.



A TWO-VALVE POWER AMPLIFIER

By C. P. Allinson

IN many cases the amateur who sees the words "power amplifier" promptly imagines a large instrument, difficult to construct and complicated to wire, and, in many cases an important point to him, costly to build.

The instrument described in the following article need not, however, cost a great deal more than an ordinary two-stage L.F. amplifier to make, while it has been so designed and laid out as to enable it to be constructed and wired up without difficulty even by the comparative beginner. At the same time certain refinements have been included, so that the greatest purity of tone may be obtained under varying conditions.

Neat Appearance

As will be seen from the photograph, the unit presents a neat and businesslike appearance; while its perfectly symmetrical lay-out, as viewed from the front of the panel, renders it pleasing to the eye. Further, the use of a polished ebonite panel gives it a certain distinction. Only four terminals appear on the panel, two of which are connected to the telephone terminals of the receiver, the other two being connected to the loud-speaker. All the other terminals to which the batteries are connected are carried on a terminal strip at the back of the instrument.

Jack Switching

The plug-and-jack method of switching is employed to connect the loud-speaker in the plate circuit of either of the two valves; while the jacks, being of the filament type, automatically switch on the requisite valve or valves. The loud-speaker is not connected directly into the plate circuit, a filter circuit being employed so as to protect the loud-speaker windings from any possibility of ill effects owing to heavy plate currents that may be flowing. A valuable feature is the inclusion of jacks in both the high-tension leads in order that a milliammeter may be placed in circuit so as to check up the actual plate current flowing and also any distortion that may be occurring.

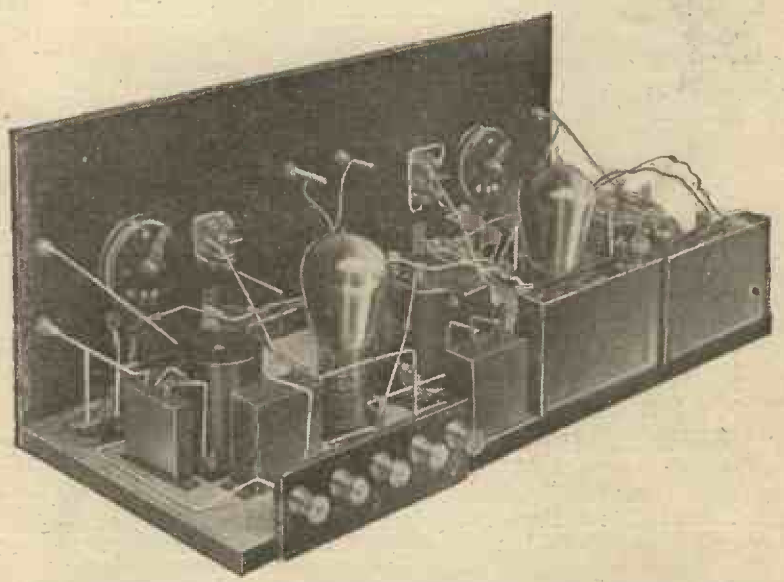
As is probably known to most readers, if distortion is occurring owing to incorrect high-tension voltage or incorrect grid bias, this is shown on a milliammeter included in the plate circuit by slight variations of the current. The more violent the "kicking" of the needle the worse the distortion.

In order to handle very large signals with the maximum purity obtainable it is, of course, necessary to use a power valve. The valves employed should be of the DE5, B4, or DFA type, with which a maximum plate voltage of about 120 volts should be used.

Separate H.T. tappings are provided for each valve, as also separate grid bias, so that each valve may be adjusted independently to work under the best conditions.

Shunt Condensers Across Transformers

A further refinement is the provision of means by which condensers may be connected across the primaries of either or both the L.F. transformers used, and resistances across the secondaries. The condenser across the loud-speaker



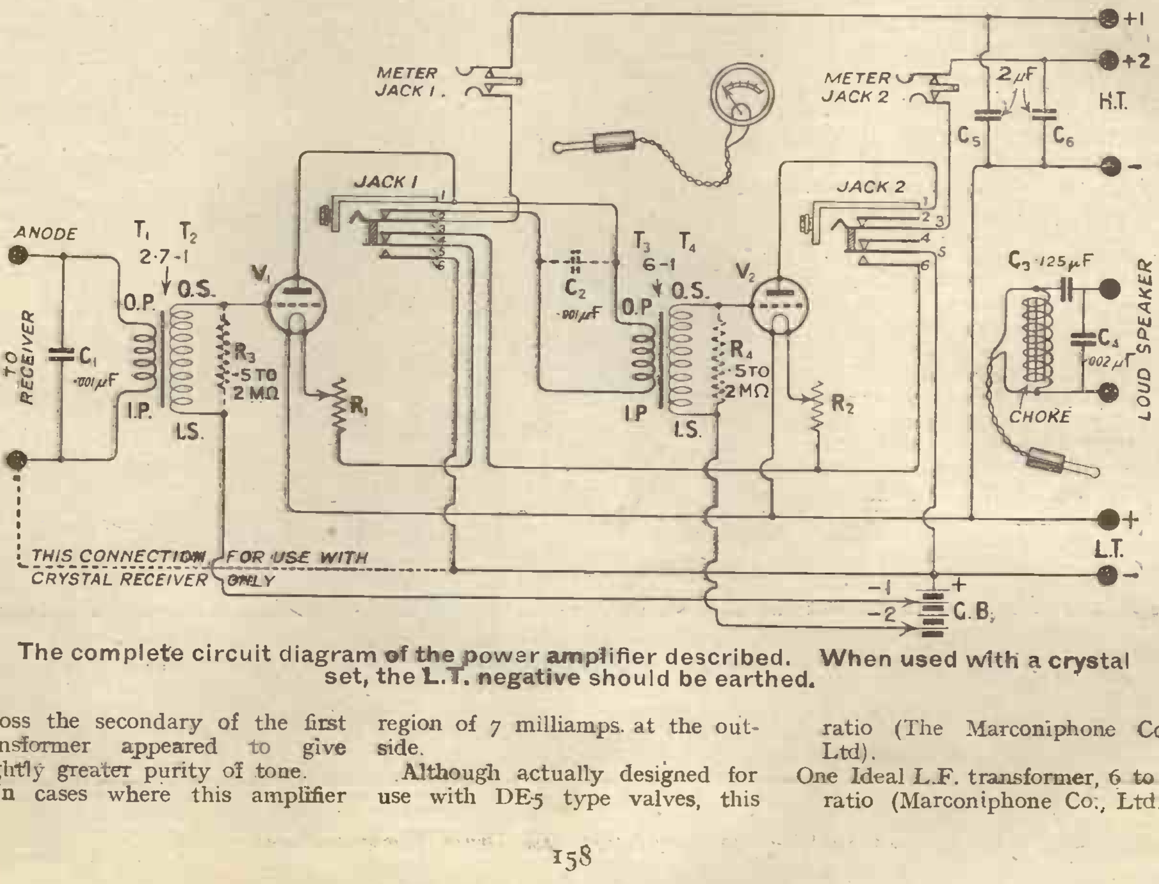
Provision is made for the grid bias batteries inside the case. They can be seen resting on the baseboard on the right of the picture.

is also of the clip-in type, so that different values may be tried out here. Where a fixed condenser is provided across the output terminals of the receiver with which this amplifier is to be used, the fixed condenser C_1 across the primary of the first inter-valve transformer may not be required; while the condenser C_2 indicated across the primary of the second transformer will only seldom be needed.

The appearance of the set is neat and distinctive.

Optional Resistances

The values for the resistances to be connected across the secondaries of the transformers, where they are needed, should be determined by experiment; but in very few cases will they need to be lower than half a megohm. Their function is to apply a small load to the secondary so as to reduce any resonance effects which may cause certain frequencies to be amplified more than others. In the instrument used by the author they were not really found necessary, though a 2-megohm leak across the secondary of the first transformer appeared to give slightly greater purity of tone.



The complete circuit diagram of the power amplifier described. When used with a crystal set, the L.T. negative should be earthed.

In cases where this amplifier is used with a crystal receiver, it will probably be found necessary to earth the L.T. negative lead, as otherwise there may be a slight tendency for a high-pitched whistle of low frequency oscillation to develop.

Small Anode Current

It is generally believed that a power amplifier takes a very heavy current from the high-tension battery, but provided that the maximum allowable negative grid bias is used, this need not be more than 3 or 4 milliamps. per valve. The total current thus taken by the amplifier would be in the region of 7 milliamps. at the outside.

Although actually designed for use with DE5 type valves, this amplifier will function very well with other types, and dual filament resistances have been employed so that any valve may be used. Non-microphonic valve holders have also been used so as to reduce to a minimum any noise that might otherwise be occasioned in the loud-speaker through shock or vibration. They further serve to protect the filaments of the valves.

Components

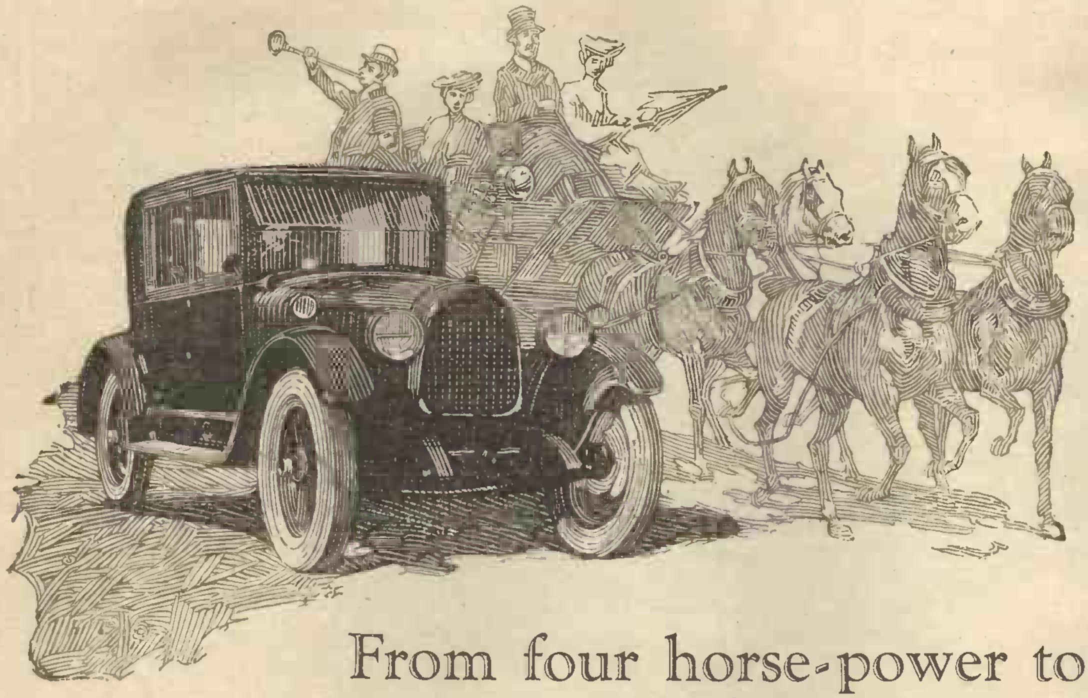
In accordance with our usual practice, we herewith give a complete list of the components required to build this receiver, and for the guidance of those who wish to have the set exactly duplicated, we give the makers' names. It is, of course, understood that provided that other components of known quality are used, the ones actually specified need not be employed.

One ebonite panel, 20 in. by 8 in. by ¼ in., polished (Paragon).

One cabinet, with loose baseboard for same (W. H. Agar).

One Ideal L.F. transformer, 2.7 to 1 ratio (The Marconiphone Co., Ltd).

One Ideal L.F. transformer, 6 to 1 ratio (Marconiphone Co., Ltd.).



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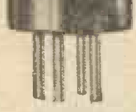
NOTHING can stem the pitiless tide of progress. The four-horse coach of two decades ago has now been superseded by the 40 h.p. car. And the bright emitter valve of two years ago is now being rapidly superseded by that most economical of all Dull Emitters—the Wuncell.

Wireless enthusiasts are everywhere realising that economy in valves means much more than actual current consumption. It means *long life*. Obviously a valve with an ultra-low current consumption and a short life—due to its fragile nature—cannot truthfully be called an economical valve.

The Wuncell puts life first and current consumption second. In spite of this, its wattage is still less than one-sixth of any bright emitter valve. That is to say, any six-volt accumulator which might, for example, have given 20 hours at a charge with bright emitters would give 120 hours using Wuncells.

The abnormally long life of the Wuncell Valve is due to its special filament, manufactured under a patent process known only to Cossor. Instead of being whittled down, as in most dull emitters, it is actually built up layer upon layer until it is as stout as that used in any standard bright emitter, and when in use it merely glows at a temperature not exceeding the embers of a dying match.

Its prolific output of electrons—harnessed to the well-known Cossor principles of construction—ensures a sensitivity which has no counterpart in any make of valve. For the first time since the Dull Emitter appeared on the market, users are saying that here at last is a perfect match in performance for the best bright emitter valve ever made.



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W2 for H.F. amplification ... 14/-
W3 Cossor Valve for Loud Speaker use
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Price 18/6

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Gilbert Ad. 3694

Two dual filament resistances (Burndept Wireless, Ltd.).
Two Antiphonic valve holders (Burndept Wireless, Ltd.).
Two double circuit double filament control jacks, long type (General Radio Co., Ltd.).
Two double circuit jacks, short type (General Radio Co., Ltd.).
Two plugs (General Radio Co., Ltd.).
One milliammeter, 0 to 20 milliamps. (Burndept Wireless Ltd.).
Three fixed condenser mountings, clip-in type (L. McMichael, Ltd.).
Two grid-leak mountings (L. McMichael, Ltd.).
One Super-Success Audio choke (Beard and Fitch).
One .125 μF fixed condenser (T.C.C.).
Two 2 μF fixed condensers (T.C.C.).
One terminal strip, 6 in. by 2 in. by ¼ in. (Paragon).
Nine large lacquered brass terminals (Burne-Jones).
Four 'phone tags.
Two 9 volt grid bias batteries and wander plugs.
One set Radio Press panel transfers.
Quantity of square tinned wire and double flex for connections.

Construction

The first step in the construction of this receiver is to drill the panel according to the panel lay-out diagram shown in Fig. 1. Care should be taken when doing this work not to scratch the surface of the panel and so spoil its appearance. The panel should therefore be laid face downward on a piece of tissue paper, below which again is a piece of brown paper, and all points at which holes are to be drilled should be carefully marked out on the back with a set-square and scriber. The positions of all holes should be centre punched so that the drill may not wander. Next fix the panel transfers where required, and then mount the components on the panel itself. The panel may now be mounted on to the baseboard, after which the components which go on the baseboard are fixed into position. The lay-out of this baseboard may be obtained from the wiring diagram shown in Fig. 2. Next drill the terminal strip, fix the panel transfers to it, put the terminals on and fix to the baseboard where shown.

Wiring of Jacks

The wiring may now be commenced. First of all wire up the low tension filament supply circuit, taking particular care to get the connections to the filament contact from the jacks correct. The jacks are numbered in the wiring diagram to correspond with the numbers shown in the theoretical circuit diagram, while the enlarged view of the jacks in Fig. 3 has the tags numbered to correspond with both of these. There should, therefore, be no difficulty in completing this.

In case there should be any doubt, however, as to the connections for the jacks, the following points should be noted :—

Jack No. 1—Contact 1 to Anode V_1 and OP of the Second Transformer.
Contact 2 to IP of Second Transformer.
Contact 3 to meter jack 1, other side of this going to HT + 1.
Contact 4 to contact 6 jack 2, and to R_2.
Contact 5 to R_1.
Contact 6 to contact 5 jack 2 and LT –.

Jack No. 2—Contact 1 to Anode of V_2.
Contact 2 blank.
Contact 3 to meter jack 2.
Contact 4 blank.
Contact 5 to contact 6 jack 1, and LT –.
Contact 6 to R_2 and contact 4, jack No. 1.

Remainder of Wiring

Having completed the wiring of the low-tension circuits, the other connections may be put in in the most convenient order. It will be found that ample space has been left for making these connections, and that no difficulty need be encountered in completing the instrument. The holes in the panel through which the two flex leads pass are 3/16 in. in diameter, while the single hole in the centre of the panel below the milliammeter is a ¼ in. hole to allow of the milliammeter plug being inserted therein when not required to be inserted in the anode circuit of either of the valves. In order that a sound connection may be made to the jacks with the flex leads, all round telephone tags have been soldered on the ends of the flex. The flex leads from the filter circuits are fastened to the baseboard at one point by means of a screw and a washer, so as to take the strain of any pull that might accidentally be placed on them, and so eliminate any risk of the soldered joints being injured.

Testing Out

Having completed the instrument, it should next be carefully tested out. To do this, first of all

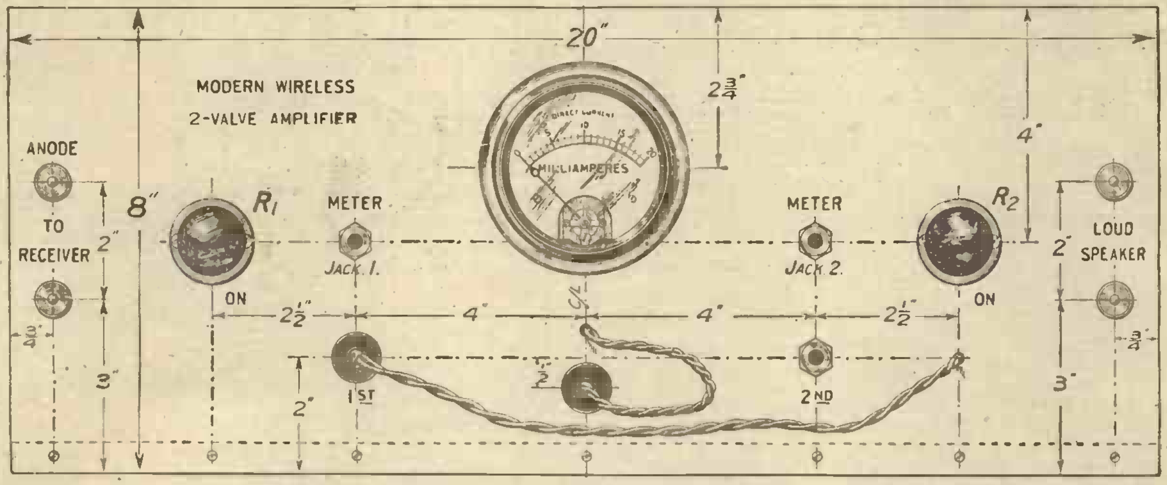

Fig. 1.—The layout of the panel may be obtained from this figure. The milliammeter may be omitted from the panel if desired. A blue print of this panel (No. 133a) has been prepared, price 1s. 6d., post free.

connect the low-tension battery to its terminals, and insert two valves, one in each valve-holder. See that the filament resistances are in the "off" position and insert the loud-speaker plug into jack No. 1. Turn on the filament resistance and see that the valve lights correctly. Now turn on the second filament resistance, and in this case the second valve should not light. On transferring the plug from jack No. 1 to jack No. 2, both valves should light. If this is in order, O.K., and separate leads taken to each of the high-tension terminals, giving the correct voltages. These will depend, of course, on the valves being used and the amount of volume requiring to be handled.

Milliammeter Connections

Next find out the correct connections for the milliammeter by plugging it into one of the meter jacks with the valve alight, and a small value of high tension plugged in. If the needle swings is which. If the meter is not mounted, it should be noted that the holes for the flex and plug will not be needed.

Connections to Receiver

Having ascertained that the connections of the instrument are correct, connect it to the receiver with which it is to be used. It should be noted that the top of the two input terminals should be connected to that terminal on the receiver which goes either direct

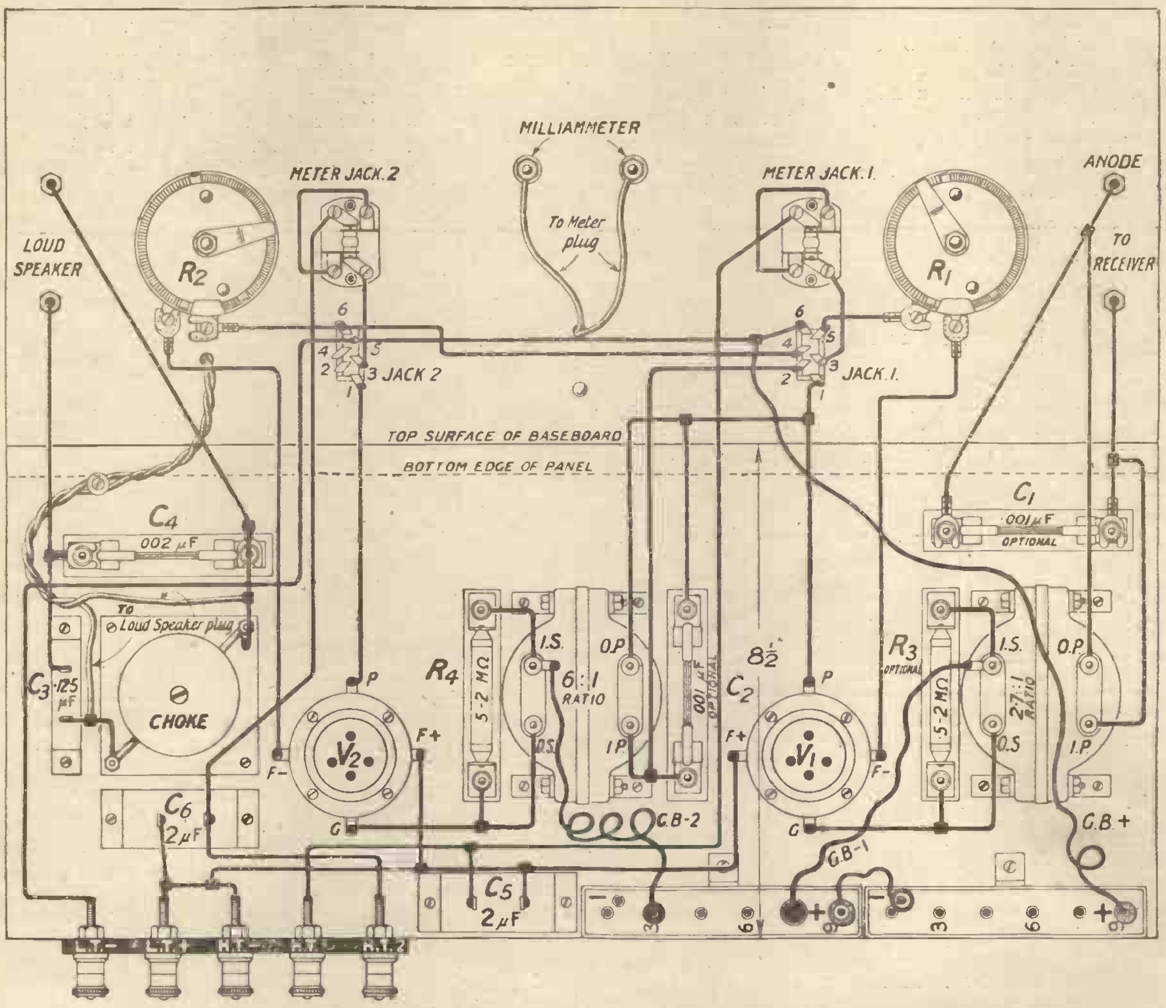

Fig. 2.—The wiring will present no difficulty if carried out as indicated in the text. A blue print of the wiring (No. 133b) may be obtained, price 1s. 6d., post free.

turn out the valves and attach the high-tension battery to its terminals. First of all plug-in a small value such as 6-volts, using a common lead for the two H.T. tappings, and turn on both the valves. If they appear to be burning correctly plug-in the high-tension wander plug to the 12-volt socket, and notice whether any brightening of the filament occurs. If this does not happen, the connections can be taken as to the wrong side of the zero the connections should be reversed.

Some amateurs may, perhaps, not wish to tie up a milliammeter to one instrument. In this case the meter need not be mounted on the set, but used loose. The plug-and-jack method still enables it to be used when required. In this case the plug leads should be marked in some way. A knot for negative (note the alliteration) is a good mnemonic for remembering which to the anode of the detector valve, or to it through the reaction coil. The other one will, of course, go to the terminal which goes to the high-tension positive, in the case of the unit being used with a valve receiver. In this case it will not be necessary to take a lead from the high-tension negative terminal of the amplifier to the high-tension battery as this connection will always be provided in the receiver itself. Try the amplifier out on the

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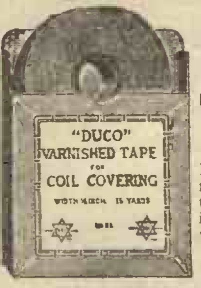

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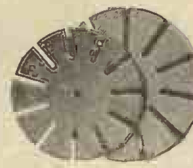

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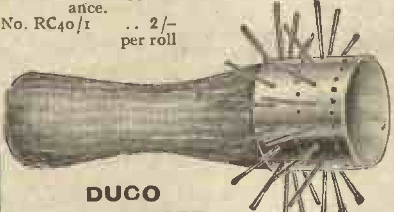

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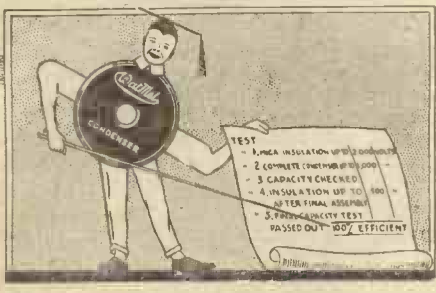

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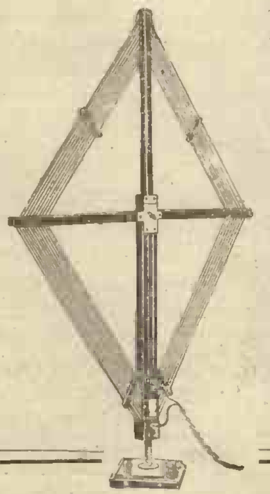

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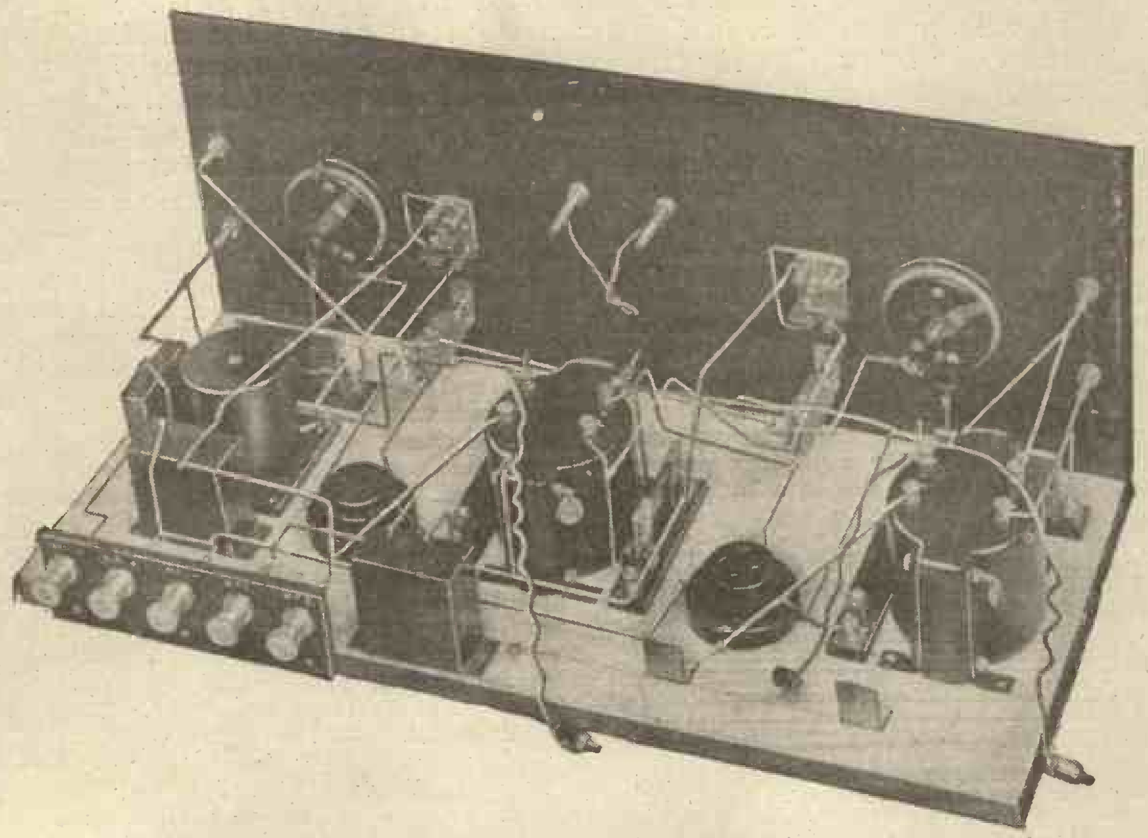
local broadcast station, using only one of the valves at first. Tune the station in as loudly as possible and insert the milliammeter in its jack, and note how much current is passing, and whether the milliammeter needle kicks or swings at all. If 80 volts are being used on volts. A larger anode voltage will, of course, call for greater negative bias, and *vice versa*.

It is always preferable to adjust the grid bias to the maximum allowable without producing distortion, in order to effect economy in high-tension current.

stage of L.F. amplification only, and with this signals were as loud as could possibly be required even in a large sized room. After the necessary adjustment had been made, the reproduction was noticeable for its excellent quality. On switching on the second valve,



The apparatus is well spaced, giving ample room for wiring.

the anode of this valve, the necessary grid bias may be from 4 to 6 volts, and the anode current passing may be in the region of 2 to 4 milliamps, depending on the type of valve in use.

Adjustment of Grid Bias

If the receiver is very close to a broadcasting station, and the volume is at all large, it may be necessary to raise the anode voltage in order to eliminate kicks on the needle, in which case the grid bias will, of course, have to be increased accordingly. If signals are loud with only one stage of the power amplifier in use, the second stage will make signals absolutely unbearable. The receiver should, therefore, first be detuned before switching in the second valve. The anode and grid voltages of this should then be adjusted by using the milliammeter as a check, by plugging it into the other jack. If 120 volts are being used on the plate of this valve, then the correct grid bias will be in the region of 9

Test Report

Separate tests were made with this instrument, in one case using two DE5 valves, and in the other using a couple of small power valves

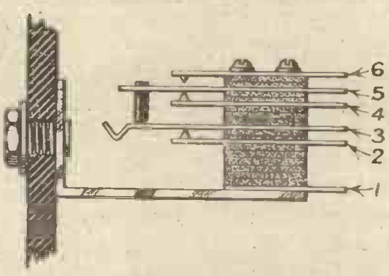


Fig. 3.—The numbers are referred to in the text.

of different denominations, B6 and B7, which were handy. The amplifier was connected up to a single-valve reaction receiver.

The broadcasting from 2LO was first of all received, using one results were truly shattering, and even with the set detuned, the volume produced by the loud-speaker was too great for comfort.

Foreign Stations

In the late afternoon, when 2LO was not on, a number of foreign stations were received on the loud-speaker with the greatest of ease. Among these were Vox-Haus (Berlin), San Sebastian (Spain), Hamburg (Germany), and one or two of the B.B.C. stations which were not identified. No difficulty was experienced in tuning the stations in directly on the loud-speaker, and quality was all that could be desired.

Is Self-Capacity a Bogey?

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

One hears a good deal about self-capacity of coils and the general impression is that self-capacity is to be avoided at all costs. In this article Mr. Barton-Chapple shows just where self-capacity can cause trouble and how ill effects may be avoided.

BEFORE commencing to discuss the effects of self-capacity, it is desirable to obtain a clear idea of what self-capacity really is. In order to produce a current through a coil of wire it is necessary to apply a voltage across the ends of the coil. In a similar manner if a coil is carrying current there must be a voltage developed across the coil.

Thus in a coil inserted in a wireless circuit the wireless currents which are set up in the coil will produce voltages across the coil (these voltages being applied to the detector or amplifier which is in use). Now considering this in a little more detail it will be clear that every portion of the coil must have a small voltage across it, produced by the current; that is to say, there must be a small voltage between each individual turn of the coil.

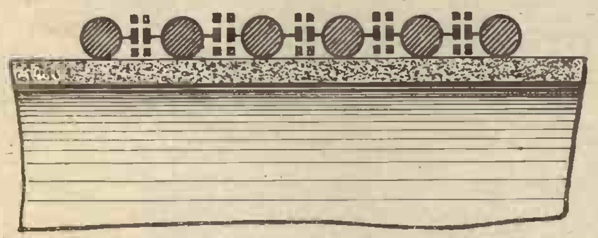


Fig. 1.—Illustrating the capacity effect between the adjacent turns of a coil.

A Small Condenser

We have here all the elements of a condenser. We have two conductors at a different voltage, separated by an insulator; that is, the insulation of the wire itself. There is thus a capacity between the two parts of the coil.

The effects of all these small capacities between the various internal portions of the coil all add together to produce an effect which is the same as if a small capacity were connected across the terminals of the coil itself. It is this somewhat imaginary capacity which we term the "self-capacity" of the coil. Actually, of course, as we have just seen, the capacity is really made up of a somewhat complex system of little inter-turn capacities. But the effect on the coil when used in a wireless circuit is found to be exactly the same as that of connecting a parallel capacity across the coil, and for this reason it is usually regarded from this point of view. The point is illustrated in Fig. 1.

Value of Self-Capacity

Let us now consider some of the effects produced by this self-capacity. We are interested technically in three aspects of the question. First of all there is the effect of the capacity upon the tuning of the circuit, and this introduces the second question; that is to say, the actual value of the self-capacity and its dependence upon the type of coil and the nature of the windings. The third question is that of the losses which are introduced into the circuit by this additional capacity.

Now the value of the self-capacity is normally very small. The author recently measured the self-capacities of a large range of coils suitable for broadcast reception made by both amateurs and commercial firms, and found that the values varied from 4 $\mu\mu$F for a single layer coil to as much as 35 $\mu\mu$F for multilayer coils. The higher values were no doubt due to poor mounting, for the coil windings were particularly good, and an improvement could be effected by remounting on a reliable coil mount of best quality material. With large multilayer home-made coils even larger capacities were obtained, the extreme being found in a coil of just over three henries inductance, which reached a figure of over 700 $\mu\mu$F.

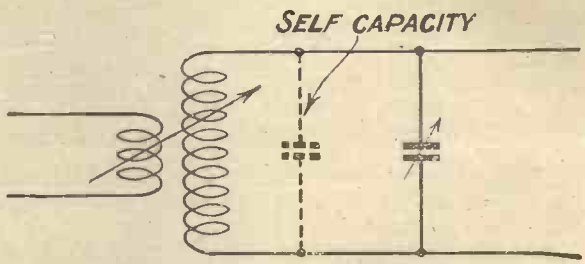
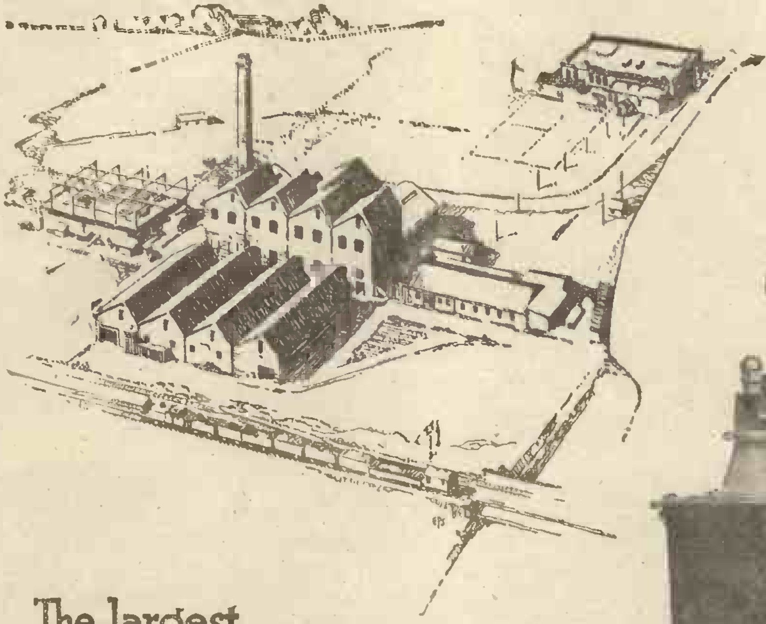


Fig. 2.—A common type of circuit in which the voltage is introduced in the coil itself.

The various methods of avoiding self-capacity have been discussed on various occasions, and it is not proposed to dwell upon these in this article.

The main principle to be followed in winding coils is to ensure that the turns at the beginning and end of the coil shall be kept well apart. Care should also be taken to avoid adjacent turns being too close to each other, and this has given rise to the practice of winding well spaced types of coil. The question we have to discuss at the moment, however, is not how to reduce the self-capacity, but what is the effect of the self-capacity on the circuit and whether it is as serious as is generally supposed.



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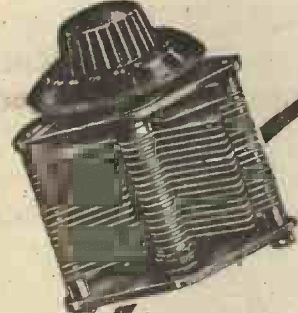
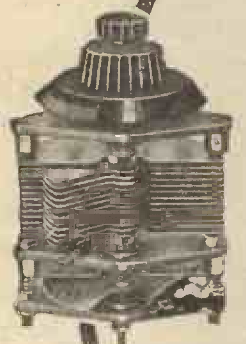
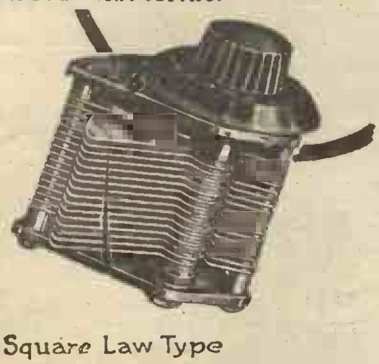


Standard Type



Standard with Vernier



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Effect on Tuning

Let us now consider the effect of the self-capacity on the tuning of a particular coil. There are two particular cases to be considered. In the first case we have circuits of the type shown in Fig. 2. Here the signal voltage is introduced into the coil itself. This may come from an aerial circuit or by coupling from a previous circuit in a valve amplifier or some similar arrangement.

The coil is tuned by connecting a variable condenser across the two ends, and it will be seen that the only effect of the self-capacity in this case is to increase the value of the tuning condenser. The result of this will be that the maximum value will be slightly higher, although this increase will be almost inappreciable, and the minimum value will also be increased by the same amount.

Restriction of Tuning Range

Now at the minimum value of the condenser the capacity of the variable condenser itself is very small, so that the self-capacity of the coil becomes appreciable, and it is quite possible for the resultant capacity across the coil to be two or more times as great as the minimum value of the condenser. The effect of this, therefore, is to reduce the tuning range of the coil to some extent. With normal circuits working on broadcast frequencies, this does not cause any appreciable trouble, with a well-wound coil. With a poorly wound coil, however, tuned with a small condenser, this restriction of tuning range may be very serious, and may cause considerable trouble in actual practice.

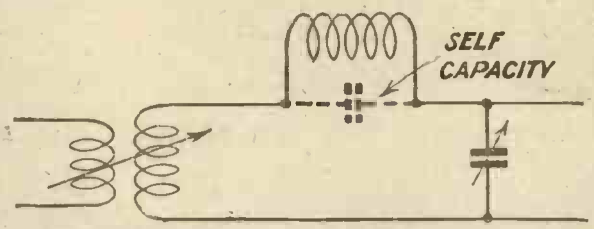


Fig. 3.—In this case the voltage is introduced into the circuit in series with the coil.

For this reason it is customary to use well-spaced windings and to avoid any solid dielectric in the make-up of the coil. This form of construction is also useful from the other points of view, such as the reduction of losses in the circuit, as will be seen later.

Rejector Effect

The second type of circuit in which a coil may be employed is that shown in Fig. 3. In such a case the voltage induced in the circuit is not in the coil itself, but is in series with it. In this case the coil acts as a parallel tuned circuit, and it is well known that such a circuit has the properties of a rejector. It has a very high resistance at the frequency to which it is tuned, and it can be shown that the resistance is also quite appreciable even at frequencies some distance away from the natural frequency of the coil.

If, therefore, we have a coil having an appreciable self-capacity in circuit in this manner, it is quite possible that the actual resistance of the complete circuit may be increased to several times the normal value.

This particular form of trouble is prevalent in cases where loading coils are used when the circuit is of the type shown. We see, therefore, that the self-capacity of the coil is more harmful in a case like this than in the previous case where the energy is introduced into the coil itself. The case in Fig. 3 is fortunately less commonly used than the type shown in Fig. 2, but this type of circuit has to be used on occasion, and it is desirable to employ a coil having a low self-capacity in such a case.

Losses in the Circuit

We now come to consider the third aspect of the question; that is to say, the problem of the losses set up in the circuit. Now it can be shown that whenever there is any solid insulation for a condenser, there are losses set up by the presence of the insulation in the electric field of the condenser.

In the case of a coil we have just seen that the insulation in between the "plates" of the condenser is really the actual insulation of the wire of the coil itself. This insulation, in many cases, is cotton or silk, and this does not constitute an ideal insulator at high frequencies. The losses in such a dielectric are very often heavy, and this makes the condenser connected across the coil a very poor one. That is to say, the current flowing through this self-capacity will give rise to very appreciable losses which are to be avoided as far as possible.

Special Forms of Construction

This has led to the development of special forms of winding for low-loss coils. In such coils the insulation on the wire is made of as good a quality as possible. Cotton-covered wire is avoided where practicable, and either silk, or even better, enamelled wire is used. If the coil is wound with a spaced winding then no insulation need be used on the wire at all. This method, unfortunately, has the disadvantage that the wire of the coil is liable to oxidise on the outside, which increases its resistance, so that a thin coating of enamel is desirable to avoid this oxidation.

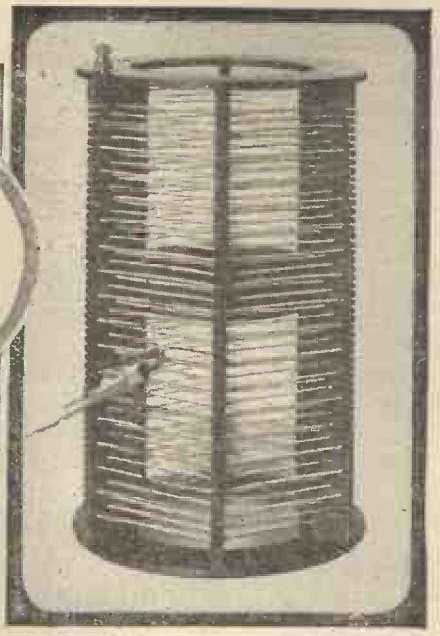
Losses the Principal Trouble

We see, therefore, that the most serious effect of self-capacity is the loss which is set up in the circuit, due to the imperfect insulation between the turns from a point of view of high frequency currents. The insulation may be perfectly good as far as actual conductivity is concerned, but it may nevertheless be very poor for high frequency work. With adequate precautions, however, this loss may be reduced to a negligible quantity, and that is one reason for the great prevalence of the low-loss coil at the present moment.

Multi-layer coils have to be used in certain circumstances, in which case the precautions necessary to avoid loss are more complicated, but with suitable care a reasonably low loss can still be obtained.

IS THE AERIAL CIRCUIT EVER APERIODIC?

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



An account of some extremely interesting investigations upon a popular method of aerial coupling.

SOME little time ago a tuning arrangement of the general form illustrated in Fig. 1. began to achieve a considerable degree of popularity, and the name "aperiodic aerial circuit" was given to it. The main features of this arrangement are that we have

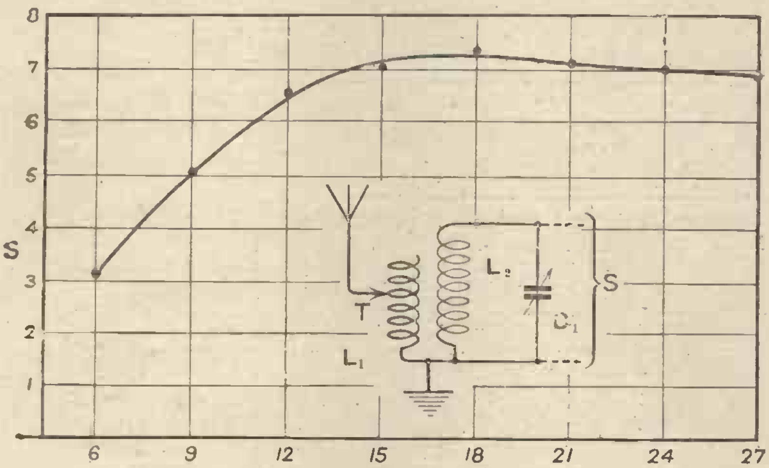


Fig. 1.—This graph shows the relation between turns in the aerial winding (plotted horizontally) and signal strength (S) measured across the secondary.

a secondary circuit comprising the coil, L_2, and condenser C_1, across which the first valve of the set will be connected in the ordinary way, while the aerial and earth are connected to a separate winding L_1, which is usually arranged to couple fairly tightly with L_2. The coil L_2 should be of the correct size for a secondary circuit to cover the desired band of frequencies, whereas the coil L_1 is usually quite small, say 10 or 12 turns.

It has been argued that with this arrangement the aerial functions as an aperiodic collector of energy, the circuit comprising the aerial, actually aperiodic in its functioning. It has further been maintained that the only tuned circuit in this arrangement is the secondary circuit L_2C_1 which, of course, provides the only adjustment in the circuit, and that it possesses most of the good points of a loose-coupled tuner of the conventional type containing separately tuned primary and secondary circuits, with the advantage that only one tuning control is necessary.

An Advantage

The principal property of this arrangement which has been found so attractive is the fact that its selectivity under proper conditions is very considerably higher than that of an ordinary direct coupled arrangement, so that it serves a very useful purpose in cases where it is desired to improve the sharpness of tuning of a given circuit. This desirable end is achieved, moreover, without sacrifice of signal strength, when the correct number of turns has been found for the aerial winding.

Need for Adjustment

The arrangement has certainly proved its merits in actual practice, but certain curious variations in its behaviour on different aerials have led to a certain amount of disappointment in some cases. Many experimenters have noticed that although someone may recommend, say, ten turns as the correct number for the aerial winding, yet on their particular aerial nothing less than fifteen gives anything like the signal strength which could be obtained with an ordinary direct-coupled arrangement.

It has been concluded by almost everyone who has tried the arrangement upon more than one aerial that some adjustment of coupling turns is needed to suit a particular aerial if the very best results are to be obtained, although an average number can be applied which will give fair results upon the great majority of aerials. Anyone who has taken the trouble to make up one of these coupling arrangements with tappings upon the aerial winding, giving the power to vary the number of turns in the aerial circuit from, say, five to thirty, will have discovered for himself that what takes place is something as follows.

Obtaining Selectivity

Starting with only a few turns in the aerial circuit, it is observed

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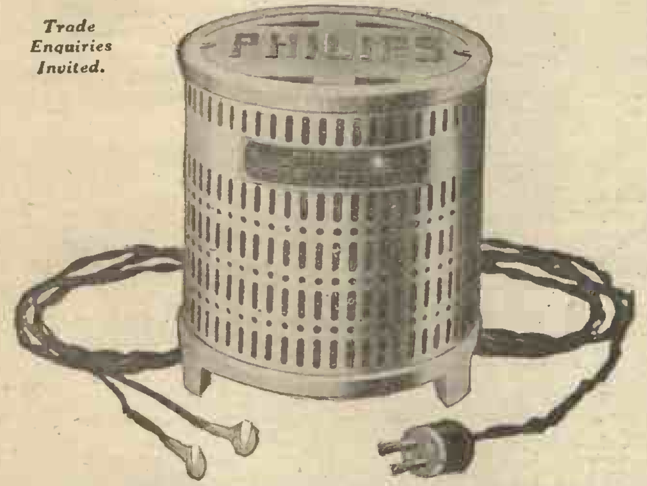

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that selectivity is extremely high, and signal strength rather poor, and that as the number of turns is increased selectivity gradually falls off, while signal strength rises

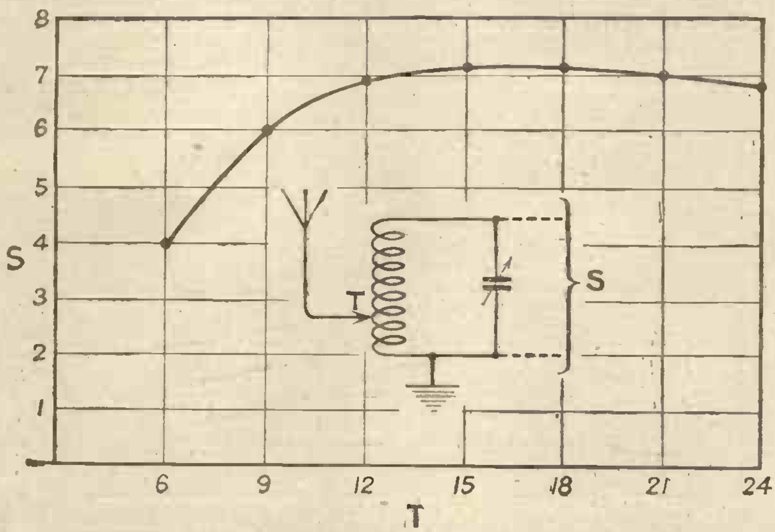

Fig. 2.—The auto-coupled type of circuit gives a curve which conforms closely to that of a circuit with a separate aerial winding (see Fig. 1).

up to a certain point, remains more or less constant over a wide range of turn numbers, and then gradually falls off again as the aerial turns are increased above a certain point; it is necessary to reduce the aerial turns as far as possible to obtain a high degree of selectivity without undue sacrifice of signal strength.

These points, and a number of other somewhat obscure ones, connected with the functioning of this so-called aperiodic aerial arrangement, have led to a good deal of investigation being carried out upon its properties, notably by Mr. A. D. Cowper, M.Sc., most of whose results have been published in *Wireless Weekly*. Much interesting and useful information has been derived from this work, but the point regarding the actual functioning of the aerial circuit, that is to say, whether it is really aperiodic or semi-aperiodic, or whether it is tuned by virtue of the tight coupling between the primary and the secondary, in the way in which we are accustomed to consider takes place in a high frequency transformer whose secondary is tuned, has not received very much attention.

Interesting Tests

In an endeavour to obtain some light upon this point I have recently carried out a series of quantitative experiments, the results of which I think may be of some interest to the readers of MODERN WIRELESS.

All these experiments consisted in the measurement of signal strength given by different arrangements of tapping points, series condensers and resistances, and it is therefore desirable to explain the method of measurement employed.

The Method

The procedure was to tune the arrangement to the frequency of the local station's carrier wave, this station being situated at a distance of about eight miles from the receiving point, and to measure the signal strength resulting across the tuned circuit by means of a very elementary form of the Moullin voltmeter, and an example will make this method clearer than a lengthy description. If the reader will examine Fig. 1 he will see that this illustration shows a curve giving the relation between two variable factors, and inset a sketch of the circuit concerned. This circuit is the typical "aperiodic aerial" arrangement, with a variable tapping upon the aerial winding, while the bracket at the right, across the secondary, indicates that the voltage across this circuit was used as a means of estimating the signal strength S.

What was actually done was to place the aerial tapping "T" upon different numbers of turns on the aerial winding, and measure the signal strength produced across the secondary in each case, it being understood that the secondary was re-tuned to resonance each time the aerial tapping was moved. The result is shown in the graph, the number of turns in the aerial circuit being plotted horizontally, and the signal strength vertically.

Starting with 16 turns in the aerial circuit, a signal strength of 3.2 was obtained, from which value signal strength rose steadily as the number of turns in the aerial circuit was increased until the eighteenth turn was reached, beyond which point signal strength began to fall off again.

The Coil

The coil which was used for this experiment, and for all the others which we are considering, was a "Three-step" inductance, of which an illustration appears at the head of this article. It comprised 60 turns of No. 22 d.c.c. wire, and the aerial winding was wound directly in the top of the secondary, being inserted turn by turn in the slots in the former.

The form taken by the curve illustrated in Fig. 2 is a thoroughly typical one for this circuit arrangement, and this will no doubt be familiar to readers who have studied the subject, since such curves have been published several times. The exact form of the curve will depend upon the aerial on which the measurements are made, the form illustrated being that exhibited by a fairly good aerial. When the aerial is of a somewhat high resistance the curve becomes more sharply peaked—that is to say, it

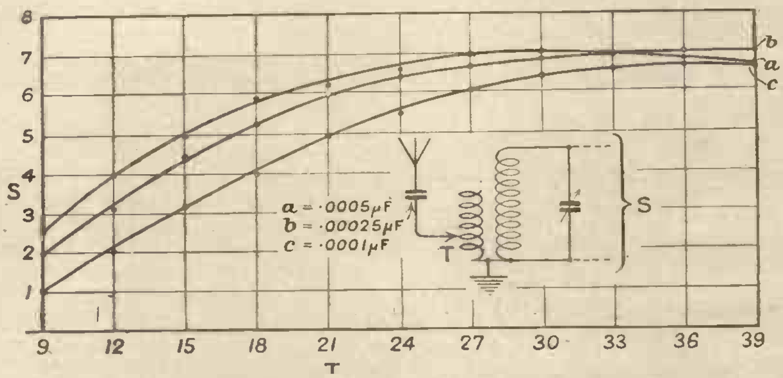

Fig. 3.—These three graphs show the effect of adding series condensers in the aerial circuit.

falls off more rapidly beyond the optimum point.

The actual position of the peak also varies with the capacity of the aerial, a large aerial showing a peak further back towards the left. In general, however, the length of the curve relatively flat portion of the curve is sufficiently great to cover quite a considerable band of frequencies, so that in one sense it is perhaps justifiable to describe it as an "aperiodic aerial" arrangement.

At the outset of these experiments it was desired to ascertain whether there was any fundamental difference in the behaviour of the simple form of the aperiodic aerial arrangement, and the scheme known as auto-coupling. (This is a method in which the earth connection is made to the lower end of the tuning coil, and the aerial to a point some ten or fifteen turns up the coil.) It might be expected that the results would be very similar to those of the "aperiodic aerial" arrangement in its conventional form, and accordingly a curve was plotted for the same coil as before, varying the position of a direct aerial tap.

Series Condensers

The result is shown in Fig. 3. The form of the curve so closely resembles that of Fig. 2 that it was assumed that further investigations might be confined to the separate winding arrangement.

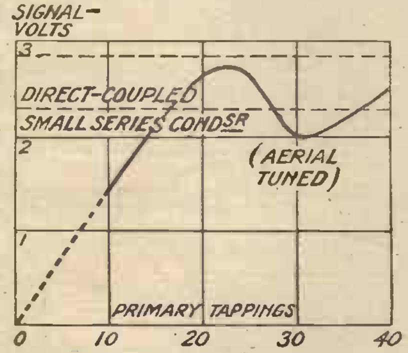

Fig. 5.—A curve obtained by Mr. Cowper for the relation between turns in the aerial winding (plotted horizontally) and signal strength.

It is, of course, to be understood that the close resemblance between these two methods depends upon the use of really tight coupling between the two windings in the "aperiodic aerial" arrangement.

The first experiment designed to elucidate one of the points as to the functioning of the aerial circuit was the insertion of series condensers of various capacities in the aerial lead, as shown in Fig. 4. Three different sizes of condensers were placed in series, and a curve plotted, showing the relationship between the signal strength and turns in the aerial circuit. The three curves given, viz. : *a*, *b* and *c*, show the effect of the series capacity upon the shape of the curve, and it will be observed that it is very much flattened out, and that the strength as the aerial turns are increased beyond the optimum value.

Doubt

These two experiments confirmed previous observations that the "aperiodic aerial" arrangement is decidedly sensitive to changes of aerial capacity, in that the peak

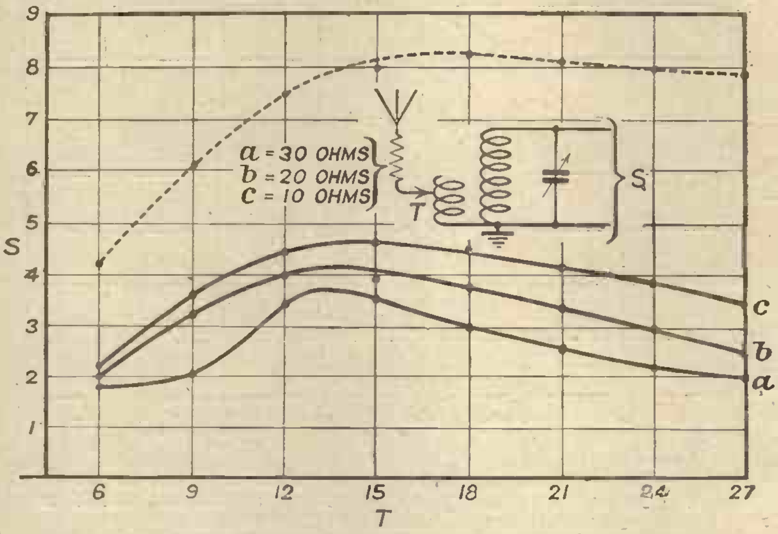

Fig. 4.—The "aperiodic aerial" circuit proves to be decidedly sensitive to the addition of resistance in the aerial lead. The dotted curve is that of Fig. 1 (no added resistance) repeated for comparison.

peak is pushed forward very considerably. This result of course, confirms the observation that the peak of the curve falls in different positions with aerials of differing capacity.

Effect of Resistance

The next experiment was designed to show the effect of greater or less amounts of resistance in the aerial circuit, and for this purpose the usual circuit was set up and curves plotted showing the relationship between turns in the aerial circuit and signal strength, with varying amounts of resistance inserted in the aerial lead. The three curves, *a*, *b* and *c*, in Fig. 5, show the result, curve *a* being the result of the insertion of approximately 30 ohms resistance in the aerial circuit, *b* 20 ohms, and *c* 10 ohms. The dotted curve is inserted for reference, this being the form obtained when no resistance is added. It will be seen that the effect of adding resistance is to increase the sharpness of the peak and also to remove the peak to the left, *i.e.*, towards the smaller numbers of turns in the aerial circuit. In effect, the results obtained are thus merely the imitation of a high resistance aerial, which will be remembered as having the effect of increasing the sharpness of the peak, or perhaps one should say, of accelerating the fall of signal of the signal strength curve is shifted by such changes and, further, that it is also sensitive to the resistance of the aerial circuit, which has a considerable influence upon the actual shape of the curve. Neither of these observations seems to accord very well with the conception of an aperiodic aerial circuit, and it was therefore decided to seek some more decisive method of testing the point.

Further Tests

Now, one of the main arguments in favour of the aperiodic theory is to be found in the fact that the number of turns included in the aerial circuit for the best signal strength across the secondary is far below the number which would be required to tune the aerial circuit in itself to the received frequency. As a matter of fact, signal strength falls off seriously long before such a number of turns is included in the aerial circuit as would tune that circuit to the received frequency. It therefore seemed that it would be profitable to enquire into the shape of the curve up to and beyond the point at which the aerial circuit is actually tuned, since the greater number of published curves show only that portion of the range illustrated in the various diagrams which have appeared in the preceding part of this article.

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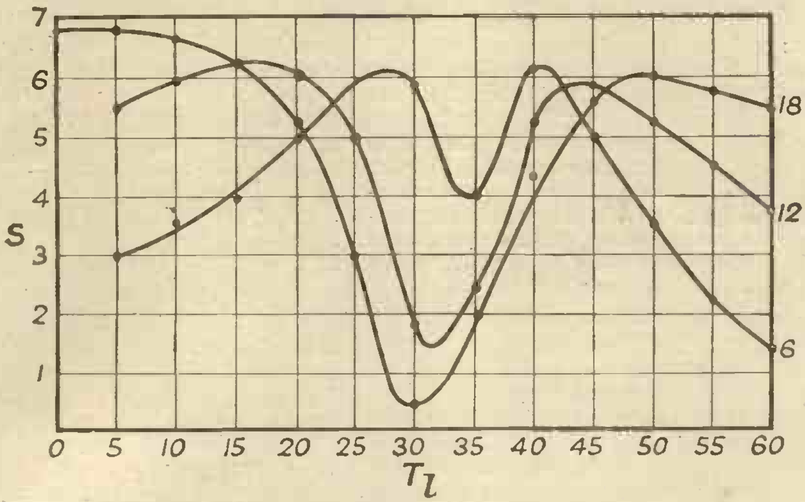
Mr. Cowper has recently published in *Wireless Weekly* an article upon this subject, in which he showed the relation between signal strength and the number of turns included in the aerial circuit over a much wider range than had previously been done, the curve being of the general form shown in Fig. 5.

The Tuning Point

This is naturally an extremely suggestive result, and it becomes even more so when it is remembered that the curious minimum point immediately following upon the peak corresponds to such a number of turns in the aerial circuit that that circuit was tuned to the received frequency.



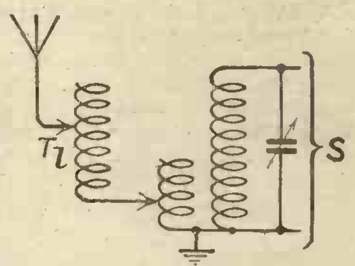


Fig. 6.—The author's last experiment was to vary the number of turns in a separate aerial loading coil (T_l, plotted horizontally), The numbers 6, 12, and 18 indicate the number of turns in the coupling winding.

Coupling Effects

In the method adopted by Mr. Cowper in carrying out his investigations, all the turns included in the aerial circuit were fairly closely coupled to the secondary winding, and it was decided to endeavour to determine the shape of the curve when it could be decided that the effect was more that of tuning the circuit, and not to such a great extent one of variation in the coupling between primary and secondary, since it was thought that when all the turns included in the aerial circuit are closely coupled to the secondary winding, it is possible that the effect may be one more of variation of coupling than of actual tuning.

The Last Test

The procedure therefore adopted was to include a fixed number of turns in the coupling winding, say, 15, and then to insert in the aerial lead a tapped loading coil whose turns might be varied at will, and which was not coupled in any way to the other winding. In this way the aerial circuit could be tuned to the received wavelength without increasing the coupling between the two circuits. Several curves were next plotted to show the relationship between the number of turns in the loading coil and the signal strength obtained in the secondary circuit, and three of these are shown in Fig. 6.

Each of these curves is marked with the number of turns included in the coupling winding, while horizontally can be read the number of turns in the separate loading coil, the signal strength being recorded vertically. Now, these curves will at once recall to mind the "double humped" resonance curve obtained with the ordinary tuned primary and secondary arrangement, when the coupling between the two coils is too tight, and this resemblance is very suggestive as to the true mode of functioning of the so-called aperiodic aerial circuit.

Conclusions

The curves show that the arrangement conforms to the behaviour of a very tightly coupled primary and secondary, in the sense that when the coupling is tightened, that is to say when the number of coupling turns is increased the two humps are pushed further apart and the "dip" or notch between them becomes deeper, and, further, that the two side humps are flattened out. A test was made to determine whether the number of turns in the aerial circuit which corresponds with the bottom of the notch between two humps was actually the tuning point for the local carrier wave, and this was found to be so. When the aerial circuit, therefore, is actually tuned to the frequency of reception, the familiar effect of a too tightly coupled tuned primary and secondary is produced. The phenomenon of excessively flat tuning when the aerial circuit was actually tuned to resonance was also observed as a further confirmation.

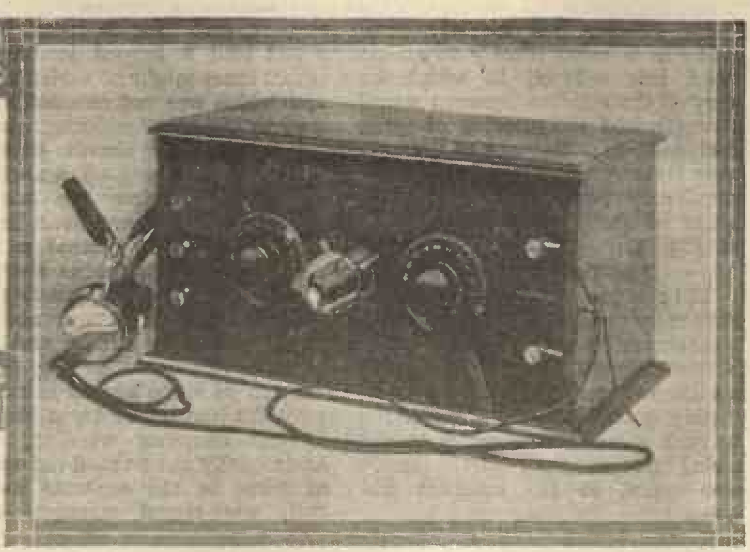
It would seem that an inspection of these curves must lead to the conclusion that what we have in the so-called aperiodic aerial arrangement is simply a primary circuit so closely coupled to the secondary circuit that two very much flattened humps are produced instead of a sharply peaked resonance curve, and that we commonly work upon one of these humps, usually the one appropriate to the smaller number of turns in the aerial circuit rather than the larger.

It would follow from this that the curve shown in Fig. 1 and in Fig. 3 are each one of these flattened humps. Such a hump appears to be wide enough upon its relatively flat portion to accommodate quite a considerable band of frequencies.

Weakening the Coupling

It is worthy of note that if the coupling between the aerial and the secondary winding is weakened notably, perhaps with the idea of getting selectivity, the flatness of the humps disappears the two humps approach each other, and we revert to practically the ordinary separately tuned primary and secondary scheme. When this is done it is no longer possible to cover a wide band of frequencies with a fixed number of turns in the aerial circuit, and the term "aperiodic aerial circuit" is less appropriate even than before.

A DOUBLE CIRCUIT CRYSTAL SET



By
A. JOHNSON-RANDALL
STAFF EDITOR

PERHAPS one of the biggest difficulties of those listeners living within crystal range of a broadcasting station near the coast is to eliminate the annoying background of Morse so prevalent in these areas.

Any attempt to increase selectivity, so difficult in crystal receivers on account of the damping effect of the crystal itself, is a step in the right direction; and although receivers of this type may be a little more complicated than those of the direct-coupled types, the final results are well worth the slight extra care needed in the construction.

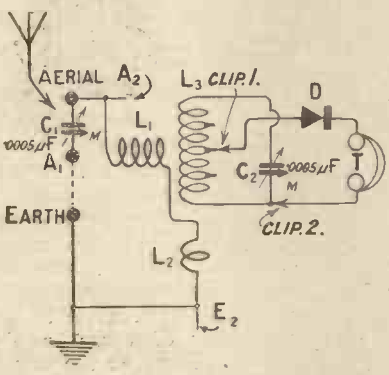


Fig. 1.—The aerial circuit is loosely coupled to the secondary.

In the last issue of MODERN WIRELESS I described a simple three-valve receiver of a type specially suited to coastal dwellers, and it is with the object of assisting the crystal enthusiast that I have designed the little set described in this article.

The Circuit

The circuit is shown in Fig. 1, and consists mainly of two tuned circuits—the aerial circuit and a closed secondary circuit. It will be noticed that the aerial circuit is in two portions indicated by the two inductances L_1 and L_2. L_1 consists simply of a plug-in coil of the usual commercial pattern placed in relation to the secondary inductance L_3 in a position of minimum coupling, that is the axes through the centres of the two coils are at right-angles.

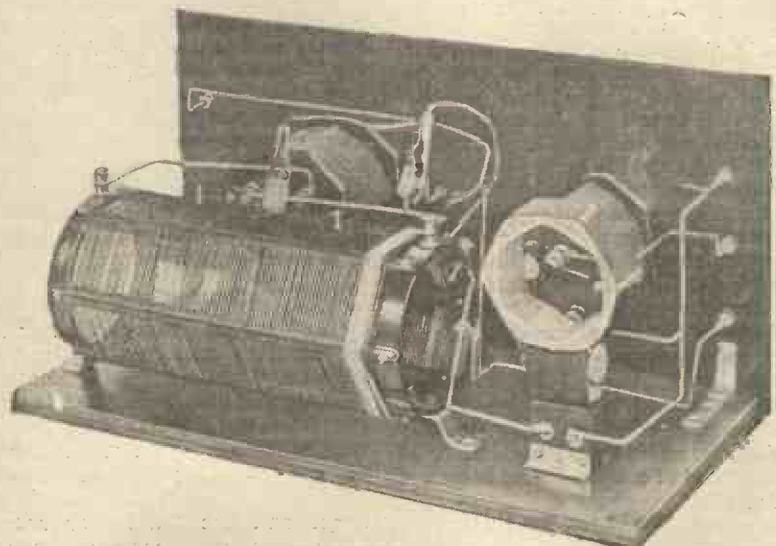
Loose Coupling

The aerial circuit is coupled magnetically to the inductance L_3 by means of a very small coil L_2, consisting of two to three turns wound directly over one end of L_3. Since the aerial load exercises a damping effect upon the aerial tuned circuit, no appreciable advantage is gained by attempting to eliminate all possible sources of loss in the aerial circuit inductances. These are tuned by a ·0005 μF variable condenser which may be placed in series or parallel with the aid of the conventional three terminal arrangement.

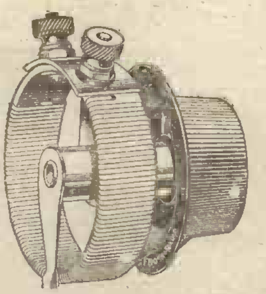
Low-Loss Secondary

The secondary circuit inductance is of the low-loss type, and is tuned by a variable condenser of ·0005 μF. To lessen the effect of the crystal damping upon this closed circuit, one side of the crystal detector has been connected to a flexible lead and spring clip (1) which may be attached to tapping points along the inductance.

The general utility of the receiver has been increased by the simple expedient of attaching a flexible lead terminating in a spring clip (2) to one side of the telephones in addition to that already mentioned. By joining clip 1 to A_2



Note the few turns of D.C.C. wire forming the coupling between the aerial and the secondary.



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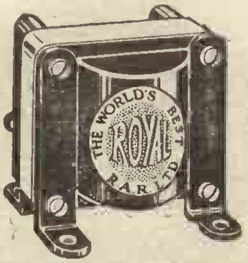

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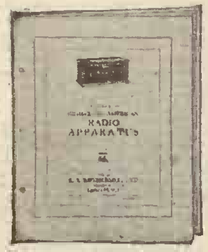

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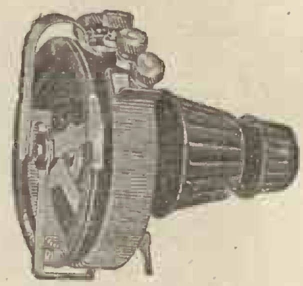
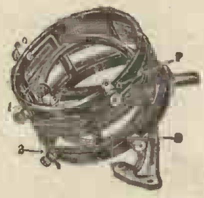


FROST CONTROL UNITS.

No. 607, 6 ohms. rheostat
400 ohms. potentiometer 8/9 each
No. 610, 35 ohms. rheostat
400 ohms. potentiometer 8/9 „

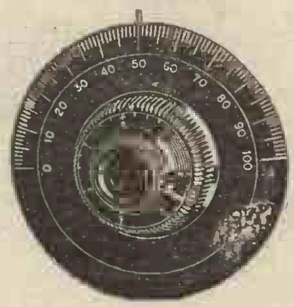
BREMER TULLY NAMELESS KITS.

£6 18s. 6d. each.



B.T. LOW-LOSS TUNERS.

Type S.W. 50 to 150 meters 26/6 each
Type B. 200 to 565 meters 26/6 each



E-Z-TOON VERNIER DIALS.

3-in. for 3/16 or ¼ shaft 10/6 each
4-in. „ 3/16 „ ¼ shaft 11/9 each

THE HOME OF PERFECTION IN RADIO

(Fig. 1 and Fig. 3) and clip 2 to E_2, it will be seen that the set now becomes direct-coupled and can be used for any wavelength by the use of the appropriate plug-in coil.

So much for the design, and now for the construction. The components you will require are as follows :—

1 Cabinet and baseboard, 14 in. by 7 in. (Camco.)
1 Insulating panel, 14 in. by 7 in. by 3/16 in. (Radion.)
2 ·0005 μF variable condensers, square-law pattern. (Collinson Precision Screw Co., Ltd.)
1 Crystal detector. (C. A. Vandervell & Co., Ltd.)
1 Low-loss coil former, 7 in. by 3½ in. (Peto-Scott Co., Ltd.)
1 Coil plug for baseboard mounting. (Burne-Jones & Co., Ltd.)
5 Terminals.
2 Brass angle brackets. (Burne-Jones & Co., Ltd.)
2 Spring clips. (S. H. Collett.)
Approx. ¼ lb. of No. 20 S.W.G. enamelled wire and a very small quantity of No. 22 S.W.G. d.c.c.
Some square-section tinned-copper wire. (Sparks' Radio Supplies.)
One set of Radio Press panel transfers.

The construction of the receiver itself is extremely simple, and the first thing to do is to drill the panel to the dimensions given in Fig. 2. The two variable condensers are upon the centre line of the panel, but the crystal detector is mounted ⅛ in. above this line, the left-hand stud being ⅛ in. to the left of the vertical centre line when viewed from the front; in other words, ⅛ in. above the horizontal line and ⅛ in. to the left of the vertical one. This was necessary in order to retain symmetry.

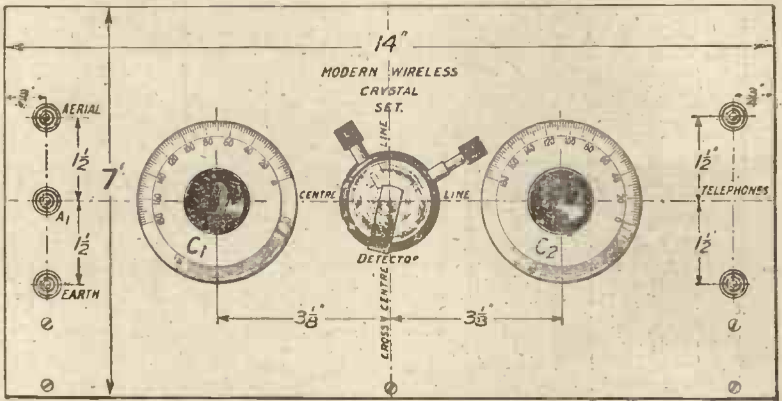


Fig. 2.—The panel lay-out is neat and symmetrical.

The components are not mounted upon the baseboard to any specified dimensions, their position having been determined by trial, and the constructor would do well to follow the lay-out as closely as possible.

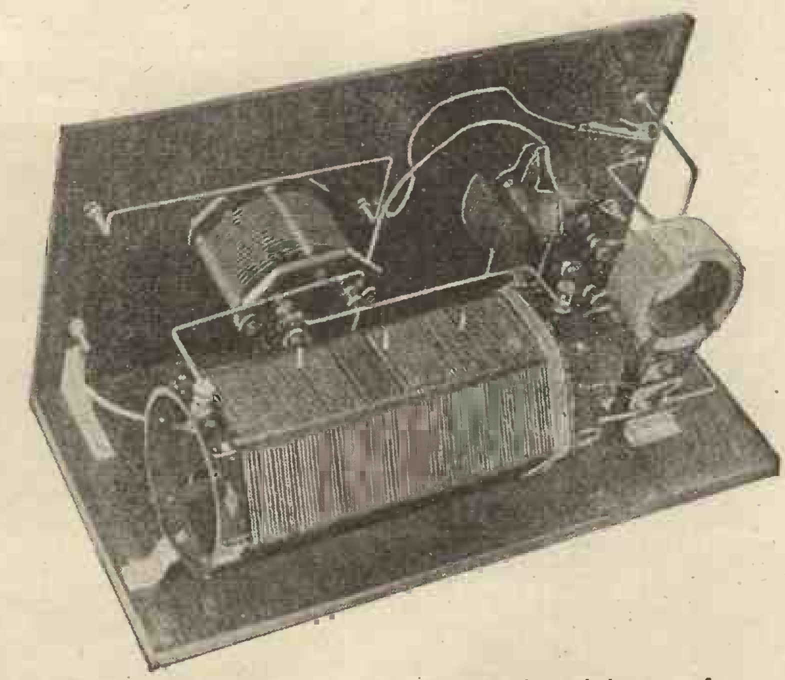
Having drilled the panel and mounted the two variable condensers crystal detector and terminals, commence winding the low-loss coil. This is wound with 82 turns of No. 20 gauge enamelled wire, and an ebonite ring is placed in the middle to stiffen up the former. The two ends of the coil are soldered to the two terminals. At the centre and at two points between it and the ends of the winding three short lengths of square wire are soldered to enable the crystal tap to be used. One of the end rings of the former is drilled to take two small terminals, to which the ends of the coil L_2 are secured. This small coil may consist, to commence with, of three or four turns of No. 22 S.W.G. d.c.c. wire, the number of turns being adjusted on test in actual reception. Next mount the former and coil plug upon the baseboard, and wire up, following out the connections shown in Fig. 3. You will notice that short lengths of square wire are soldered at three points marked A_2, E_2 and clip 2.

To operate the set connect the aerial to the terminal marked "Aerial," and the earth to "Earth," joining A_1 and "Earth" together with a short piece of wire, and connect the telephones to the two terminals marked. Attach clip 1 to A_2, and clip 2 to E_2, inserting a No. 35 or 40 coil in the socket L_1. Rotate the condenser dial C_1 until you hear your local station, if necessary adjusting the crystal detector at intervals. Tune in the station until signals are loudest, and find the best spot on the crystal.

Then attach clip 1 to one of the tappings upon the low-loss coil and clip 2 to the short length of wire as shown in Fig. 3. Rotate the condenser C_2 until signals are heard, and then re-tune slightly on C_1.

Selectivity

You are now in a position to conduct some interesting experiments in selectivity. Attach the spring clip (clip 1) to the tapping points along the inductance L_3, and note the effect, re-tuning after each


The lay-out of the components occupies the minimum of space.

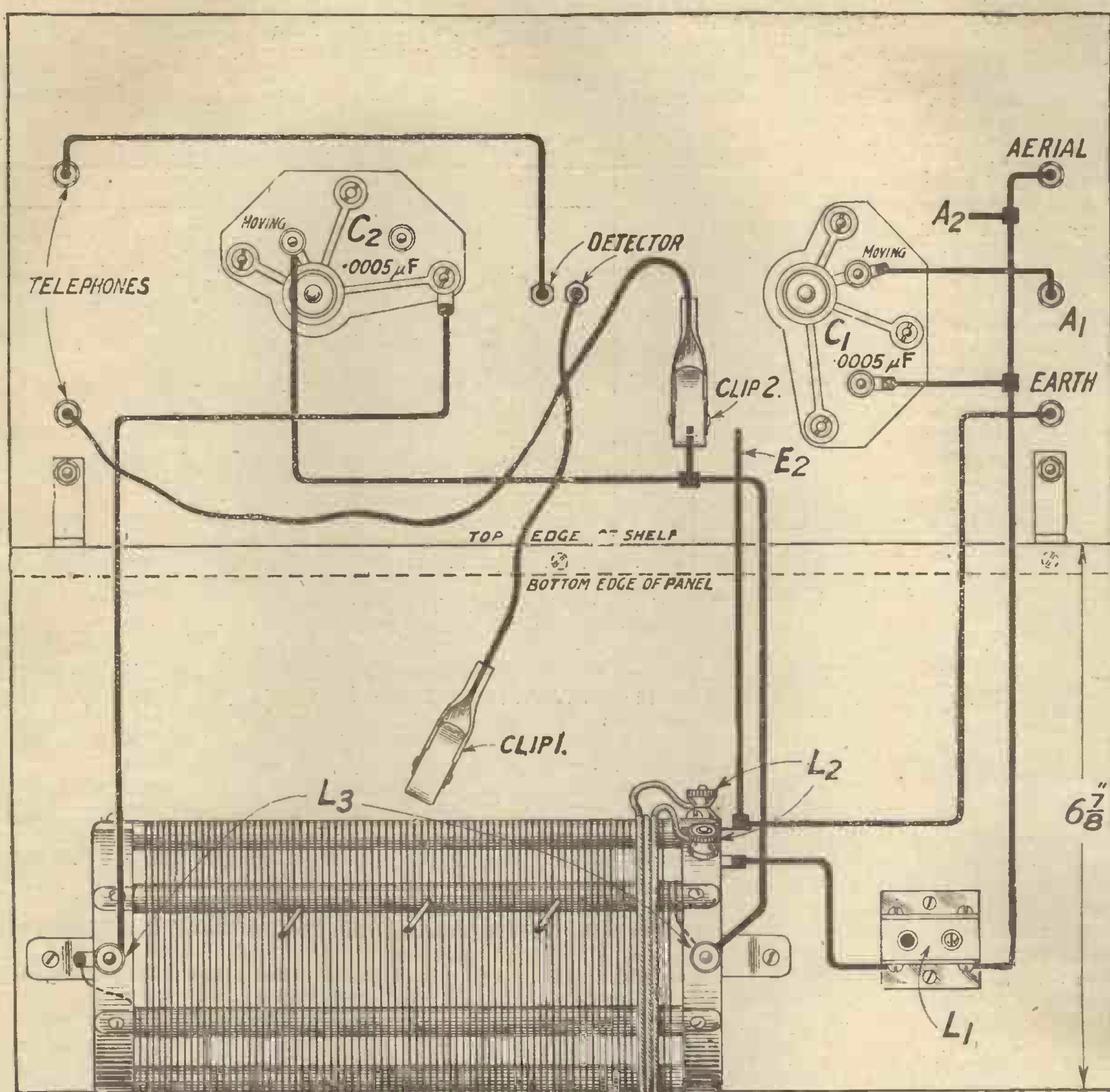


Fig. 3.—The wiring diagram is easily followed and has been arranged to give maximum flexibility.

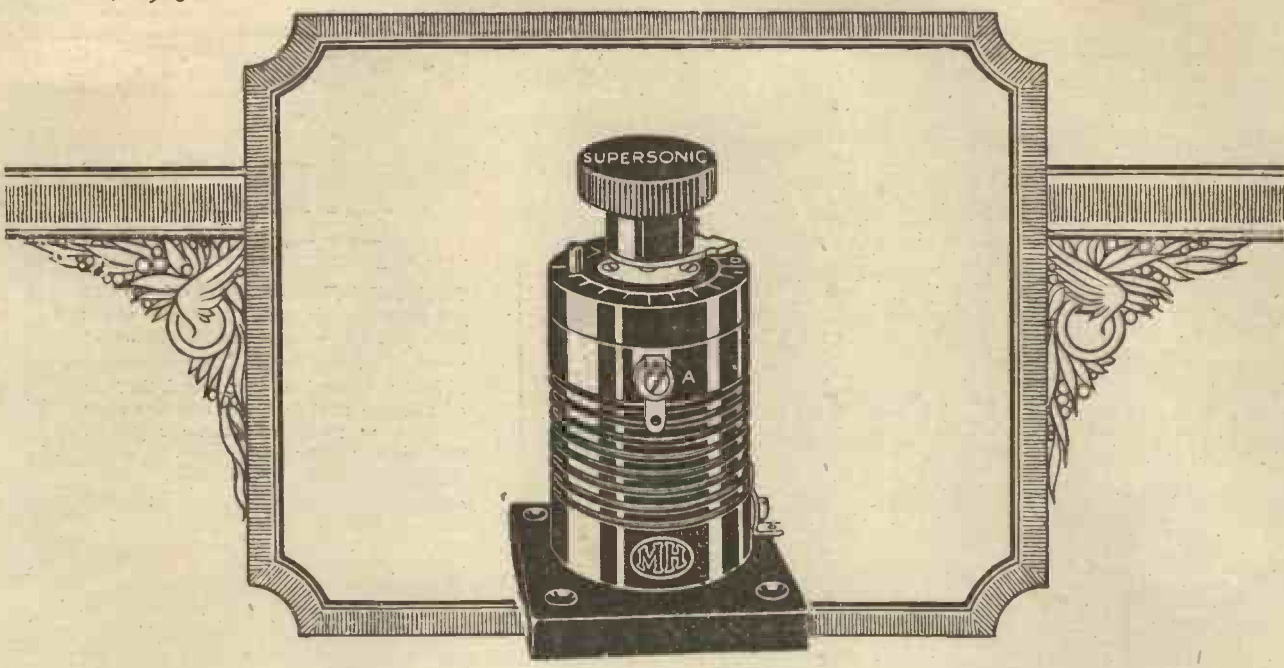
alteration. Try decreasing the number of turns in the coil L_2, removing one turn at the time until the best selectivity is obtained. You will probably find that it is possible to use one turn only with good effect.

For Belfast, Aberdeen, and stations above, say, 420 metres a No. 50 coil should be tried for L_1, but for Newcastle, Bournemouth and Cardiff a No. 35 or 40 will usually be adequate. To receive Daventry attach clip 1 to A_2 and clip 2 to E_2 and insert a No. 150 coil or its equivalent in the socket L_1. On the shorter wavelengths, it is interesting to note the effect of placing the condenser C_1 in series, first removing the piece of wire joining A_1 to "Earth" and then connecting the aerial to A_1. A coil one size larger than that used with the parallel arrangement will probably be necessary.

Test Report

The set was tested upon an aerial 35 feet high and 100 feet in length, at a distance of 15 miles from 2LO. For the reception of this station a No. 40 (Lissen) or a Gambrell B1 gave good results. The number of turns in the coil L2 varied from five downwards, and finally two turns were found adequate. Increasing the number of turns to four flattened the tuning very considerably and for maximum selectivity close up to the local station one turn or, at the most, two should be ample. The effect of varying the position of the coil L_1 was tried and any variation from the position shown in the wiring diagram resulted in a loss in selectivity, thus proving that the position of minimum coupling had been adopted in the first instance.

The final position of clip 1 was on the centre tap on the coil, but in other cases better results may be obtained with one of the other tapping points. Using the direct coupled arrangement, *i.e.*, with clip 1 on A_2 and clip 2 on E_2 and using a No. 150 coil or a Gambrell E_1 in socket L_1 Daventry was obtained at excellent strength. The low-loss coil was tested for wavelength range with a wavemeter reading from 200-500 metres, the readings on the closed circuit condenser C_2 being 45 degrees and 146 degrees respectively for these two wavelengths. It will, therefore, be seen that the coil described covers the broadcast waveband with a large margin.


SUPERSONIC
A
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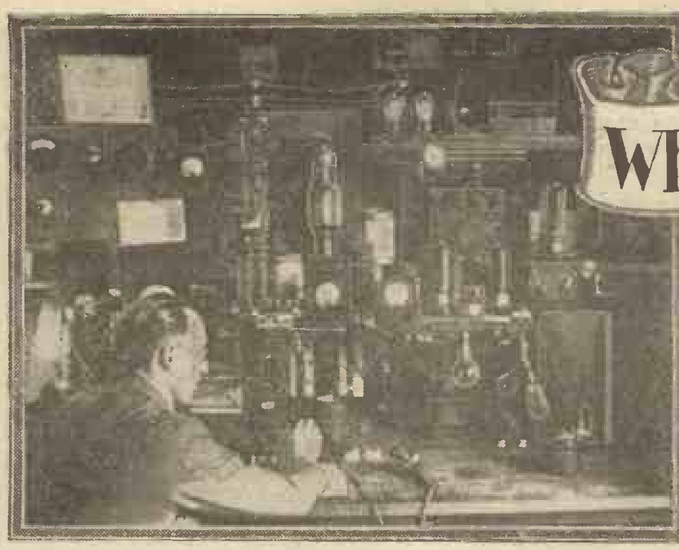


What to Listen for on Short Waves

By

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

There is an increasing amount of activity at frequencies above the broadcast band. This article gives some idea of what may be received in this region of the ether.

THE use of short wavelengths has now been common practice for a considerable time, but there are probably still very many wireless enthusiasts who have never had actual experience of listening to transmissions on these waves. I have often been asked, "What is there to hear that is interesting?" and in this article I hope to give some answer to this question. The possession of a suitable receiver for the purpose is assumed; and here it may be said that there is a great deal to be heard on the band of frequencies between 2,000 and 7,500 k.c. (150 to 40 metres) without going any higher up the scale. Undoubtedly many enthusiasts will want to reach 15,000 k.c. (20 metres) and even higher frequencies, but there are plenty of transmissions to be picked up on the lower frequencies mentioned, especially in the neighbourhood of 6,000 to 7,500 k.c. (50 to 40 metres).

A Single-Valve Receiver

For reception at these frequencies the writer uses a single-valve receiver of quite simple design, the actual set used having been described in WIRELESS WEEKLY, Vol. 6, No. 23. A single stage of L.F. amplification can always be added to this externally if required.

Distance Distortion

On most nights there is usually a certain number of stations to be heard transmitting telephony. The best known example, of course, is KDKA, the station at East Pittsburg, in Pennsylvania, which operates at about 5,000 k.c. (60 metres). The frequency employed varies from time to time. This station can be heard any night, with the exception of Sundays, between the hours of 11.15 p.m. and midnight G.M.T., and there is rarely any difficulty in picking up the transmission. The period quoted is devoted to the "dinner-hour programme," which usually consists of musical items. The regular evening programme does not ordinarily begin till 1.30 a.m. by our time. The transmission may vary considerably in strength from night to night, and sometimes fading is very pronounced, together with a curious form of distortion, commonly described as "distance distortion." But the occasions are very rare when the transmission is altogether inaudible, and now that the winter

One-Valve Receiver. Oct. 6-7. 4,000 to 7,500 kc.

Time G.M.T.,	Station heard.	Signals heard, etc.	"R" strength.
2340	German	Unidentified German Amateur	4
2342	—	Weak telephony	–
	U.S.A.	ABC de WIR	7
2343	KDKA, East Pittsburg	Music and speech, clear though faint	–
2350	Czecho-Slovakian Amateur	3BWJ U CS 1KJ	6
2355	U.S.A.	AGS de WIZ	7
2357	,, Amateur	CQ foreign U 2CXL	4
0000	,, ,,	1BZP U (unidentified)	3
0002	,, ,,	CQ U 1KA	6
0003	,, ,,	5AT G U 8ALY	5
0005	,, ,,	4FL U 3LR	6
0007	U.S.A.	ABC de WIR (harmonic)	4
0007	,, Amateur	CQ U 1SI	5
0010	U.S.A.	ABC de WQO	8

October 7.

2030	2LO	Harmonic—very strong	9
2035	,,	Lower harmonic	8
2037	French amateur	8BP de F8CA	6
2039	British ,,	Test de G 5HX	3
	Italian ,,	NRL de I 1AU	7
2043	2LO —	Harmonic	6
2045	Norwegian amateur	de LA4X	4
2047	Italian amateur	CQ de I 1CO	7
2050	2LO	Harmonic	5

months are approaching reception conditions are almost noticeably improving each night. Comfortable headphone strength of this station's programmes is easily obtainable with a receiver consisting of a detector and one stage of low frequency amplification.

Telephony Transmissions

Another American telephony transmission is that sent out by WGY, the Schenectady station of the General Electric Co. The programmes from this station, which itself transmits at a frequency within the ordinary broadcast band, are relayed on 3,000 k.c. (100 metres) by 2XK, the General Electric Co.'s short-wave station. Normally this transmission does not begin till about 2.30 a.m. G.M.T.; good signal strength is usually obtainable.

Telephony transmissions by amateur transmitters are, of course, somewhat irregular, but on most nights a certain number of stations may be picked up, many Continental stations being frequently heard at good strength.

Knowledge of Morse Code

To obtain the greatest interest from reception on the short waves it is really necessary to have at any rate an elementary knowledge of the Morse code. Familiarity with the code makes possible the identification of the many hundreds of stations to be heard working any night, and indeed at almost any time in the twenty-four hours. It is not by any means essential to sit up till the small hours of the morning in order to pick up stations at long distances, though, of course, the man who is out to set up new records in reception or transmission finds the early morning the best time for his purpose.

Half an Hour's Reception

In order to give some idea of what may be heard any night, two tables are given here, which may be taken to be a fair sample of the possibilities of reception on short waves. The transmissions recorded in these tables were heard on the evenings of October 6th and 7th, dates which were selected quite at random, and the list shown represents about half an hour's reception in each case. The dial of the main tuning condenser was turned on each occasion once only from maximum to minimum during the period of listening, and each station heard was recorded as it was picked up. The coils in use at the time covered a frequency range of from about 3,500 k.c. to slightly above 7,500 k.c. (85 to 40 metres). The group of U.S. amateurs heard about midnight on October 6th were all working on the 6,000 to 7,500 k.c. band; many others were also heard at varying strengths, but the time available was too short to record accurately more than a few. It will be noticed that the tables include stations spread over a considerable area, six European countries being represented, as well as three of the American amateur districts.

Good Signal Strength

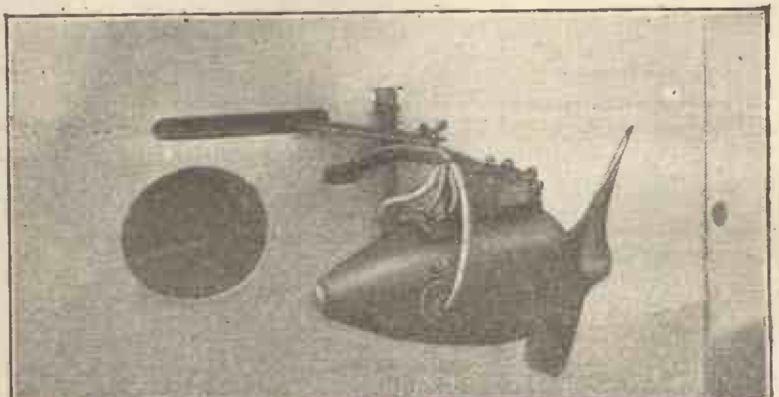
The column headed "R" strength, indicating the comparative strength of signals on the "R" scale (from R1—"audible but unreadable"—to R9—"very strong indeed"), is given mainly in order to show that to hear most transmissions there is no necessity to possess extreme acuteness of hearing. It is also worthy of note that there is usually a considerable amount to be heard on the short waves even without sitting up very late.

Those who wish to calibrate their short-wave receivers or wavemeters will find that many stations send their wavelength immediately after their call sign, when "signing off" at the end of a message. As a general check on the wavelengths on which reception is being carried out this information is extremely useful. Accurate calibration checks may also be obtained from the signals sent out by certain commercial and experimental stations, notably by NKF, the United States Naval Experimental station, at Bellevue, Anacostia, D.C. Details of certain test transmissions carried out by NKF are to be found in *Wireless Weekly*, Vol. 6, No. 23.

Atmospheric Disturbances

During broadcasting hours listeners in the vicinity of a broadcasting station will usually find that they can receive the programme at quite good strength on one of the harmonics at these high frequencies. The writer has even found this of some service in special circumstances. One of the peculiarities of short-wave reception is that sometimes when atmospheric disturbances are sufficiently pronounced to interfere with pleasant reception at the broadcast frequencies, this interference is much less marked, even hardly noticeable, at the higher frequencies. When this is the case it may be found worth while to sacrifice a certain amount of signal strength and receive the programme on a harmonic without the annoying crackles caused by atmospherics. It must not be supposed that this remedy is infallible, but on several occasions the writer has used the method with success; when thunderstorms are in the vicinity of the receiver, it is, of course, very unlikely that the experiment will prove to be worth while.

H.T. Supply on Aeroplanes



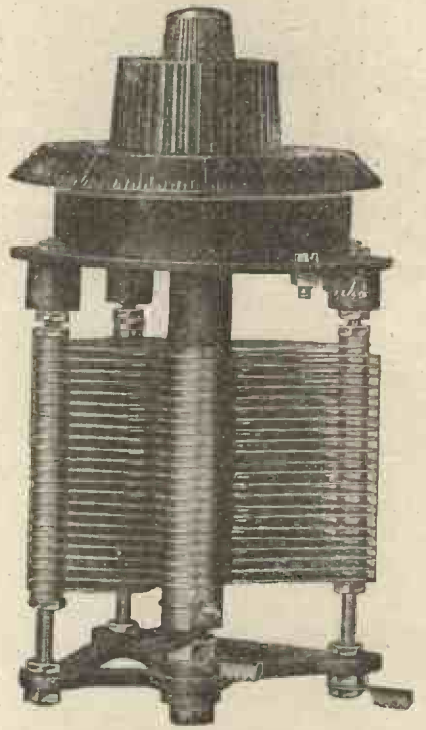
The necessary high-tension voltage for aircraft wireless equipment is usually obtained from a small generator similar to the one shown above. In this particular case the angle of the small propeller can be varied relatively to the slip stream of the aeroplane propeller, so varying the speed of the generator and thus the voltage produced.

The Fulstop picks them all out

It's easy with a Fulstop Super Condenser—you can pick out stations which hitherto you had never been able to get. The Fulstop guarantees to abolish all hand capacity effects and the consequent increased audibility is very marked. The Fulstop patent clockwork multigear gives the use of two ratios of movement: a 2 to 1 and 125 to 1, and enables the most minute adjustment to be made with ease. The Fulstop is a no-loss condenser, perfectly square law and has brass vanes.

Send for full descriptive leaflet. All models are guaranteed for 12 months.

Fulstop
VARIABLE CONDENSER



SUPER FULSTOP
Variable Condenser

PRICES:

.00025	25/6
.0005	28/6
.001	30/6

Also made in two other models.

STANDARD FULSTOP. (Geared 2 to 1.) Guaranteed to abolish hand capacity.		PLAIN FULSTOP. (No gear.) Guaranteed to abolish hand capacity.	
.0002	9/6	.0002	8/3
.0003	10/3	.0003	8/9
.0005	11/3	.0005	9/6
.001	13/6	.001	11/6

If any difficulty in obtaining, write us and we will send direct, post free.

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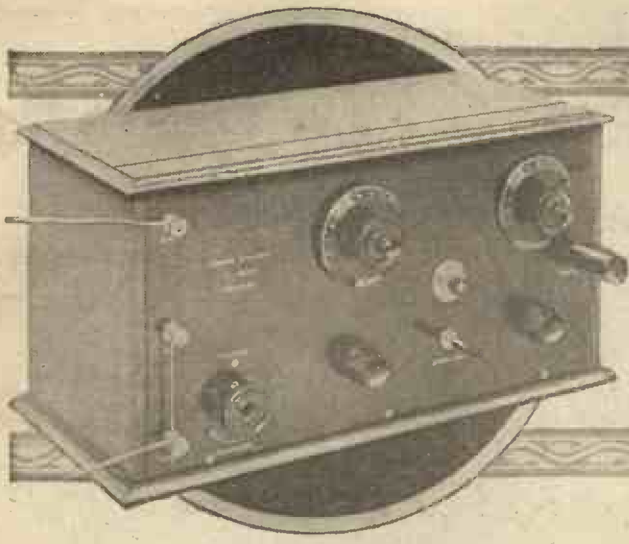


THE CONTINENTAL TWO

By E. J. MARRIOTT

THE final choice of the type of circuit to be used by the constructor of a wireless receiver must be determined by his individual requirements. If, for instance, the loudest signals possible with two valves are desired from the local station, then the circuit used must include as much low-frequency amplification as possible; whereas, when distant reception is aimed at, high-frequency amplification is indicated.

Increased Range

A high-frequency amplifying valve preceding the detector, when correctly operated, allows considerable ranges to be covered without recourse to that edgelike reaction adjustment, and consequently without so much distortion. In the receiver to be described, the first valve is arranged as an H.F amplifier, and the second as a detector.

The neutralised capacity method of stabilizing the H.F. valve is incorporated, but here the arrangement is perhaps slightly different to that to which we have become accustomed.

Neutralising Coils

Instead of the now commonly used H.F. transformer type of neutrodyne unit, two plug-in coils are used, and to allow a certain degree of flexibility they are mounted in a variable two-coil holder.

A variable grid-leak is also incorporated, and in some cases this will be found useful on distant receptions.

Short Wiring

A perusal of the photograph of the back of the panel will show that all the wiring has been kept as short as possible, consistent with efficient spacing; and the anode and neutrodyne coils (L_3 and L_4) are mounted at an angle of 90 degrees to the aerial and reaction coils (L_1 and L_2) in order that a minimum of coupling shall exist between them.

It will also be seen that the internal connections from the terminals to the aerial tuning condenser (C_1) and coil (L_1) differ slightly from those usually made. It is possible with this modified arrangement to place C_1 either in series or parallel with L_1, and further to use the aperiodic aerial arrangement, when desired, without having to connect the aerial lead directly on to the coil in the cabinet.

The correct methods of connecting up aerial and earth for the three possible arrangements will be made perfectly clear from the diagrams given in Fig. 2.

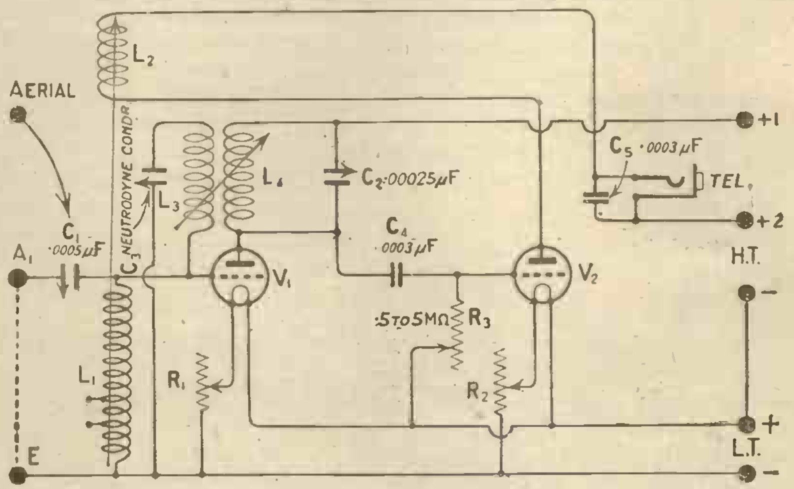


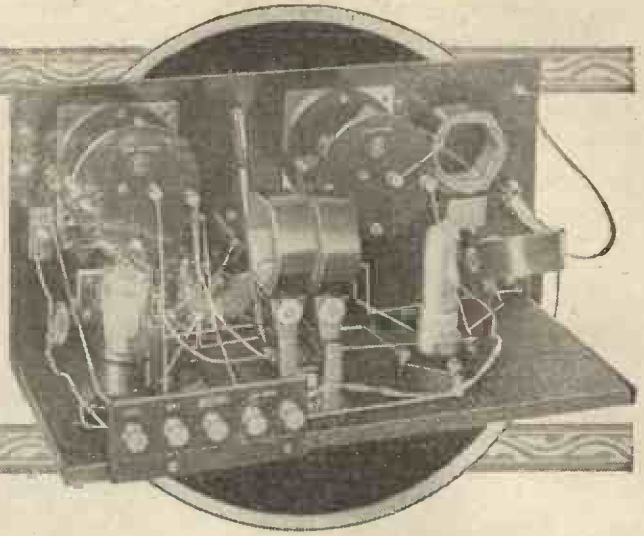
Fig. 1.—The circuit employed is simple and straightforward.

Components Required

A complete list of the components used to build this receiver will be seen below, and as is usual in Radio Press journals, those makes actually used are indicated. Other good quality makes, however, will serve equally as well:

Panel 16 in. by 8 in. (Radion).
Cabinet (All Concert de Luxe, with opening in back for terminal strip) (Camco).
One variable condenser, square law type, ·0005 μF (R.I.).
One variable condenser, square law type, ·00025 μF (R.I.).
Two fixed condensers ·0003 μF (Watmel).
One variable grid leak (Watmel).
One back of panel coil holder (Quality) (Goswell Engineering Co., Ltd.).
One 2-coil holder (Magnum) (Burne Jones & Co., Ltd.).
Two Clearer Tone valve holders (Benjamin Electric, Ltd.).
One Neutrodyne condenser (L. McMichael, Ltd.).
One Terminal panel No. 1 Magnum (Burne-Jones & Co., Ltd.).
One Telephone jack (General Radio Company, Ltd.).

A Neutralised Receiver for Plug-in Coils



One Telephone plug (General Radio Company, Ltd.).
Two Filament rheostats (General Radio Company, Ltd.).
One spring clip.
Three Lacquered brass terminals.
Flexible wire and square section tinned copper-wire.
Screws, etc.
One Packet of Radio Press panel transfers.

Panel Layout

A diagram of the panel, with all the measurements necessary for marking out and drilling it, is given in Fig. 3. It will be seen that this is a perfectly straightforward and simple operation.

Modification to Coil Holder

The valve holders and variable coil holder may now be fixed in their correct positions. With regard to the latter, it should be noted that the type used will not normally fit into the cabinet behind the other components on the panel, and so the control arm has been bent to a more upright position, thus overcoming the difficulty.

In the position in which this coil-holder is fixed, the variable condenser (C2) limits the possible variation of coupling between coils plugged in the holder to about 20 degrees. This variation is however, quite sufficient for the purpose of the receiver.

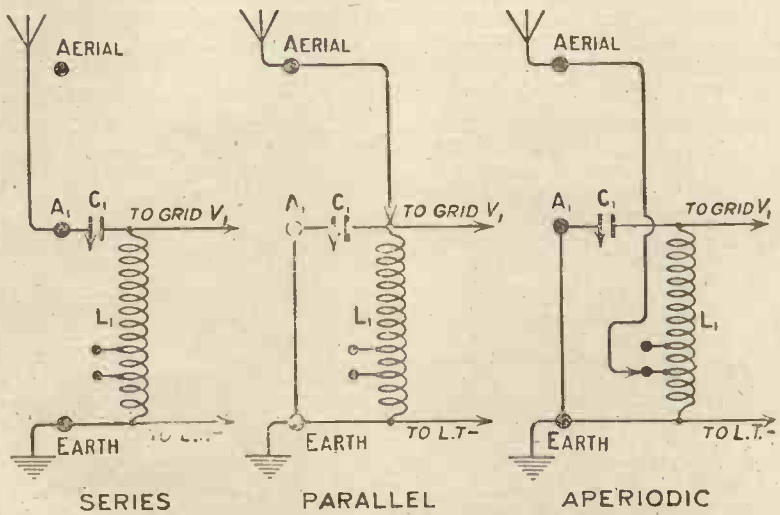


Fig. 2.—The aerial may be connected in a variety of ways, as shown above.

The usual precautions regarding the panel surface, if it is not of a guaranteed brand, must of course be taken.

Having completed the drilling, fix the components to the panel, and screw this to the baseboard.

Having fixed the various components on to the baseboard, screw the terminal strip to the back edge, in the position shown in the photographs.

Wiring Up

Wiring up must now be proceeded with, and, so far as possible, the actual paths taken by the wiring as shown in the photographs should be carefully followed.

Be very sure to connect up the aerial, anode, and neutrodyne coils exactly as shown in the wiring diagram, otherwise it may be found impossible to neutralise V_1 in order to prevent oscillation.

The flexible reaction leads must, of course be joined up, and the correct way round for these will only be discovered by actual test later on. Care should also be taken to connect the positive phone terminal to H.T. +.

Neutralizing the H.F. Valve

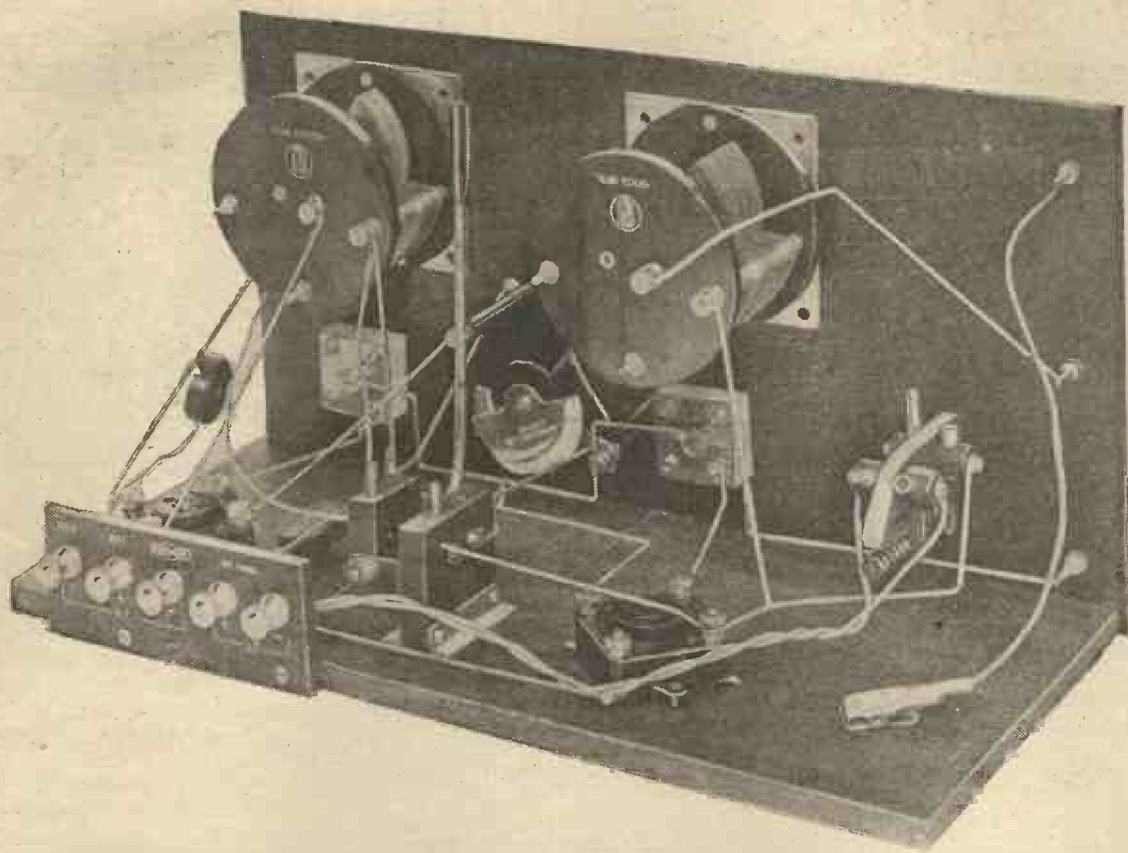
Before testing out the receiver the H.F. valve V_1 must be neutralised.

Connect up both the H.T. and L.T. batteries, short the reaction coil socket, and plug in the phones. The H.T. and L.T. for each valve must be adjusted according to the makers' instructions, Do not apply too high a potential to the anodes, especially that of V_1, otherwise neutralising will be a difficult matter.

Aerial and earth leads must not yet be connected, but the two lower terminals A_1 and Earth should be joined together with a piece of wire, and the necessary coils must of course be plugged in. The following sizes will generally be found correct:

Aerial – 75X, Anode – 75, Neutrodyne – 60. For 5 XX the coils are 250X, 250 and 200 respectively. The neutrodyne coil is on the *left-hand* side, and the tuned anode coil on the *right-hand* side, looking from the front of the set.

Now light up the valves to their correct brilliancy, set the condenser C_1 to a fairly low value,



All wiring on the receiver is kept as short as possible. Note that the handle of the neutrodyne two-coil holder is bent at right angles.

say 20 degrees, and let L_3 and L_4 be tightly coupled.

Testing for Oscillation

Now on swinging the condenser C_2 throughout its entire range, it will be found that oscillation occurs over a certain number of scale degrees, a definite click in the phones indicating both the commencing and finishing of the oscillatory state. Touching the grid connection of V_1 with a wet finger will always confirm whether the set is oscillating or not. If it is, a loud plonk will be heard both on making and breaking the finger contact, otherwise only a click will be heard on making contact.

The number of scale degrees over which oscillation occurs will be found to diminish as the neutrodyne condenser C_3 is adjusted towards maximum, until a point

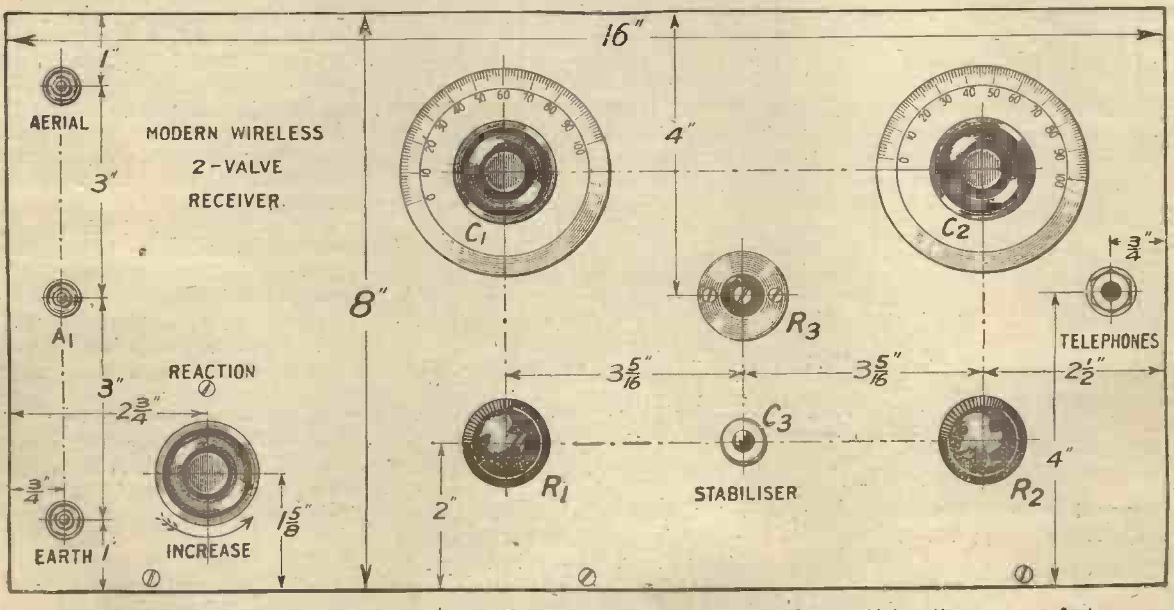
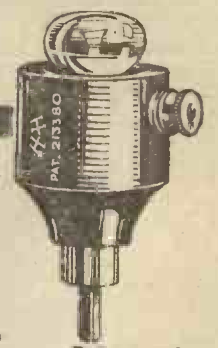


Fig. 3.—The layout of the front of the panel may be seen from this diagram. Ask for Blue Print No. 131a, price 1/6 post free.

PREPARE FOR H.A.H.'s CHRISTMAS !



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Two shillings spent on a Hunt's Patent Safety Fuse Wander Plug saves you the price of several valves. Accidents will happen and one that might mean a burnt-out valve costs only 6d. to replace the flash-light bulb in the plug. May be used with either bright or dull emitter valves. Price 2/–, postage 2d. extra.

Fig. 828.
"SAVEIT" FUSE.
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Keen research workers demand Hunt's variable Grid-Leaks. They are invaluable for pure reproduction and delicate long-distance tuning. Under Panel, *Single Hole* fixing model, Fig. No. 1104 "NEWLEAK," 5/- each, as illustrated. Standard Model, ½—5 meghoms, other calibrations to order. 5/- each, postage 3d. extra. Anticapacity handle, 5½ in. long, Fig. No. 1110, 9d. each.

Fig. 1104.
"NEWLEAK."
5/-

HUNT'S "Three Dee" Spade Terminals.

Here is the finishing touch to every well constructed set. No lead can last so long or so neatly as it does when fitted with a "spade" terminal. (Pro. Pat.) Adjusted in a second, no trouble, permanent. Red or black body, nickel-plated spades. Price 3d. each, postage extra.

Fig. 1200.
SPADE TERMINALS.
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Fig. 455.
"CLUTCH" TAPE.
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Fig. 910. Hunt's "Easitune" (Pro. Pat.) Anti-capacity Vernier Tuning Handle fine tunes any condenser without dismantling the set in any way. One touch at the spring catch and the handle grips tightly any condenser knob. The handle is perfectly insulated and the tuner's hand is 5½ ins. away from the condenser knob. Price 2/–, postage 3d. extra.

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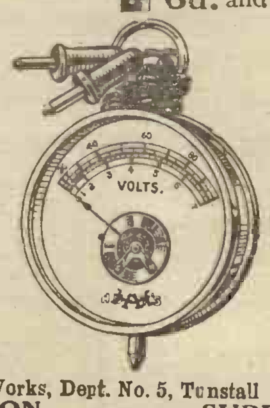

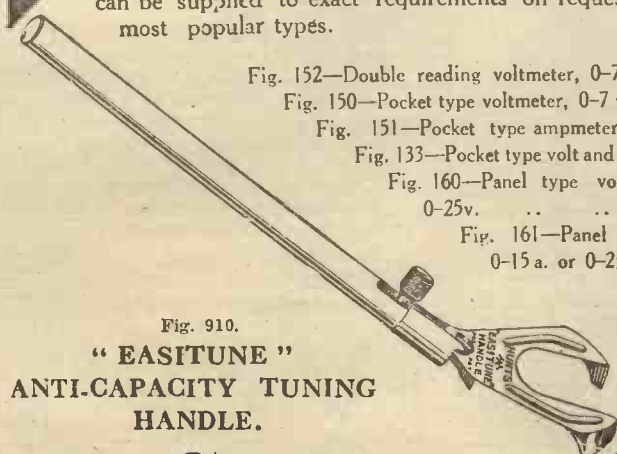

Fig. 910.
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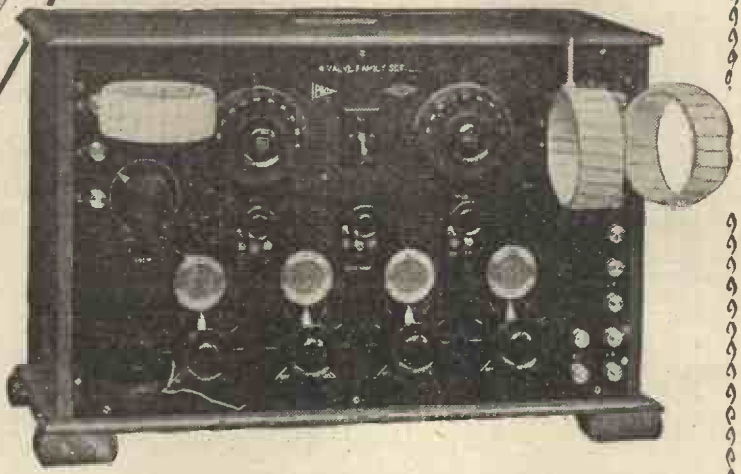

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George Wickes simply wouldn't believe I built it myself——

I WAS always such a duffer at making things. Even when a boy I was the despair of old Croggins—the master who took the woodworking classes.

No wonder George Wickes was surprised when he saw my 4-Valve Set the other evening. "But you did not build this yourself?" he gasped. "Yes," was my reply, "every bit of it except the cabinet." "Well, I am surprised," he said, "and to think that as a kid you were so utterly hopeless with tools and always bottom of the Science Class. Tell me where you picked up all this expert wireless knowledge." "Oh, it's quite easy," and then I told him all about the Pilot System.

I told him how we had practically decided to buy a 2-Valve Set until one day a fellow at the office related his experiences with a Pilot Set he had made himself with absolutely no skill or electrical knowledge. Fired by a spirit of emulation I sent for the particulars* of these Pilot Sets and found that I could get all the parts for a fine looking 4-Valve Set for less than the money I should be called upon to pay for the ready-built 2-Valve Set. The only question was "Could I build the Set?" Well, the long and the short of it was that I decided to make the plunge and I sent for the parts.

They duly arrived, neatly packed, and I made a start. It was an easy job fitting them together—even a duffer like myself could not very well insert the components in the wrong holes in the panel—the diagrams were so clear. The soldering was a bit of a problem and I must have got through at least half a stick of solder and made quite a few bad joints before I discovered that a red-hot iron won't work! However, all good things have to come to an end some time and eventually the soldering part of the job was finished.

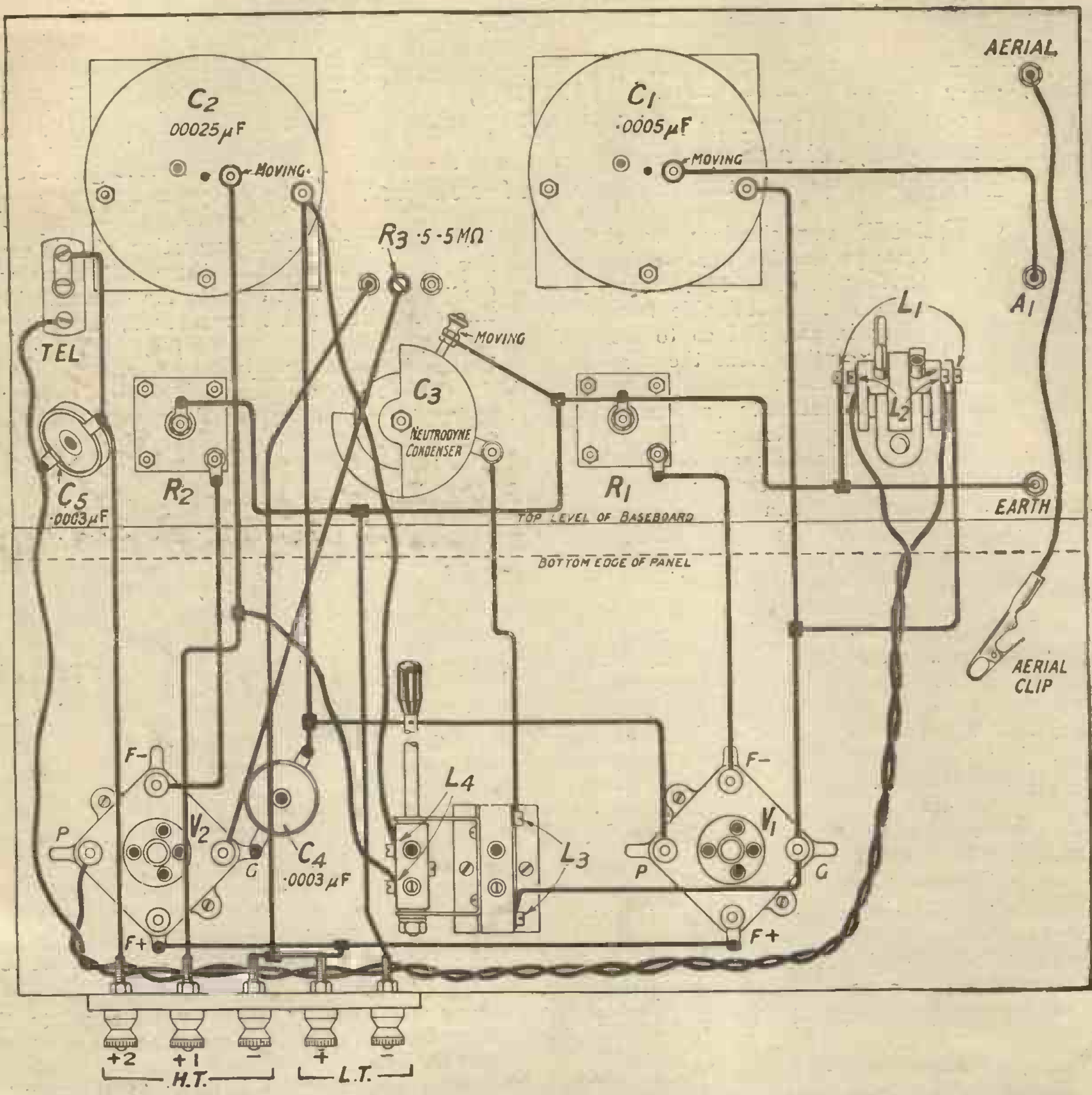
I unscrewed the panel from the cabinet and proudly showed George the results of my handiwork.

"And now let me hear it," he suggested. After a round of the B.B.C. Stations, with one or two Continental ones thrown in for extra measure, poor old George could only express his bewilderment. "It is far better," he said, "than the three-valve Set I paid £30 for three months ago. I can only get London and Bournemouth, and you can get practically every Station you want on yours." So George is a red-hot prospect for a Pilot Set, and I'm going round in a week or two's time to see what progress he is making with his new five-valver.

** The Pilot Chart of 32 pages, fully illustrated, will be sent (post free 3d.) on application to Head Office.*

PILOT RECEIVERS

P. S. 3714



The wiring may readily be followed from this diagram. Readers preferring a blueprint, however, may obtain one (No. 134b), price 1/6 post free.

will be reached where oscillation ceases altogether. Make sure, by turning both C_1 and C_2 to various positions, that complete stability has been obtained. For other wavelengths, the same procedure must be followed after suitable coils have been plugged in. Having arrived at this stage, testing out may be proceeded with. Join the aerial lead to A_1 and earth lead to the terminal so marked. Leave the wire joining A_1 and Earth in position, and if an X coil is used in the aerial socket, as is advised, clip on the aerial flex lead to one of the side tappings. Now, should the local station be broadcasting, it will certainly be heard, and from its reception, the constructor can obtain a slight idea of the tuning of the set. This should be done before attempting distant reception.

The Distant Stations

A small reaction coil may be plugged in, in place of the shorting plug if desired, and, if the connections are the correct way round, will be found to increase signal strength as its coupling with L_1 is tightened.

Although very good results are obtainable with this set, it is not advised that a beginner constructs it, but those who have had some experience with neutrodyne circuits will find it of great interest. The size of the neutrodyne coil was not found to be extremely critical, one size smaller than the anode coil usually being suitable.

Test Report

The receiver was tested on a moderately small aerial, about 3½ miles west of 2LO, and signals from that station were, of course, very loud indeed in the telephones.

Bournemouth and Birmingham were heard at good strength, the former with a slight background from London, although not sufficiently strong to spoil the reception.

Several amateur transmitters were heard at a strength sufficient to work a loud speaker.

Of Continental stations the following were received with comparative ease :—

Radio Toulouse, Madrid, Munster, Hamburg, and two or three other French and German stations which were not identified.

On the longer waves, Daventry came in only slightly weaker than 2LO, and Radio Paris was heard at fair telephone strength, as was also Eiffel Tower.

Reaction Control Circuits

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

That fine control of reaction which makes all the difference is partly a matter of the circuit employed, but also very largely one of adjustment. This article gives some useful advice on the subject.

ALMOST every simple valve circuit employs reaction in some form or another in order to increase the amplification obtainable from the valve in use, and so to increase the reception from the long-distance stations.

It is proposed in this article to discuss a variety of different methods of producing reaction and to indicate how the best results may be obtained. Before actually discussing the circuits themselves, however, a brief consideration of the principle which underlies successful reaction adjustment will be of considerable advantage.

Consider any tuned circuit connected across the grid and filament of a valve. The voltages developed across this circuit will cause amplified currents to flow in the anode circuit of the valve, and in a reaction circuit these currents are arranged in some manner to produce voltages in the grid circuit in such a direction as to increase the voltages already existing. As the amount of this energy fed back is increased so the voltage on the grid circuit gradually increases until a point is reached at which the set commences to oscillate.

Smooth Control Essential

Now when the oscillating condition of affairs commences there is a change in the character of the events. Under normal conditions the currents in the grid circuit of the valve are limited by the resistance losses in the circuit. As the reaction is increased so a certain proportion of this energy loss is made up, but there still remains a damping effect which limits the current. When the oscillation point is reached, however, the energy fed back by the valve is equal to the energy loss; if there is no resultant loss of energy, then the effective resistance of the circuit must be zero, and there is nothing to prevent the current from increasing indefinitely. Under certain conditions it may actually increase until a point is reached where the valve commences to saturate. That is to say the set will suddenly commence to oscillate very violently, giving a sharp " plonk," which is very undesirable.

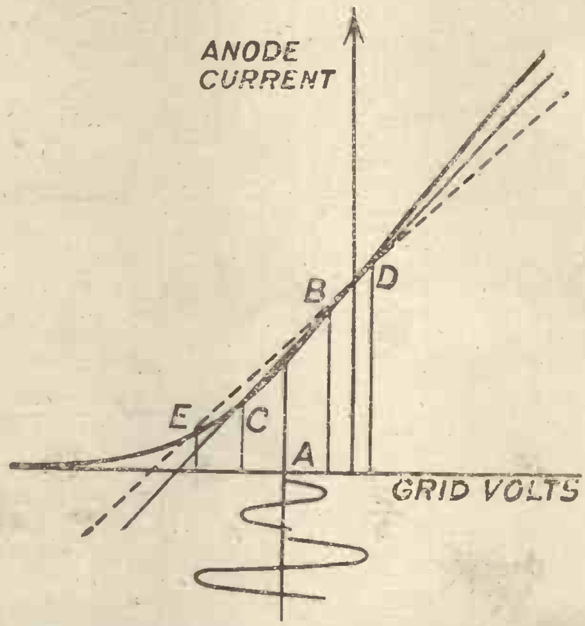


Fig. 2.—By altering the working position on the characteristic the oscillation tends to limit itself.

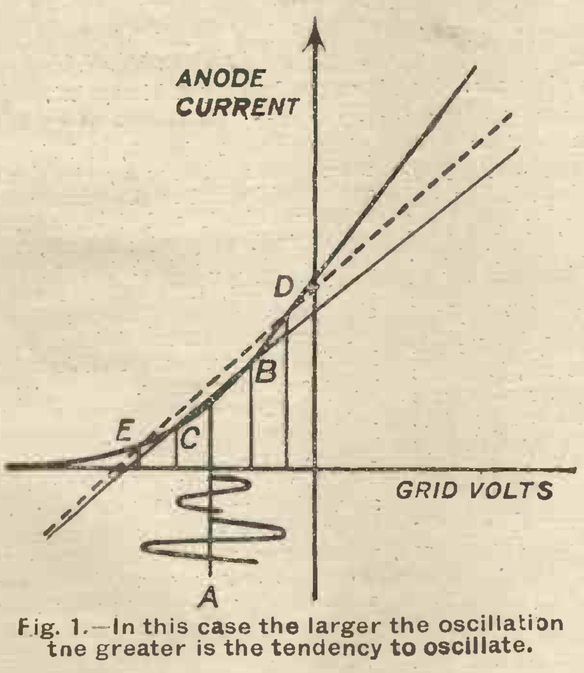


Fig. 1.—In this case the larger the oscillation the greater is the tendency to oscillate.

Backlash in Reaction Circuits

Another effect which is very often noted in a poorly designed or badly adjusted circuit is that of backlash. If the reaction is gradually increased until the set commences to oscillate, then the reaction setting must be reduced an appreciable amount before the set ceases to oscillate. This means to say, of course, that if the reaction has been gradually coaxed up to the oscillation point, then if the set suddenly oscillates, it is impossible to come just off the oscillation point, for when the set does stop oscillating, it is no longer near the critical reaction point.

These several effects can be explained by referring the characteristic curve of the valve.

Consider Fig. 1. Assume that the valve is working at the point A. For small variations of voltage the anode current will vary between B and C of

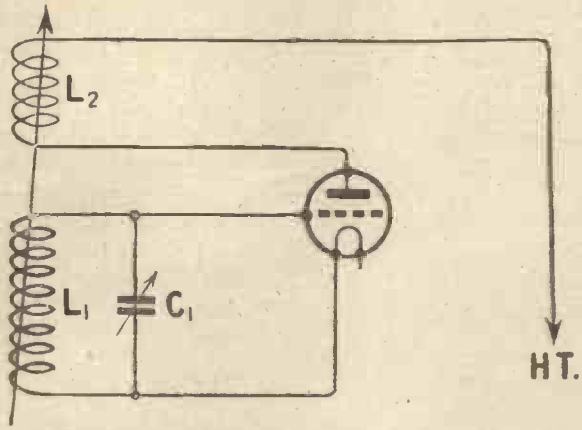


Fig. 3.—A simple magnetic reaction circuit.

the particular characteristic shown. At this point the effective slope of the characteristic is as indicated by the full line.

Assume now, however, that the circuit commences to oscillate. The current in the oscillating circuit, and thus the voltage on the grid, will increase and the valve will now, perhaps, be oscillating between the points D and E. It will be seen that the effective slope of the characteristic between these two points, as shown by the dotted line, is steeper than it was in the previous case. Consequently the amount of reaction which is required to maintain oscillation will be less, since the critical value of the feed-back required depends upon the amplification factor of the valve.

Tendency to Oscillate greater when Set is Oscillating

Thus, if the reaction coupling is reduced the valve will continue to oscillate below the point at which it commenced to oscillate. When it ultimately stops oscillating the current in the circuit will drop again, and the grid voltage will fluctuate between B and C. As we have seen, the effective slope of the characteristic over this range is less and therefore more reaction will be required. There is thus a backlash effect such as we have just described, the reaction adjustment at the point where the valve stops oscillating being appreciably less than that required to make it oscillate again.

Consider, however, the arrangement shown in Fig. 2. If the valve is working a little farther up the characteristic, then for small variations of voltage the slope will be as shown by the full line. If the voltage variations are increased so that the valve is working between the points D and E on the characteristic, then the effective slope will be as shown by the dotted line.

A Limiting Effect

It will be seen that in this case the slope of the dotted line is *less* than the slope of the full line. This means to say that once the valve starts oscillating the strength of the current will tend to increase. As soon as it does so, however, the effective amplification factor of the valve will begin to decrease, so that the current will very shortly be limited. The sudden rapid increase of current,

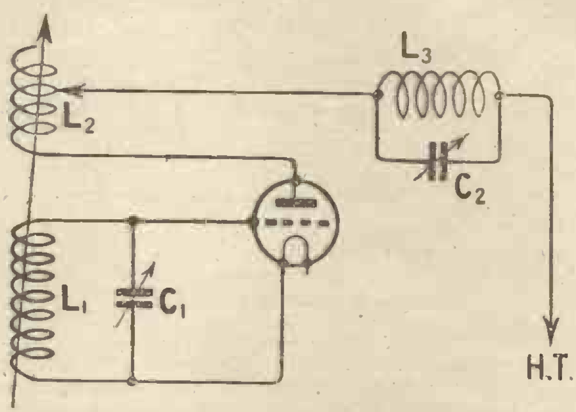


Fig. 5.—Variation of the bypass condenser C_2 controls the reaction in this circuit.

therefore, which causes the undesirable "plonking" will be obviated if the valve is working in a manner such as this, and the set will gradually slide into oscillation. Backlash will also be avoided by this means, because at the point where the set finally stops oscillating, as the reaction adjustment is slacked off, it is quite ready to commence oscillating again, and if the reaction adjustment is increased the smallest amount, the set will once again commence to oscillate.

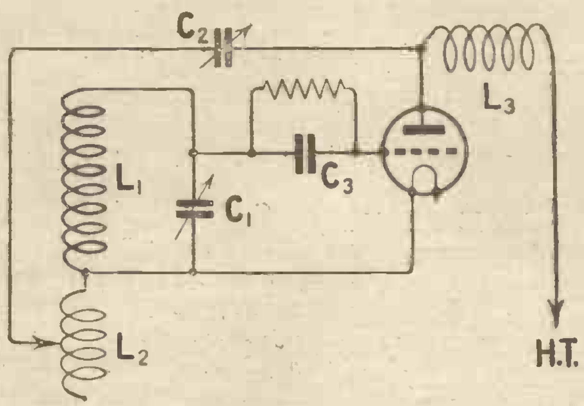
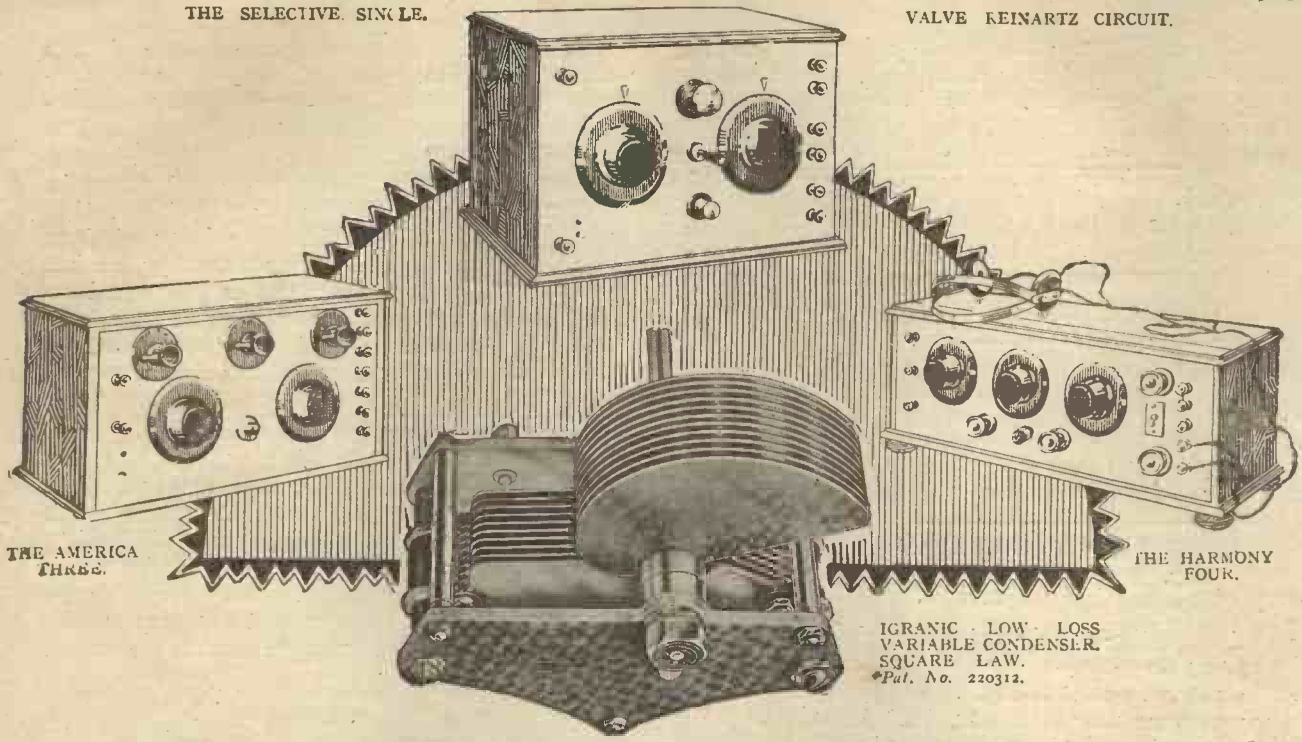


Fig. 4.—The Reinartz circuit, a magnetically coupled circuit the reaction effect of which is controlled by C_2.

Adjustment of Working Point

It will thus be seen that the working point of the characteristic has a considerable effect upon the smoothness of the reaction obtained. If the working point is properly adjusted the reaction control will cause the set to slide smoothly into oscillation without any "plonking" or any backlash. The adjustment of the working point of the characteristic can be carried out by means of a potentiometer control, which is the most satisfactory method. It may also be adjusted to a large extent by variations in the filament current and H.T. voltage of the valve.



The Choice of Experts

WERE one doubtful as to the merits of the Igranic Low-Loss Square Law Variable Condenser one has but to note the type of circuits for which this Instrument is specified by well-known experts on receiver construction to be assured that here at last is available a laboratory instrument, and at a reasonable price.

In the September issue of MODERN WIRELESS three Igranic Low-Loss Variable Condensers were specified for "The Harmony Four," an instrument for which the author claims surprising volume, purity, and very sharp tuning. In the same issue appear also particulars of "The America Three," by yet another author, in which Iganic Low-Loss Variable Condensers are also given pride of place. This circuit, as its name implies, being designed for the reception of American stations.

In WIRELESS CONSTRUCTOR of the same month Igranic Low-Loss Variable Condensers are recommended by yet another author for a Low-Loss Reinartz Circuit, a selective single-valve receiver. These three examples serve to show the favour in which this highly efficient Igranic Radio Device is held when longer range and greater selectivity are required.

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2. LOW EFFECTIVE RESISTANCE connected to moving plates by means of flexible spiral conductor ensures positive electrical contact and noiseless operation.
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For the "Coastal Three" described in the October issue of *Modern Wireless* Igranic Square Law Condensers were again specified.

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If the circuit includes a condenser and leak in the grid circuit, an adjustment of the value of the grid leak will also have a beneficial effect.

Some circuits are better than others in respect of the smoothness of operation, but in many cases it will be found that a circuit will give disappointing results because of the wrong adjustment of the working point on the characteristic. With these few remarks, which are just intended to throw some light upon a point which is not always appreciated, we will pass on to the consideration of some actual reaction control circuits.

Magnetic Reaction

Fig. 3 shows the ordinary simple electro-magnetic reaction circuit. (In the majority of the figures which follow, the aerial and earth connections and the several batteries have been omitted, because they are not relevant to the matter under discussion.) In this simple case smooth reaction can be obtained if considerable care is taken, but the circuit suffers from the disadvantage that the movement of the two coils L_1 and L_2 relative to each other causes a variation of the tune of the grid circuit, which is undesirable.

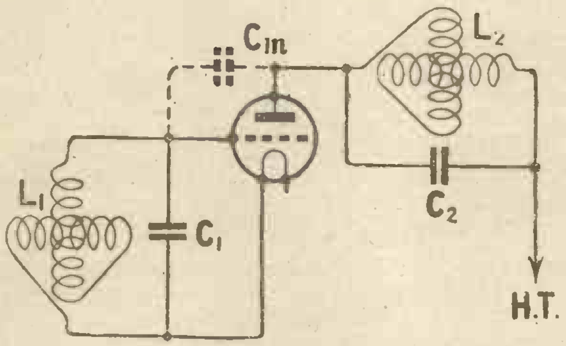


Fig. 6.—A true capacity reaction circuit, feed-back being obtained through the valve capacity C_m. The Condenser C_2 may usually be omitted.

A circuit which has come into considerable prominence is that employing a capacity control over the feed-back. The circuit is shown in Fig. 4 and is usually known as the Reinartz circuit. This circuit is not a capacity reaction circuit, but the high-frequency current in the anode circuit passes through the condenser C_2 and through the inductance L_2, back to the filament. The choke coil L_3 prevents the high-frequency currents from passing round through the high-tension battery. The condenser C_2 acts as an impedance to the high-frequency current in the reaction circuit, and the smaller this condenser is made, the higher is the impedance, and consequently the smaller the current. Thus, increasing the value of C_2 increases the current which is allowed to flow through the reaction coil L_2 and so increases the feed-back. This circuit is capable of giving very smooth reaction control, quite free from "plonking" and backlash, if the correct values of high-tension and filament currents are obtained. It has the advantage that the reaction control near the oscillation point is very fine.

Another Form of Capacity Control

The circuit shown in Fig. 5 is another form of electro-magnetic reaction controlled by means of a condenser. In this case there is a fixed coupling between the grid coil L_1 and the reaction coil L_2 and a choke coil L_3 has been inserted in series with the lead from the high-tension battery. This choke coil, of course, tends to prevent the high-frequency currents from flowing through the anode circuit, and is, therefore, shunted by a small condenser C_2. This condenser acts as a by-pass for the high-frequency current, and the larger the value of this condenser the easier will be the path for the high-frequency current, and consequently the greater the reaction effect. This circuit, however, only exercises a control over a comparatively small range, and it is, therefore, advisable to make L_2 variable in order that the best adjustment may readily be obtained.

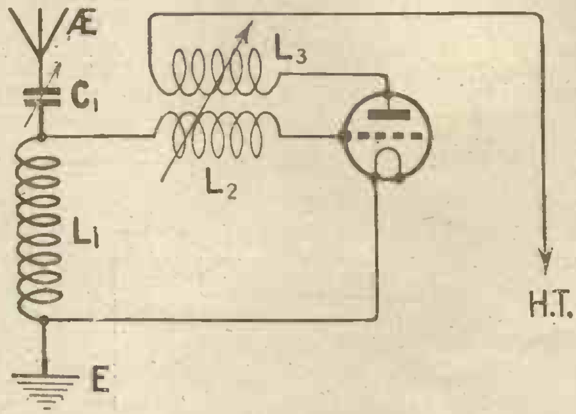


Fig. 7.—In this circuit the magnetic reaction between L_3 and L_2 opposes the capacity reaction.

Capacity Reaction

Fig. 6 is a proper capacity reaction circuit. Here there is a variometer L_1 in the grid circuit tuned with a condenser, and there is also a tuned circuit L_2C_2 in the anode circuit. The voltages developed across the coil L_2 produce voltages across the capacity between anode and grid shown in the Fig. dotted as Cm. Under certain conditions this voltage is sufficient in value and in the right direction to produce oscillation, and it is found that with any valve having a fairly high capacity

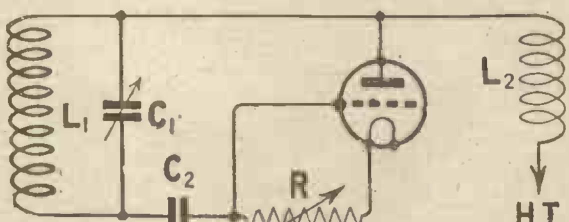


Fig. 8.—The Ultraudion circuit. Reaction is controlled by varying the grid leak R.

between the electrodes, oscillation will be set up when the two circuits are approximately in tune. The oscillation in this case is controlled by detuning one or other of the circuits, and by this means a comparatively critical control of reaction may be obtained. Quite satisfactory reaction control may be obtained even if C_2 is omitted, particularly if L_2 has a high self capacity. Fixed coils and variable condensers may be used if desired.

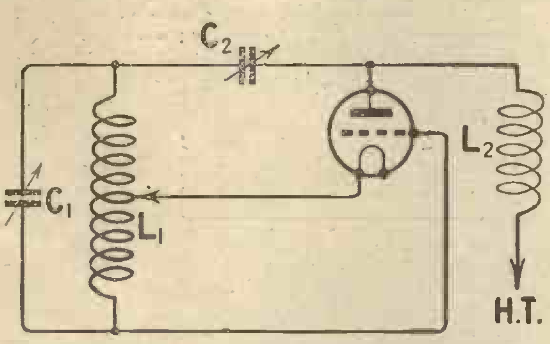


Fig. 9.—Another direct-coupled reaction circuit. Reaction in this case is controlled by C_2.

The circuit shown in Fig. 7 is another form of capacity reaction circuit. In this case, due to the presence of the coil L_3 in the anode circuit, there will be a certain reaction effect through the inter-electrode capacity of the valve as in the previous case. The coil L_3, however, is coupled to the coil L_2 in the grid circuit in such a direction as to oppose oscillation, and by this means the electrostatic feed-back may be neutralized by an equal and opposite electro-magnetic reaction, so keeping the circuit just off the oscillation point.

Direct Coupled Circuits

A third class of circuit is that in which the anode and grid circuits are tapped across different portions of the same oscillating circuit. One of the most satisfactory of these is the Ultraudion circuit. This circuit is shown in Fig. 8, and will readily oscillate under normal conditions. It will be seen that the anode is connected to one end of the oscillating circuit and the grid to the other end

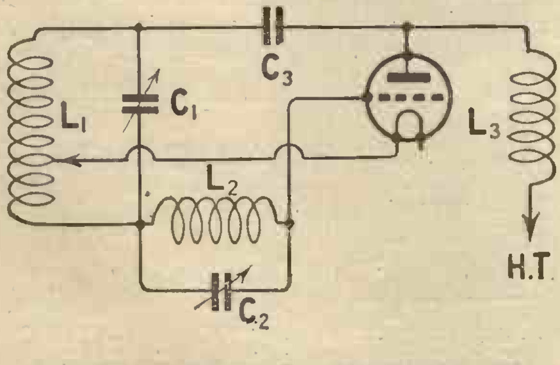


Fig. 10.—In this case reaction is controlled by varying the bypass condenser C_2.

through a condenser, and there is also a grid leak R between the grid and the filament. Reaction is controlled in this case by varying the value of this grid leak resistance, which introduces damping across the grid circuit and so ultimately stops the oscillation. Provided a reliable form of grid leak is available, this circuit will give very satisfactory results.

The circuit shown in Fig. 9 is a form of the well-known Hartley circuit. In this case the filament is tapped to a point about the centre of the oscillating circuit, and the grid and the anode to the extreme ends of the oscillating coil. The reaction is controlled by the variable condenser C_2 which controls the amount of high-frequency current which is allowed to pass from the anode through the coil back to the filament. The control in this case is somewhat similar to that of the Reinartz circuit.

A modification of this circuit is shown in Fig. 10, in which the condenser in the anode circuit is fixed. The grid end of the coil, however, is not connected direct to the grid, but is connected through a choke coil L_2 which is shunted by a condenser C_2. The coil L_2, of course, tends to prevent the high-frequency current from reaching the grid, and the condenser C_2 by-passes these currents and permits oscillation. The filament tap need not be at the centre of the coil L_2 and will very often be found to be more satisfactory somewhat nearer the grid end of the coil, as shown in Fig. 10.

Absorption Circuits

A type of circuit which has also been used with particularly satisfactory results is the absorption circuit. This circuit was originally known as the Cockaday circuit and various modifications of it have been made from time to time. The essence of the principle is shown in Fig. 11, which will be seen to be a simple electro-magnetically coupled oscillating circuit. This circuit is normally permitted to oscillate, but is controlled by the absorption circuit L_2-C_2, which is coupled to the oscillating circuit L_1-C_1. When it comes into tune therewith it will absorb energy from this circuit and so cause it to stop oscillating. By this means a very fine reaction control may be obtained, and one which is to some extent less dependent upon the valve characteristics than the other methods.

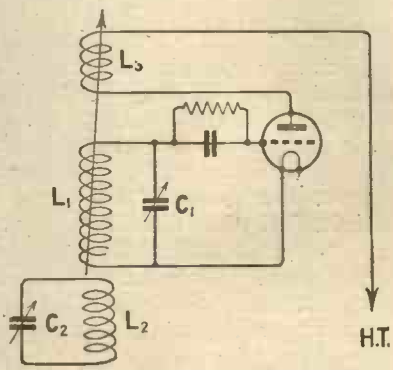
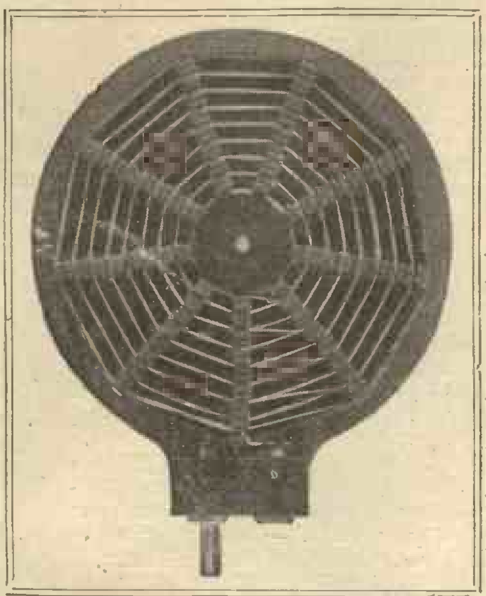


Fig. 11.—A type of absorption circuit. When L_2C_2 comes into tune with L_1C_1 the circuit stops oscillating.



A Gambrell Coil with front removed showing the air-space between layers.

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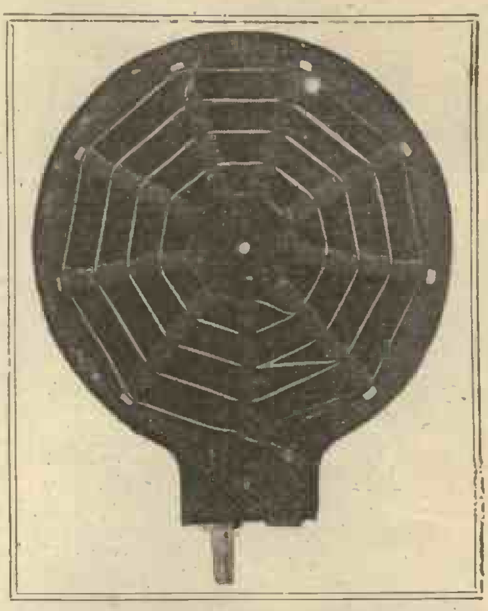

Increased air-space is obtained in coils for higher frequencies. Note the difference between the two illustrations.

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Nearest Size in Ordinary Coils	18	25	30	40	50	75	100	150	200	300	500	750	1000	1500

¶ There are other components and instruments which have been designed solely to give greatest efficiency, including the Transadapta which, with Gambrell Coils, is the finest method for H.F. Transformer work. Fill in the coupon and obtain particulars of those productions which interest you.

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Messrs. Gambrell Bros., Ltd.
76, Victoria Street, London, S.W. 1.

Dear Sirs,
Please send the leaflets marked with a X

1. RECEIVING SETS. Name........................
2. WAVEMETER. Address........................
3. COMPONENTS. ....

M.W.11.

Readers' Results with the "Harmony Four"

Distant Reception

Sir,—I have constructed the "Harmony Four" as described by Mr. Percy W. Harris, in the September, 1925, issue of MODERN WIRELESS.

The ease, strength and purity with which distant stations can be tuned-in is truly remarkable—B.B.C. and Continental stations being received at excellent loud-speaker strength.

I have had experience with various sets described in MODERN WIRELESS, but for purity and volume on distant stations the "Harmony Four" is easily the finest circuit I have tried, and must be at least as good as the wonderful American circuits we hear so much about.

The first evening the set was constructed, Thursday, October 1st, the School of Posts and Telegraphs, Paris, was tuned in on the loud-speaker without the slightest trace of 2L.O., four miles distant, and for strength was comparable with the latter station on D and power L.F., and with a remarkably silent background.

I enclose photo of the set, and I might mention incidentally that I have used Filament Dimmers and L.C. Valve Holders, made by the Enterprise Company, which, besides giving efficient filament control, very essential on the H.F. stages, allows a considerable saving in space on the panel and baseboard, therefore making wiring much easier.

I might add that I have experimentally fitted an additional stage of L.F., resistance coupled, which can be switched on when desired, and also a switch on the terminal principle to cut out the 2 H.F. stages, as I find D and 1 L.F. ample for the local station.

The set was originally constructed from components I already had, but since the photo was taken I have substituted a .0005 variable condensor, as recommended, in place of the .001.

I must congratulate you on designing a really efficient method of H.F. amplification. I am sure this circuit will meet with approval from all amateurs who desire to select their evening's programme from the various British and Continental stations without having to rely on "S.B."—Yours truly,

A. W. KELLY.

Tooting Bec, S.W.17.

The "Harmony Four" constructed by Mr. A. W. Kelly, with its additional L.F. stage.

No Equal

SIR,—I have just completed the "Harmony Four," described by Mr. Percy Harris, in the September MODERN WIRELESS.

I have made up some 40 or 50 sets all told, but so far I have not discovered its equal.

The three controls are not difficult to handle, and the fact that there is no reaction coil makes it a real pleasure to use.

I used it on Sunday night between 6.30 and 8, and logged some ten Continental, stations, all at full loud-speaker strength, and the great majority perfectly clear and free from the distortion which usually accompanies reaction in its usual form.

I also obtained good full loud-speaker results from Rome and Madrid on Monday.

I find a slight difficulty in cutting out 2LO from Manchester and Cardiff, and also Bournemouth in a lesser degree, but altogether it is a topping circuit and, as Mr. Harris says, "not difficult to handle."—Yours truly,

E. W. PEARSON.

Welwyn, Herts.

Duodyne

6,500 NAUTICAL MILES
ON LOUD-SPEAKER

REGULAR AND CONSISTENT PERFORMANCE

The Times, Los Angeles, on Loud-Speaker in Scotland

. . . As mentioned in my previous letter to you, wonderful results are still regularly and consistently received on my Ducdyne V. at home. The latest result to hand, the writer being at sea, is, up to August 3rd, the loud-speaker reception of KFI, Radio Central, and KHJ, THE TIMES, PACKARD MOTOR CAR BUILDING, LOS ANGELES, CALIFORNIA. Time of reception, 05.15 G.m.t. to 05.50 approx. G.m.t. Loud speaker medium strength, signals then weakened, but excellent phone reception was possible from Los Angeles until 06.30 G.m.t., which is 7.30 a.m. standard time and full daylight. Other stations heard were WTAM, WJL (special test?) KGO and XAD, two latter stations unknown—possibly American.

The above-mentioned results were obtained on the ordinary £18 18s. 0d. Model of your manufacture.

Hope I am not boring you with this long account of results, but anyone wishing to receive long-distance broadcasting—specify the Duodyne V, and extreme saitsfaction and many hours of enjoyment will result.

F.V., s/s ——

BUILD YOUR OWN DUODYNE.

The wholly inexperienced can build this long range receiver with the aid of "Hints to Constructors," containing :—

1. Curtis diagrams for 3 and 5 valves.
2. Simplified Lay-out and Wiring Charts for 3 and 5 valves.
3. Instructions for Operation.
4. Complete schedule of all material required.

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CURTIS SUPER-HETERODYNE VIII

THE only Super-Heterodyne circuit designed for Broadcasting conditions existing throughout the world *excluding the U.S.A.* The Broadcasting conditions existing in the U.S.A. do not prevail in any other part of the world.

Instrument complete, excluding Royalties and batteries, £52 10s. 0d.
Full particulars upon application.

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PRICE, 2/6.

THE
CURTIS SUPER-HETERODYNE KIT

1 Oscillator Coupler.
1 Filter Transformer
3 Inter-Frequency Transformers

The exclusive design of these units will indicate a considerable advance on hitherto accepted practice.

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A New Series of British Valves

OUR readers will probably have noted the arrival of a new series of British valves which have recently been placed on the market. These valves are being manufactured under the auspices of Burndept Wireless, Ltd., who have formed a separate company, known as Radio Accessories, Ltd., for the manufacture of valves.

The valves are produced under the direction of Mr. C. F. Trippe, who has become well known in the wireless world owing to his association with the valve department of the General Electric Co., where he was responsible for a large number of popular types of valve.

A complete series of these valves has been submitted to our Elstree laboratories for test, and a full report on the results obtained is given in *Wireless Weekly*, Vol. 7, No. 4. The general information regarding these valves is tabulated here. For further information our readers are referred to the complete report.

In some cases several valves of the same type were submitted, and these samples were found to be consistent as regards their characteristics and performance, and all the valves tested gave very satisfactory results as regards volume and purity.

All the valves except the 565 class are of the dull emitter type, but no valve has a current consumption of less than 100 milliamps. This we believe is a deliberate policy in order to secure a definite tension on the filaments and thus to ensure uniformity of characteristics.

The general characteristics are given in the list below. It will be noticed that the classification adopted is novel, and is a serious attempt to overcome the chaos which exists in the valve world to-day.

The valves are classed as H. (high frequency), L. (low frequency) or H.L. (general purpose), followed by the filament voltage and the filament current. Thus H.310 is a 3-volt valve taking ·10 amp. filament current, and intended for use as a high-frequency amplifier.

The internal impedances and amplification factors given below are average values.

The value of V_g (grid bias) quoted in each case is the value at approximately the middle point of the straight part of the characteristic to the negative side of the zero line.

The value given is thus a fair indication of a suitable grid bias to employ in use.

As has been stated, the valves are very satisfactory in use, and we have no hesitation in recommending them to our readers.

VALVE TYPE L.240.

Filament voltage 1·8 to 2 volts. Internal impedance 10,000 ohms.
,, current ·40 amp. Amplification factor 4·6
Anode voltage 60 to 120
Anode current at V_a=80, V_g= —7 is 3·85 milliamps.

VALVE TYPE H.L.213.

Filament voltage 1·8 to 2 volts. Internal impedance 30,000 ohms.
,, current ·13 amp. Amplification factor 7·8.
Anode voltage 40 to 100.
Anode current at V_a=80, V_g= —1 is 1·5 milliamps.

VALVE TYPE H.310.

Filament voltage 2·8 to 3 volts. Internal impedance 60,000 ohms.
,, current ·10 amp. Amplification factor 16.
Anode voltage 40 to 150.
Anode current at V_a=80, V_g=0 is 0·825 milliamps.

VALVE TYPE H.L.310.

Filament voltage 2·8 to 3 volts. Internal impedance 17,000 ohms.
,, current ·10 amp. Amplification factor 5·6.
Anode voltage 40 to 100.
Anode current at V_a=80, V_g= —4·0 is 2·4 milliamps.

VALVE TYPE H.512

Filament voltage 4·5 to 5 volts Internal impedance 37,000 ohms
,, current ·12 amp. Amplification factor 14
Anode voltage 40 to 150
Anode current at V_a=80, V_g= —0·5 is 1·4 milliamps.

VALVE TYPE H.L.512.

Filament voltage 4·5 to 5 volts. Internal impedance 15,000 ohms.
,, current ·12 amp. Amplification factor 8·5.
Anode voltage 40 to 100.
Anode current at V_a=80, V_g= —0·25 is 2·25 milliamps.

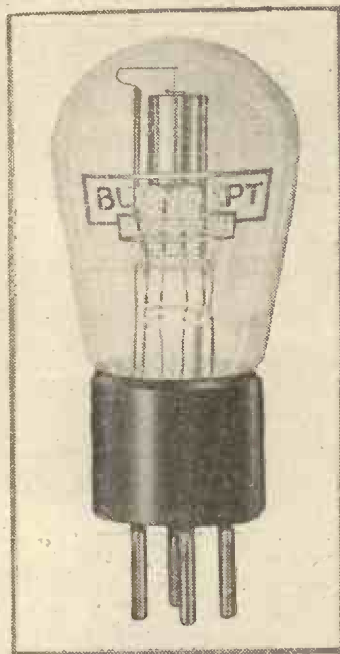
VALVE TYPE L.525.

Filament voltage 4·5 to 5 volts. Internal impedance 7,000 ohms.
,, current ·25 amp. Amplification factor 7.
Anode voltage 90 to 150.
Anode current at V_a=80, V_g= —3 is 4·35 milliamps.

VALVE TYPE H.L.565 (Bright Emitter).

Filament voltage 4·5 to 5 volts. Internal impedance 28,000 ohms.
,, current ·65 amp. Amplification factor 9·75.
Anode voltage 40 to 100.
Anode current at V_a=80, V_g= —2 is 1·6 milliamps.

The L 240 is a 2 volt dull emitter valve for LF work.

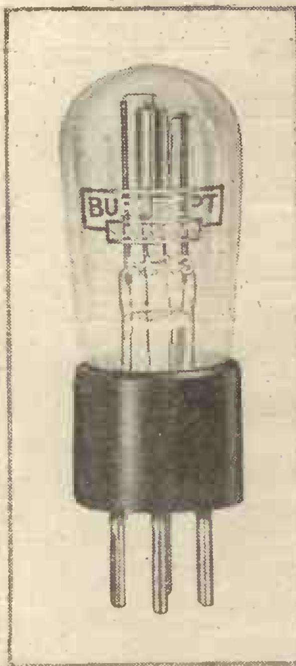


The HL 565 type. A general purpose bright emitter.

The L 525 type is a 5 volt power valve.

A 5 volt HF valve, the H 512 type.

The L 550 type is a good dull emitting power valve.



A good general purpose valve is the HL 213 type.

K. RAYMOND

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All Post Orders, Parcels or postal communications of any kind to be addressed to 7, Grape Street, Shaftesbury Avenue, W.C.2.

All second-hand goods are sold over the counter at 7, Grape Street, ONLY. Minute from Museum or Tottenham Court Road Tubes. 'Phone: Gerrard 2821.

All orders post free over 2/- U.K. Foreign orders extra postage, please.

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All Post Orders from this Address.

TWIN-VALVE LOUD-SPEAKER RECEIVER by John Scott-Taggart

Radio Press Envelope No. 10. A really wonderful set. First valve is a dual High and Low-Frequency Amplifier, the second being the Rectifier. No crystal employed; thus the set is perfectly stable when once adjusted. Inclusive of parts (excluding box and panel), as specified by Author, £4 12s.

ONE-VALVE REFLEX

R.P. Envelope No. 8.

.001 and .0003 Variable, Eureka Detector, 2-way vernier coil stand, W.O. Terminals, R.I. Transformer, Valve Holder for baseboard. Fixed Condensers .001 and .0002, 18 gauge wire, screws, etc. Sent post free for 62s. (less box and panel).

COMBINED DETECTOR AMPLIFIER

"Wireless Constructor," Nov., 1925.
Parts (less Box and Ebonite), £3 3 0.

RADIO PRESS ENVELOPE No. 9

EFFICIENT SINGLE-VALVE SET.
Set of Parts .. .. 35/- (less box and ebonite).

2-VALVE COCKADAY SET

1925, November issue, "Wireless Constructor"
Parts (less box and panel) £3 17s. 6d., post free U.K.

COLOURED CONNECTING WIRE, yellow or fawn, 24 ft., 1/-; better than higher priced goods.

CLIMAX Earth Tube, 5/-; Anti-Microphonic sockets 2/- Set.

CURTIS Constant Tuned H.F. Amplifier, 150/800, 15/-; 800/3,000, 17/6; 2,000-7,000, 18/6 (for Super Het).

BACK OF PANEL, geared 2-way coil stand, ideal article, 8/6.

C.A.V. gramophone attachment, 25/-.

MULLARD VALVES

THOUSANDS SOLD WITHOUT A COMPLAINT

PM4 LOUD-SPEAKER VALVE

Low current consumption, absolutely non-microphonic. Extremely rigid construction. Only a 4-volt accumulator or 3 dry cells wanted to run it. 22/6

ALL MULLARD VALVES HIGHLY RECOMMENDED

LIST FREE

BENJAMIN VALVE HOLDER

For good reception with Dull-Emitter Valves Benjamin Clearer Tone Anti-Microphonic Valve Holders are absolutely essential. 2/9.

VAN RADEN

Accumulators guaranteed for 12 months. Send for list.

PELICAN UNIVERNIER DIAL

Makes your set Micro-selective.
The 12 to 1 Reduction has been proved most efficient for selective control, AND the price! 6/-

FAMILY 4

Sets of parts (less box and panel) £3 14s., to author's list.

PARTS FOR ALL-CONCERT de LUXE

(Less box and Panel) to author's list, £6 16 0
Reliable parts, £5 5 0

"COMBINE"

Vernier dial 5/9.

GENUINE Dr. NESPER LOUD-SPEAKER

Post free 15/11

BATTERY BOXES

ready for filling, 63 volts - - 5/3

FLASH LAMP BATTERIES

for same 14 for 6/-

T.C.C.

genuine green Mansbridge Condensers,

2 mfd. - - 4/6
1 mfd. - - 3/10
25 - - - 3/- etc.

Don't be bluffed by people trying to trade on their reputation.

VARIABLE CONDENSERS

K. RAYMOND "DE LUXE" MODEL.

High grade ebonite ends, one-hole fixing, knob and dial.

With Vernier.

·001	8/11
·0005	7/11
·0003	7/6

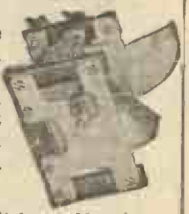
Without Vernier.

·001	7/6
·0005	5/11
·0003	5/6

Accurate, narrow spacing, splendid workmanship, high-class article. Clean cut signals. Many testimonials.

Post 3d. per Set.

K. RAYMOND



American Type Low-Loss, skeleton ends, perfectly rigid, moving vanes and end plates are at earth potential. Each complete with dial and knobs.

With Vernier		Without Vernier	
·001 ...	9/6	·001 ...	8/3
·0005 ...	8/9	·0005 ...	7/9
·0003 ...	8/3	·0003 ...	7/6

Above with Vernier. If no Vernier wanted deduct 1/3 each.
Post 3d. per set.

IGRANIC

Last word in Condensers.
·0005, 24/-; .0003 21/-.
Sq. Law with vernier.

COLLINSON'S SELECTOR.

"Low Loss" (geared).
.0005 21/-; .0003 20/-
Sq. Law with vernier.

"ORMOND."

"Low Loss" American Type, skeleton ends, knob and dial, .001 10/6; .0005 9/6; .0003 9/-.
Above with vernier. Deduct 1/6 each if no vernier required. Also with ebonite ends, same price.

JACKSON BROS. (JB) Condensers.

Low-Loss.		Geared.		Square Law.		Standard.	
.001 ...	13/-	.001 ...	17/6	.001 ...	9/6	.001 ...	8/-
.0005 ...	10/6	.0005 ...	15/-	.0005 ...	8/-	.0005 ...	7/-
.0003 ...	9/-	.0003 ...	13/-	.0003 ...	6/9	.0003 ...	6/9

Sq. Law with vernier: .001 14/-; .0005 12/6; .0003 11/6

BOWERMAN'S SUPER POWER 'PHONES,

Uniquely light in weight, first quality materials, craftsmanship perfect, true tone, comfortable, 4,000 ohms, Stallory diaphragm, highly fini Duralim headbands. Each 'phone guaranteed,

REDUCED from 21/-
NOW - - - 12/6.

N. & K. HEADPHONES

Genuine (stamped on back of each case), very fine value. Comfortable leather headbands. 4,000 ohms.

POST FREE - - - 13/11

SIX-SIXTY VALVE

Fil. Volts .. 1.5—2
" Current .. 0.3 amps.
14/-

"BRUNET"

The old original 'phones, a little lighter in weight, very fine value. 4,000 ohms.
Post free 12/11 pair.
Reduction to callers.

TELEFUNKEN

In sealed boxes.

Genuine 'Phones, 4,000 ohms. Adjustable magnets in sealed boxes. Many thousands sold without a complaint. Light as a feather. No need to try and find a better 'phone.

Post free 16/- pair.
Reduction to callers.

VOLTMETERS

Reading 0—12.
High-class instrument.
Post free - 5/6

CLEARTRON VALVES

CT 15 - - 12/6
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(Met.-Vickers)

A 45 - - 7/6
SP 18 - - 12/6
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Valve Holders, 1/9
Grid Leak, 3/-
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Grid Leak and Condenser, 50,000 ohms to 15 meg. 4/6

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(New Model)
Loud Speaker 18/11.

FRENCH THOMSON-HOUSTON HEADPHONES.

Want some beating! 4000 ohms for 12/11 nett.

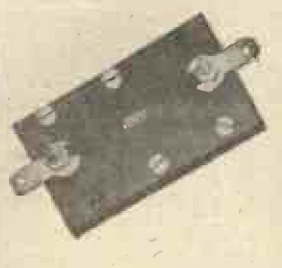
SIEMENS

EBONITE. Special Sizes 3/16 in. ½d. per sq. in. ¼ in. ¾d. per sq. in. Post extra.

CUSTOMERS!

We do our best for you all. Do you realise that we are only human beings? IF (and a large IF) the manufacturers could deliver, how happy we should be!

WATES MICROSTAT 2/9



B 508.

FIXED MICA CONDENSERS.

B 508.

Built up with copper foil and best ruby mica di-electric. High insulation and capacity adjusted to within 5 per cent Stocked in capacities from 0.0001 to 0.01 mfd.

2/- to 3/6 each.

VARIABLE CONDENSERS.

(For use as Independent Units)

B 558.

Strongly constructed on the same principle as variable condensers for panel mounting. Enclosed in dust-proof non - inflammable Celastoid covers, and fitted with dial, knob, two terminals and three feet for fixing to table or board if required.

Price 12/- each.

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Silvertown

WIRELESS ACCESSORIES

Quality guaranteed by over 50 years' electrical manufacturing experience.

AN AID TO ENTHUSIASTS.

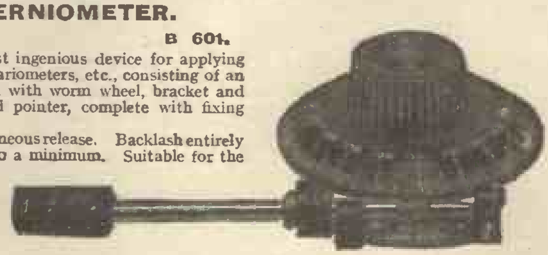
We have prepared a logging chart for recording wavelengths, condenser settings, etc., of those stations which require careful calibration to tune in. A copy of this chart, printed on stiff card, with hanger, can be obtained free of charge at any of our Branches or from any high-class dealer.

SILVERTOWN VERNIOMETER.

(Patent applied for.) **B 601.**

The Silvertown Verniometer is a most ingenious device for applying slow motion to variable condensers, variometers, etc., consisting of an ebonite dial and knob (0—180°) fitted with worm wheel, bracket and worm spindle, micrometer barrel and pointer, complete with fixing screws.

Gear ratio 240—1. Fitted with instantaneous release. Backlash entirely eliminated. Hand capacity reduced to a minimum. Suitable for the following makes of condensers:—Silvertown, Burndept, Sterling, Ormond ordinary and Ormond Low Loss. State type of condenser for which they are required when ordering. Price 6/- each.



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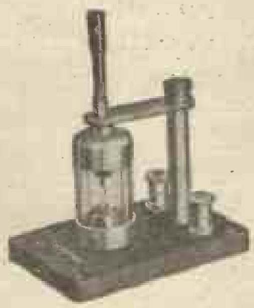


B. 506.

CRYSTAL HOLDERS.

B 506.

Mounted on ebonite base (3ins. × 2ins.) with glass tube to protect crystal from dust. The catswhisker is of silver wire. A feature of this crystal holder is that it can be easily taken to pieces and set up again.

Price 4/- each.

MOUNTED VALVE SOCKETS

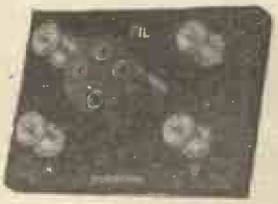
SINGLE VALVE TYPE.

B 530.

Single, double and triple. Suitably engraved for use with valves or for plug-in type high-frequency transformers.

5/6, 9/- and 13/6 each.

SILVERTOWN RADIO COMPONENTS



B 530.

Letters from Our Readers.

A Hartley-Reinartz Circuit

SIR,—As a result of reading the article in MODERN WIRELESS for August on the Hartley-Reinartz circuit, by A. D. Cowper, M.Sc., I decided to make it. The set far exceeds my expectations, as on the night of September 7 I logged no fewer than four amateurs on telephony—2XO, 2VL, 2KG, 6DA—and about a dozen on telegraphy, the call signs of which I could not read, telegraphy not being my strong point, signal strength varying between R.4 and R.6, all these on an indoor aerial with a gas-pipe earth; using one stage of L.F. 2LO romps in at L.S. strength. Yours truly,

R. LOVELL.

Paddington, W. 2.

The Autumn Double Number

SIR,—As an old reader, I hasten to congratulate you on the Autumn Number of MODERN WIRELESS.

The tendency nowadays is for a new radio journal to appear with the resplendence of a comet, only to evaporate shortly into the ethereal. Without fear of contradiction, I feel I am voicing the opinion of all your readers when I say that your latest effort is easily the most brilliant.

Not only is it brilliant and easily understood by anyone with but an elementary knowledge of wireless, but it is indeed a pleasure to be able to read through your magazine without constantly being harrowed by examples of bad grammar—a fault which is, unfortunately, much in evidence in several journals which appear during the course of a month.

Allow me also to congratulate you on having acquired the services of Dr. Robinson. Truly the Air Force's loss is indeed our gain. His intensely interesting article on Forthcoming Developments in Radio justly deserved the prominence you saw fit to give it, and I, in common with your other readers, will look forward with pleasure to many absorbing expositions from his masterly pen.

With so many shining lights I do hope Mr. Percy Harris will not be lost to us. In him one feels that one has a friend indeed, at least so think five delighted families who listen-in nightly through the medium of different sets which it has been my pleasure to construct solely from his splendid articles.—Yours truly,

C. TAYLOR BRADING.

Croydon.

Advertisements

SIR,—As a constant reader of your publications I would like to express my high appreciation of the articles therein. On the other hand, the matter of many of the advertisements (as in all wireless journals) warrants a certain criticism.

For example, reference to last month's MODERN WIRELESS shows that of nine advertisements of low frequency transformers, *five* only state the ratio of turns; *one*, curiously enough, gives the total number of turns but not the ratio; the remaining *three* manufacturers ask you to buy a proverbial pig in a poke and give no information whatsoever.

In the same way four manufacturers of loud-speakers do not deign to state the resistance of their instruments. Meanwhile, in the important matter of matching valves, transformers and suchlike, the unfortunate constructor must take a lucky dip blindfold. Surely manufacturers are not afraid of giving themselves away if, for example, they disclose data as to the impedance of their transformer primaries?

Many other cases occur to one, such as gauge of wire and H.F. resistance of tuning coils, but I must not trespass further on your time or space. Surely it is time that our manufacturers learnt that the average wireless enthusiast tries to take an intelligent interest in the apparatus he uses.—Yours truly,

R. E. TARRANT.

London, E.C.1.

Short Wave Developments

THERE can be little doubt that short waves are going to be experimented with to a considerable extent this winter. For those who have not yet experimented with these high frequencies, some articles by Mr. G. P. Kendall in *Wireless Weekly*, starting in Vol. 7, No. 4, will be of particular interest.

In commencing this series on "Practical Short-wave Reception" Mr. Kendall describes the principles governing the choice of a circuit, and follows this by a discussion on "How to Lay Out a Short Wave Receiver," and further articles giving practical details of the whole subject.

Dr. Robinson in Vol. 7, No. 2, also gives some interesting facts concerning the radiation from short wave aerials, and shows how at these frequencies the length of the aerial becomes comparable with the wavelength, giving rise to various peculiar effects. For example, certain types of aerials do not radiate at all in a horizontal direction, but only up into the atmosphere at an angle.

Selectivity is a problem which has been exercising the minds of all amateurs for some time. In order to enable amateurs to start their experiments this winter on the right lines, and in possession of the maximum of helpful information, a series of articles has been written by Mr. J. H. Reyner, commencing in Vol. 7, No. 4, of *Wireless Weekly* on the whole question of Selectivity and Tuning in general. These articles discuss first of all the number of circuits which are necessary to obtain adequate selectivity without distortion, and follow up by giving some practical details as to the resistances of coils of various shapes and forms.

A Notable Occasion

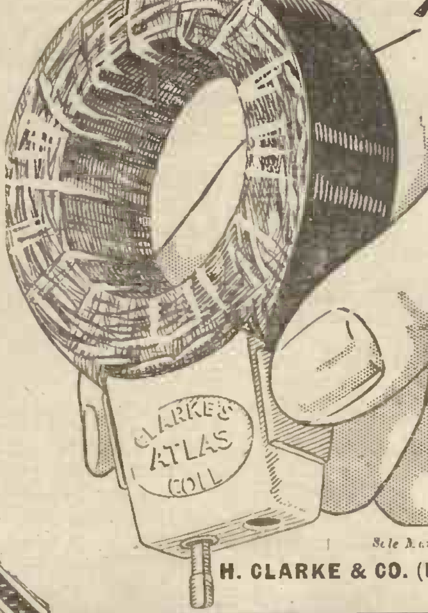
The issue of the *Wireless Constructor* for November is the birthday number of this popular journal, and to mark the occasion a special collection of interesting articles has been provided. In view of the extensive use of crystal receivers, Major James Robinson speculates as to whether valves will ever die out. Although there are several interesting alternatives, the valve is indispensable in several cases, and Major James Robinson comes to the conclusion that the valve has really come to stay.

The Ultraudion circuit is one which is capable of giving very great selectivity and at the same time very sensitive results. Mr. Harris describes an interesting two-valve receiver made up on this principle.

Other articles of interest to the enthusiastic experimenter will complete what is a particularly attractive number of a journal which has already proved its merits in catering for the public needs.

"Wireless"

The new Radio Press weekly, *Wireless*, has quickly established itself in the homes of the non-technical public. "Did Marconi Invent Wireless?" is the title of a striking article by Mr. A. H. Morse, while articles by Major James Robinson, William Le Queux, Captain Round and other well-known scientists are constantly appearing.



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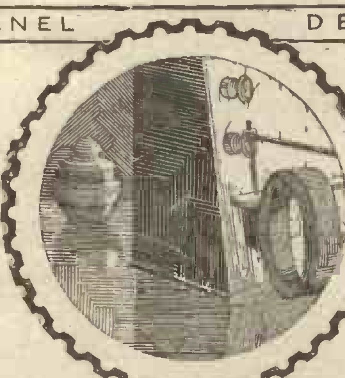

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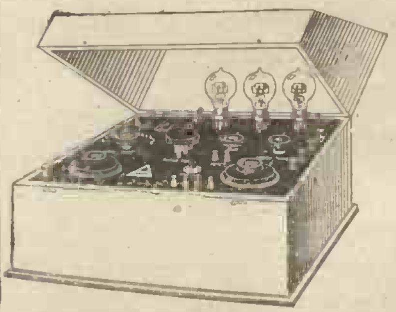

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PICKING UP THOSE DISTANT STATIONS

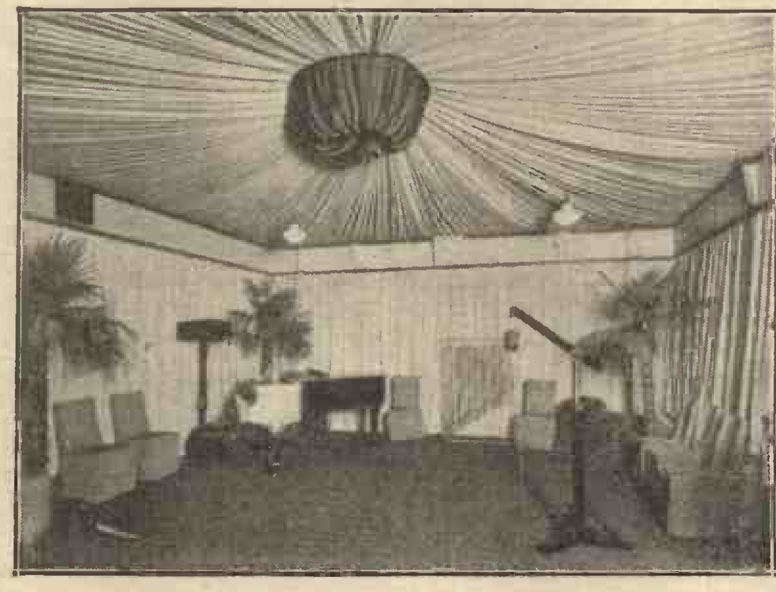
By R. W. Hallows, M.A. Staff Editor

The Barcelona station which is often received in this country.

EARLY in the last century the immortal Mr. Jorrocks put forward a scheme for a revision of the calendar which was to include the entire omission of summer. This season of the year he described as a time when life was not worth living, since he could not indulge in his favourite pastime of hunting. Were Jorrocks with us to-day he would no doubt find many ardent supporters among the ranks of wireless enthusiasts, who have little use for the hot season with its long days and short nights. They welcome the coming of autumn as eagerly as do the hunting man, the shooter and the footballer, for when the summer is past we can look confidently for improvement in every way in reception conditions. But there are, of course, enthusiasts who still struggle after long-distance reception throughout the summer, and, indeed, the very fact that conditions are adverse lends an added interest to the work; and a point not to be forgotten is that if a receiving set is built during the lighter months and gives satisfactory results, then one may feel quite sure that it is really up to the mark, and that it will do great things when the best part of the wireless year draws on.

Causes of Poor Reception

The fact that long-distance reception in summer time is not so good as that obtainable in autumn, winter and early spring is due to a variety of causes. The larger part of the broadcast transmissions takes place in daylight, the ground is often parched and dry for long periods on end, and electrical disturbances which give rise to atmospherics are of much more frequent occurrence than they are during the colder months. The passage from summer to autumn conditions is often quite a rapid one. Last year, for example, there was a sudden very marked change for the better during the last week in August, which was noted by experimenters in many parts of the country. There were slight setbacks on particular days and nights afterwards, but on the whole the improvement continued steadily until the end of the following month, when it became very rapid indeed. By the middle of October it was possible to tune in without any great difficulty on an efficient set American broadcasting stations operating on the 600 to 1000 kc. band (500 to 300 metres), which since the previous April were heard so feebly that identification was often impossible. With the coming of autumn the wireless man has the feeling that his set is becoming much more "lively," to borrow a term from the motorist. During broadcasting hours a small movement of the tuning condensers may bring in quite a number of stations at points where but a short time previously nothing was to be heard. One is no longer confined to one or two British stations.



The studio at KDKA. Note that the walls and ceiling are draped to prevent echo.

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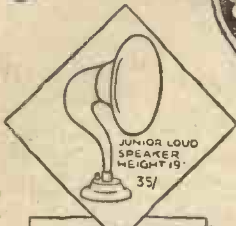

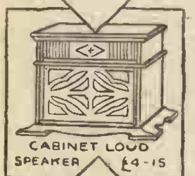

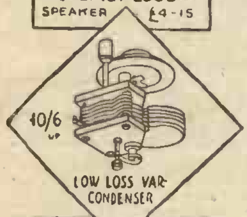

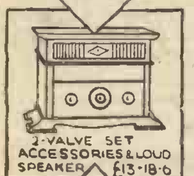

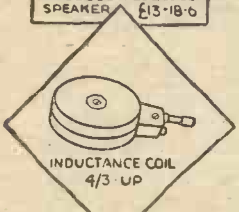

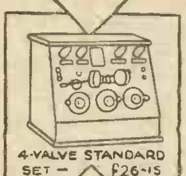

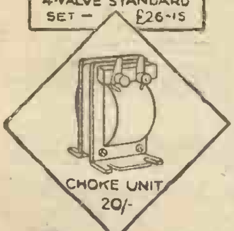

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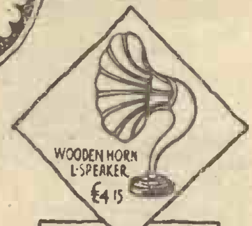

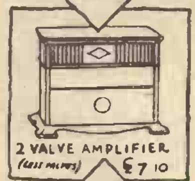

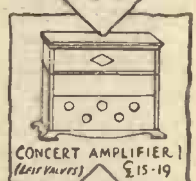

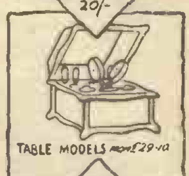

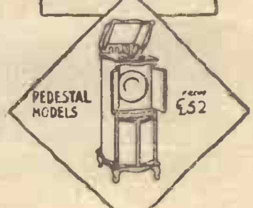

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with perhaps a sprinkling of Continental transmissions; one's travels upon the magic carpet of wireless may now be almost world-wide. I suppose that every wireless man hankers after long-distance reception, and it is natural that he should, for there is no thrill which can quite equal that experienced when some far-away station is picked up for the first time and tuned in so that music and intelligible speech can be heard. The improved conditions to be expected during the coming months will increase the range of any set, but the man who wishes to do real long-distance work will see to it that he takes full advantage of them by bringing his receiving equipment to the highest possible state of efficiency.

The large and handsomely decorated studio at the Rome station, from which many British listeners are entertained throughout the year.

Good Earth

A good earth is of paramount importance in long-distance work. You may have, for example, simply a metal tube driven into the soil. This type of earth is quite effective in clay soil, but where there is a deep layer of gravel immediately below the surface it will be found better to use another type of earth connection. Two stout wires may be buried from 6 inches to a foot below the surface. They are arranged so as to run parallel to one another and about 8 feet apart immediately under the aerial wire. This kind of earth is an extremely good one for both summer and winter reception, since in the latter case it can be relied upon to give excellent results, no matter what the soil may be; whilst in the former it is much less affected than the tube connection by the parching of the soil during the long spell of dry weather. The question of earths, however, is a very difficult one upon which to lay down general rules. In some cases a connection made to an ascending water main will be found superior to any other, and I have known many instances of excellent reception being obtained with a metal tube earth all the year round.

Interference

Where interference is experienced from power cables, tramways, electric railways, and so on, or when improved selectivity is desired, the use of a counterpoise may be found to give better results than any kind of earth connection. A type of counterpoise that has often improved long-distance reception consists of two lengths of wire or copper tape, spaced not less than 8 feet apart, stretched immediately under the aerial itself. Two insulators in series are used at both ends, and the lead-in from the counterpoise is brought into the house through an insulating tube similar to that used for the aerial lead-in. The wires of the counterpoise should be slung not less than 6 feet above earthed objects, and it should be remembered that if this device is used the effective height of the aerial is represented by the distance between it and the wires of the counterpoise. It is frequently found that the use of such a counterpoise produces an increase in both range and signal strength of the receiving set. Usually, too, selectivity is much improved. The only way to determine whether any particular kind of earth connection or counterpoise will give better results than another is to try out each in turn, for just as one man's meat is another man's poison, so a system which will give first-rate results in one case may be quite unsatisfactory in another. So much depends upon the locality in which the station is situated, the nature of the ground, the nature of the building and other factors.

Batteries

As regards the receiving set itself it is important that the valves and the batteries should be in thoroughly good condition. Valves (particularly dull emitters) which have seen a great deal of service, are apt to lose some of their sensitivity and may be far too insensitive for good long-distance work. Crackling noises, so often mistaken for atmospherics, which become particularly noticeable when the set is worked anywhere near the oscillating point, may quite possibly come from an old high-tension battery. When the set is brought into a sensitive condition for the reception of some far-away transmission, noises due to the high-tension battery are amplified to a considerable extent, and if they are bad may be sufficient to drown what would otherwise be an audible signal. Even if the battery is quiet, its voltage may be much lower than you imagine. For successful long-distance work, then, see that your battery is quiet and of full voltage.

Condenser Efficiency

For long-distance work it undoubtedly pays to have a set of really efficient inductances. It has been shown by Mr. Kendall, by Mr. Sylvan Harris and others that we have probably exaggerated in the past the proportion of losses in the receiving set that are due to condenser inefficiency; the badly designed and badly made inductance coil is a far worse culprit. It is therefore well worth the while of any amateur who contemplates reaching out with his set to purchase or to make up for himself a set of coils that can be relied upon as thoroughly efficient. At the same time, my own experience, for what it is worth, is that poor variable condensers do increase not a little the difficulty of the task of tuning in weak and distant signals even upon the broadcast frequencies. Two years ago I was using a receiving set provided with cheap metal-ended condensers of a design that one would nowadays condemn at sight. With these I was never able to receive, except on particularly favourable nights, transmissions from such stations as WGY, WBZ and WHAZ. Subsequently I rebuilt the condenser and provided watch-spring connections for their spindles, with the result that tuning-in was greatly facilitated on good nights; whilst even on poor ones it was often possible to tune-in several Transatlantic broadcasting stations.

Wavemeter

Searching for weak signals, particularly if the receiving set contains several tuned circuits, may be a difficult matter unless a wavemeter of some kind is available. The word wavemeter, of course, is a misnomer, since the instrument is really a frequency meter, but the term has become generally accepted. Those who care to make the outlay necessary for purchasing an accurately calibrated wavemeter (there are several good types on the market) will find it an exceptionally useful instrument, since with its help the set can be tuned readily to any desired wavelength, or, at any rate, to its near neighbourhood, which means that only very small movements of the tuning controls are necessary whilst searching is in progress. For all ordinary purposes a good buzzer wavemeter will give readings of sufficient precision. Since the only battery required is a small dry cell to operate the buzzer, this kind of wavemeter can be made up entirely self-contained in quite a small case.

An Important Point

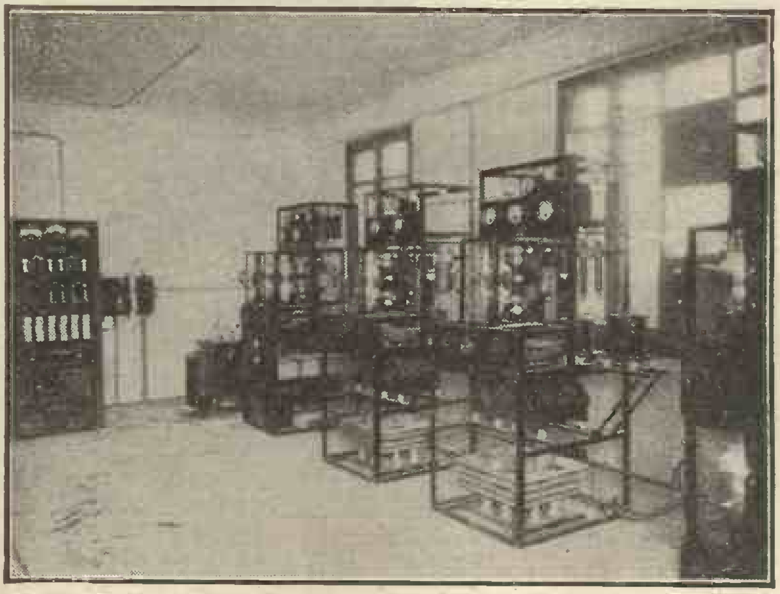
The main point to remember when using a buzzer wavemeter is that it should be placed at some distance from the aerial tuning inductance of the receiving set. If the distance between the two is small, so that the coupling between them is comparatively tight, it may be found that the note of the buzzer is heard with almost equal loudness over a number of divisions of the condenser scale. Close tuning and accurate readings are obtained only when the distance between the two is such that the note of the buzzer is just comfortably audible in the telephone receivers or the loudspeaker when tuning is made as sharp as it can be.

How to Calibrate One Wavemeter from Another

Opinions are rather divided among wireless folk at the present time over the question of high-frequency amplification for long-distance work. There are many who swear by it, whilst others will have none of it. Only the expert, however, can get the fullest amplification by reaction, and for the ordinary man high-frequency amplifying valves are a great help. Certainly for work upon the very short waves the high-frequency amplifier is out of place, since no present system appears to be able to deal satisfactorily with the enormously high frequencies involved; nor is high-frequency amplification necessary here, since shortwave signals, such as those of KDKA, even from great distances, come through with surprising strength upon a single valve set, provided that both it and its collector system are efficient and that the receiving station is not situated in a blind spot. Upon the 600 to 1000 kc. band (500 to 300 metres) there are several forms of high-frequency amplification which can be used with success, and these have been frequently used in Radio Press sets.

When to Listen

Owing to the present crowded conditions of the 600-1000 kc. band there are many foreign stations which cannot be heard at all when our own stations are working, whilst those who live near a main station may find it impossible to hear anything else upon a fairly wide waveband owing to the shock excitation of the receiving aerial caused by its powerful transmissions. The ideal time for long-distance work therefore is one at which some, at any rate, of the foreign stations are working whilst our own are not. One of the best times for Continental reception used to be on Sunday between the afternoon and the evening transmissions of our own stations. At the present moment, however, it is difficult to do any successful work at this time, in London at any rate, owing to the interference experienced from oscillating receiving sets. In the country matters are not so bad as a rule, though the effects of radiation may be troublesome at times. In long-distance work the maxim "live and let live" should be observed, for if receiving sets are allowed to oscillate the situation soon becomes ridiculous, no one being able to hear anything. Luckily many of the Continental stations may be found at work on any night of the week after the closing down of our own. Reception conditions are often very good indeed at these late hours, and as many of the oscillators have retired to bed, much less interference may be expected.



A view in the transmitting room at the Madrid station. A Marconi "Q" type transmitter is employed.

Weather Conditions

Weather and atmospheric conditions have a great deal to do with long-distance reception. Speaking generally, the best results may be looked for on a dull overcast night when rain either threatens or is actually falling. Often, too, one obtains wonderful results upon a thoroughly dirty night which anyone who is not a wireless enthusiast might well anathematise.

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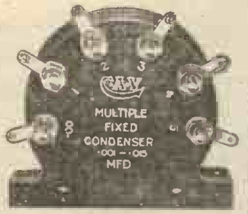

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5151 Low Ratio (second stage) ..	

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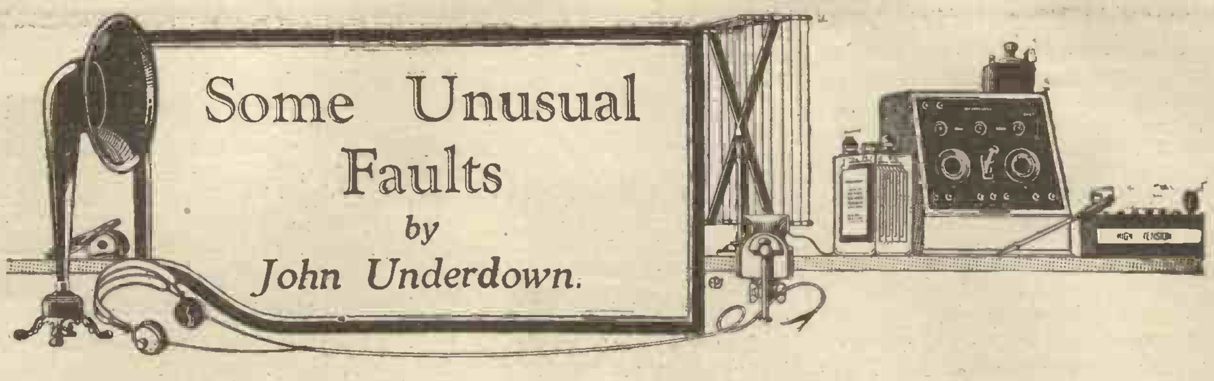

Some Unusual Faults

by

John Underdown.

TWO years ago a walk along the front at any little seaside town on the Kent coast, between Dover and Deal, disclosed scarcely more aerials than could be counted on the fingers of one hand. To-day many houses and bungalows sport an aerial, showing how greatly increased is the popularity of the Broadcasting Service. The number of listeners is being continually augmented, and many who have previously only associated the word "valve" with such everyday things as bicycles will become the proud possessors of valve receiving sets and may be confronted at any time by faults which to the uninitiated seem inexplicable. It is proposed, in the course of this short article, to deal with a few somewhat puzzling occurrences in order that the remedies, which are by no means always obvious, shall be available should such difficulties be experienced.

A Valve Fault

Recently a friend who was using a general purpose type of three-valve set employing the circuit of Fig. 1, wrote to me stating that he was experiencing difficulty. The symptoms were that the set, which had previously given every satisfaction, had ceased to function when the high-frequency valve was burning at normal brilliancy, although when this valve was switched off on its filament resistance R_1 or only just glowing, the programme from the local station (2LO), distant 20 miles, gave fair telephone strength, whereas normally sufficient volume for the loud-speaker was obtained. The effect of changing the three valves round in all three sockets had been tried, but only when the original H.F. valve was placed in the first socket and extinguished, or almost so, would the set work.

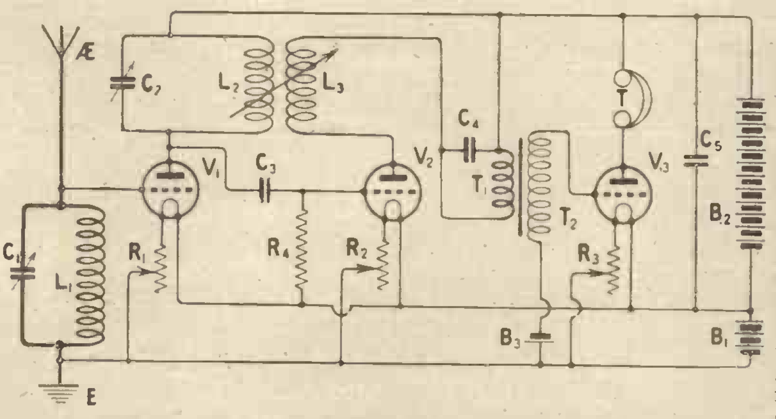

Fig. 1. A three-valve tuned anode set in which a puzzling valve fault developed.

Filament and Grid Touching

Through previously having experienced similar difficulties, the trouble was at once apparent from these particulars, and the remedy, that of replacing the high-frequency valve, given. This at once allowed the set to function in the normal manner.

The explanation of this puzzling phenomenon was that the filament of the H.F. valve had sagged badly so as to be in close proximity to the grid, and when alight at normal brilliancy expanded sufficiently to touch completely. This to all intents and purposes was equivalent to short circuiting the aerial circuit so that no voltages were applied across the grid and filament of the first valve. When cold, or the filament only just glowing, no "short" was present and the set functioned, since signal voltages were applied to the detector valve through the internal grid to plate capacity of the first valve.

Low-Frequency Circuits

A valve fault of this type, namely, the filament shorting to the grid, only gives rise to the symptoms previously mentioned when in an H.F. stage and hence in other positions is not easily detected since it will appear to light correctly, although causing a complete cessation of signals should it be used as a detector or an L.F. amplifier. If, therefore, a set becomes "dead," although all the valves appear to be glowing at normal brilliancy, attention should be paid to these accessories as well as to the more obvious points such as seeing that H.T. and loud-speaker leads are intact. By gradually turning down the filament resistances in turn it is possible, with many bright emitters, to see whether the filaments are abnormally curved, since their shape may be clearly seen when only just glowing, although sagging is not discernible at normal brilliancy. With dull emitters, generally, it is often impossible to locate such defective filaments by inspection, and if a spare valve is available it should replace each valve in the receiver in turn, when, provided one only is responsible, the offender will be easily discovered. Perhaps a better test is to try them individually in a single valve set should one be obtainable, since the very remote possibility of more than one developing the same trouble is thus guarded against.

Trouble Due to Microphonic Valves

A further somewhat unusual trouble, due to the microphonic effects in certain ·06 ampere type valves, has recently come to my notice, the user of the set in question residing in a remote part of Cornwall and employing the well-known "4-Valve Family Receiver" designed by Mr. Percy W. Harris, mainly for loud-speaker work from 5XX. In this case, in the telephones excellent reception was obtained from the high-powered station on three valves, and apparently the quality was still good on four, although so loud that it was difficult to judge with any degree of certainty. When, however, the loud-speaker was substituted for telephones a buzzing noise was heard, which grew rapidly in intensity until it completely drowned all signals. Upon switching over to phones on four valves, the trouble seemed to have ceased.

Mechanical Vibrations

A letter elicited the fact that the loud-speaker was standing very close to the set and, in fact, on the same table on which this was placed. ·06 ampere valves were employed for all stages, and these were placed in ordinary type valve-holders. From this information it was deduced that the buzzing was due to microphonic effects in the valves, and on advising that the loud-speaker be shifted into another part of the room, the trouble ceased and signals from the loud-speaker were of excellent quality.

The explanation was that actually the physical vibrations set up by signals from the loud-speaker had set the electrodes of the valves vibrating at an audible frequency, and this effect being cumulative, it finally drowned all signals. Such cases as this are not very common, but where a loud-speaker is employed close to the set, and buzzing starts, gradually growing until signals are drowned, it is always well to switch over to phones and notice whether the effect is still present. If absent it may be taken definitely that the trouble is due to vibrations from the loud-speaker affecting the valve filaments, and this instrument should be shifted to a remote part of the room, when the buzzing will generally cease.

A Tropadyne Fault

Now that Supersonic heterodyne receivers are becoming so popular, every genuine experimenter wishes to try a receiver of this type, but often the number of valves employed makes the cost of such a set prohibitive, so that any means which will reduce the number required, without sacrificing efficiency, will make special appeal. The "Tropadyne" arrangement, of which the combined first detector and oscillator portion of the circuit is shown in Fig. 2, is one that has many staunch adherents. In certain designs of American origin the oscillator coils L_2 and L_3 in the diagram are wound on one former, being separated by only a small distance such as ½ in.

Testing the arrangement

Recent experiments with the oscillator coils L_2 and L_3, wound with 24-gauge double cotton-covered wire, on a 3½ in. former, elicited a certain amount of information which may be interesting to certain experimenters and is given herewith. L_2 consisted of 51 turns with the nodal tapping point taken from the 26th turn. L_3, the reaction coil, was of 40 turns spaced at ½ in. from L_2, and wound on in the same direction. The oscillator and first detector part of the set was connected to a normal receiver employing two high-frequency stages, a detector and one low-frequency amplifier. The coil L_5 in the diagram was actually the aerial coil of the set, whilst L_4 was the reaction coil, the connections to which were altered so as to make it the primary of the input filter transformer. When the correct connections for the reaction coil L_3 had been found, the set functioned excellently, giving 2LO on the loud-speaker at good volume with employing an ordinary No. 50 plug-in coil for the frame aerial L_1, fair loud-speaker strength without any trace of 2LO. Newcastle and Bournemouth, as well as certain Continental stations, also came in well, but Birmingham was extremely disappointing in strength, although on the outside aerial,

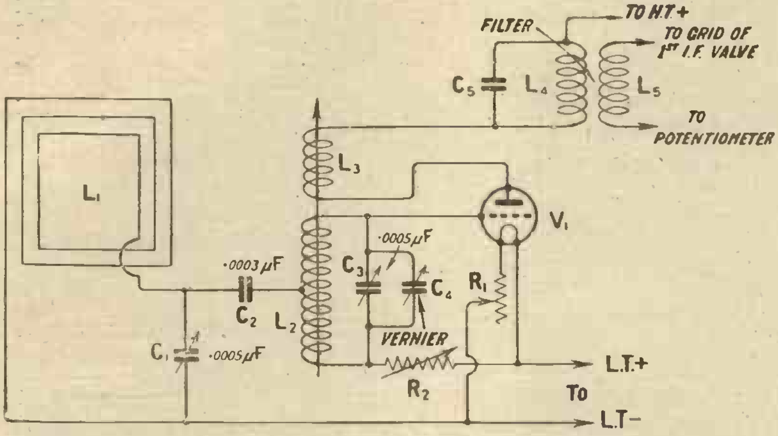

Fig. 2.—The Tropadyne arrangement employed with Supersonic receivers.

at a distance of 12 miles from the London station.

Variable Reaction Coupling

Employed on a 4-ft. frame Manchester was successfully obtained at this station is one of the best of the distant ones received in this district. From these results it was deduced that such poor reception from the Birmingham station was due to a too small reaction coil L_3. Increasing the high tension on the oscillator valve improved results somewhat, but the station was still not up to expected strength. Increasing the size of L_3 by five turns again increased volume from 5IT, but on going back to the lower wavelength stations, such as Cardiff, the set gave a continuous squeal. By cutting the former between the two coils and arranging that L_3 could be moved, thus tightening or loosening the coupling as desired, the difficulty was finally overcome.

A Puzzling Combination of Faults

When only one fault is present in a receiver the behaviour of the set is often such that a ready diagnosis can be given. Occasionally, however, several faults are present at once, giving rise to very conflicting symptoms, which in most cases call for a thorough instrument test to locate successfully their causes. An interesting combination of faults, giving rise to some rather peculiar phenomena, occurred with a set employing the circuit shown in Fig. 3. It will be observed that the circuit is a perfectly straightforward one, consisting of a direct coupled detector valve with reaction, followed by one transformer and one choke coupled stage of note magnification.

Test on an Aerial

When completed the receiver was placed on the aerial for a test, a No. 35 coil being inserted in the aerial socket and a No. 50 for reaction. An ordinary "R" type valve was used as the detector, followed by a DE5B in the second socket and B4 in the last. The H.T. supply to the detector valve was 60 volts, whilst 120 were used on the last two valves, with 1½ volts grid bias for the first and 6 for the second.

Long Wave Morse Signals

Tuning in the normal manner in order to test on the London station, the distance to which was roughly fifteen miles, no traces of this station could be found, and only weak morse was received. This appeared to be a jumble of long wave C.W. stations, to whose wavelengths the set should not have tuned. Occasionally faint strains of music could be heard, and with difficulty it was ascertained from an announcement that the station was 5XX. The very weak telephony received from this station was much distorted, although the values of grid bias for both valves were known to be approximately correct for 120 volts high tension, and the effect of reducing grid bias was tried. With no grid bias at all, that is, with the two grid bias terminals joined directly to L.T. negative, signal strength improved somewhat, but the distortion was more pronounced. No reaction could be obtained, even on reversing the leads to the reaction coil L_2. Tuning on C_1 seemed to have no appreciable effect.

The Aerial Coil Suspected

From previous observations it was well known that the effect of removing the aerial coil from a receiver often results in a number of long wave morse stations being heard. The aerial coil L_1 was therefore removed and tested for con-

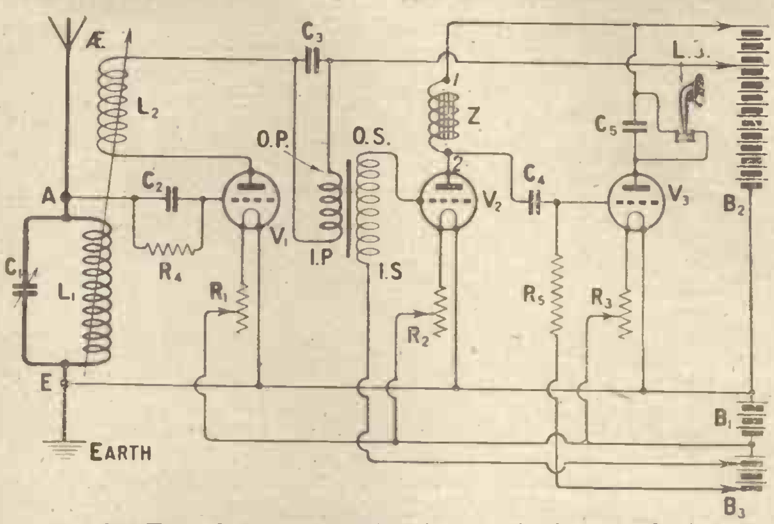

Fig. 3—The three-valve circuit in which two faults were present simultaneously.

tinuity with telephones and a dry cell. One tag of a pair of telephones was joined to one side of a 4½-volt battery, the free side of the battery to the plug of the coil, and the metal socket was tapped with the free telephone tag. Loud "plonks" were heard in the telephones, showing that the circuit was continuous.

A Disconnection

The next step taken was to test between the two leads going to the two sides of the aerial coil socket and the metal of the plug and socket fittings respectively. A test between the lead from the aerial terminal A to the metal plug, to which this lead should have been connected, gave no "clicks" in the telephones, thus showing that the circuit was broken. By replacing the screw, which should have connected this lead to the metal of the plug, by a longer one, this fault was remedied.

On re-connecting the set to the aerial the local station was received and the set could be made to oscillate, but signals were poor and still very distorted, alteration of grid bias having the same effect as previously mentioned.

Not the Low-Frequency Portion

With the set removed from the cabinet but connected to the aerial in the normal manner and tuned to the local station tests were then carried out with a pair of telephones by connecting these first across the IP and OP terminals of the L.F. transformer. Signals at a satisfactory strength for a detector valve at the distance from the local station were obtained with the telephones in this position and purity was excellent. Next the second valve was lit and telephones connected across the choke coil to the points marked 1 and 2 in Fig. 3. Signals were again heard at good strength and purity, the normal step-up from valve to valve being obtained. This exonerated the detector part of the circuit, the low-frequency transformer and the second valve.

The Choke Coil

From the previous results it was obvious that the fault was located either in the choke coil Z, the coupling condenser C_4, the grid leak R_5 or the last valve.

The telephones were therefore left connected in parallel with the choke coil Z and the loud-speaker placed between the L.S. terminals and the last valve lit. With the normal values of grid bias, as previously indicated, signals on the loud-speaker were now of fair strength and purity. Volume was, however, up to that which should be expected from a 3-valve receiver. It showed, however, that the choke coil Z was the offender, and testing this for circuit with a pair of telephones and a dry cell only gave very very faint "clicks." Testing across the secondary winding of the first transformer, for the sake of comparison, very much louder "plonks" were obtained in the telephones, thus showing the choke coil Z to be discontinuous.

The Trouble Remedied

Careful examination of the two leads from the ends of the choke coil winding to its two terminals disclosed the fact that one was loose, and the removal of the outside covering of Empire cloth showed that corrosion had taken place at the point where the stout wire from one terminal was joined to the finer wire of which the choke was wound. This was apparently due to the use of acid flux and was soon remedied. When the repair had been effected and the choke coil replaced the receiver functioned excellently.

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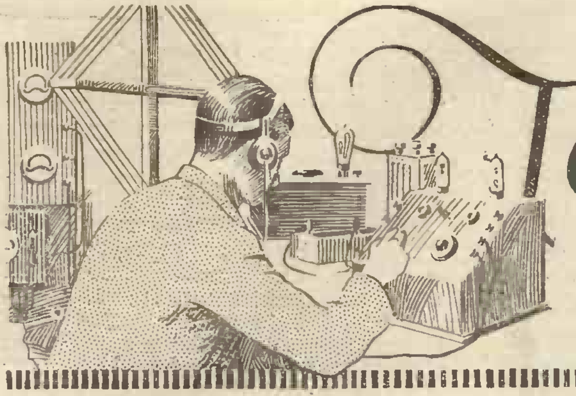
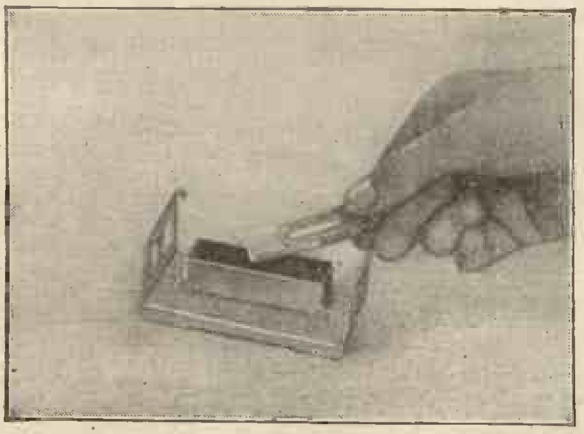


Tested by Ourselves

"Meta" Soldering Iron Heater

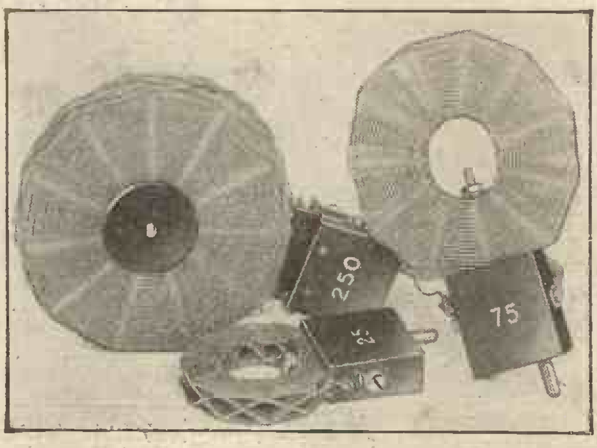
A NEAT little device for utilising "Meta" solid fuel—a substitute for methylated spirit in the form of white tablets—has been submitted for our comment by Messrs. Frederick Pratt. This has a small metal trough, for holding the "Meta" tablets, mounted in a supporting frame on which to rest the soldering iron when in use. A pair of tongs is also provided for handling the fuel. On trial a single tablet was found to bring a medium-sized iron to an adequate heat, without any danger of overheating it and spoiling the tinning; the flame being a clean one very similar to that of alcohol, and almost odourless. It was apparently stable and quite safe. Provided that the soldering operations involved were not protracted, as in wiring up a many valve set, this compact device should prove convenient to the amateur constructor. A tablet lasted from five to ten minutes, in practice, and several minutes were required to get the iron hot enough for use.

The "Meta" soldering iron heater uses solid fuel which burns with a clean flame.



"Quality" Duplex Coils

MESSRS. Goswell Engineering Co., Ltd., have sent for practical test a set of their "Quality" duplex coils. These are double basket coils of d.c.c. wire, mainly self-supporting, and are mounted on the customary plug-and-socket coil-base for use in coil-holders. The sizes submitted were the Nos. 25, 35, 50, 75, 100, 150, 175, 200, 250, 300, the last two being actually made up of two double-baskets mounted closely side by side for the sake of compactness. The No. 200 was, therefore, the largest, being 5 in. in diameter by about ⅜ in. thick: this and the No. 175 had a reinforcement of radial rods between the outer windings. On practical trial it was not found possible to obtain self-oscillation on a small single-wire outside aerial with the Nos. 25 or 35 in the grid-circuit, direct-coupled; No. 50 with No. 75 as reaction covered the ordinary short-wave range for the main stations with a .0005 μF. tuning-condenser in parallel, and distant reception was possible with this combination. The maximum frequency with this arrangement was 856 kc., thus including the Cardiff station. It was not found practicable to choose a good combination of three coils for a three-coil-tuner loose-coupled circuit; accordingly the local station effectively drowned out all others except 5XX. The latter station came in at excellent strength on Nos. 200 or 250 as primary and No. 175 as reaction; the largest coil reached about 97 kc. with the same reaction-coil. The short-wave coils appeared to be of medium resistance when tested; it is obvious that the inductance-value is in each case considerably below that of most commercial coils of the same turns-rating, in general a coil two sizes larger than usual being required. The appearance is neat and workmanlike, and it would appear as if the coils would stand quite a deal of handling, being securely mounted and tied. The price is quite moderate.



A representative group of the "Quality" Duplex plug-in coils.

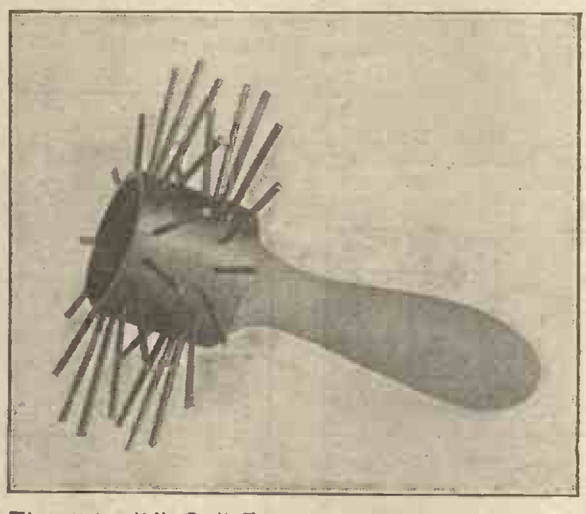
"Varic" Variometer

FROM Messrs. Lionel Robinson & Co. we have received a sample of the "Varic" air-spaced variometer, in which both rotor and stator windings are of thick wire with insulation that gives good spacing; and are practically self-supporting. The instrument is about 3½ in. diameter overall, and is designed for mounting behind the panel by two small screws and short brackets. A substantial plain spindle carries a knob and bevel scale, which are secured by a set-screw to the spindle. The frame of the instrument is built up on light fibre rings, giving a minimum of solid dielectric. It appears to be sturdily made; small terminals are provided for connections at the side of the frame, whilst good noiseless connection with the rotor windings is ensured by spring bearings. The available tuning-range, on an aerial of .0003 μF capacity, was found to be from about 1,500 to 536 kc. (200 to 560 m. wavelength), a certain amount of casual panel capacity being present as well. In valve-reception, without reaction, by the Moullin voltmeter method, the signal-voltage recorded on the local station compared with that given by an optimum design of plug-in coil; in crystal reception the figure observed was 34 microamperes on the small single-wire aerial as against 35 microamperes for a large standard air-spaced low-loss variometer, and on the large high aerial of greater capacity 114 microamperes as against 117 with the standard. The crystal was tapped across the whole inductance in these tests. The performance of this carefully designed variometer was, therefore, excellent, and it showed an unusually low H.F. resistance. It can be most heartily recommended for general use where a variable inductance is required, and should give every satisfaction so long as the windings are kept quite dry.

A photograph of the "Varic" variometer made by Messrs. Lionel Robinson and Co.

The "Anvil" Coil-Former

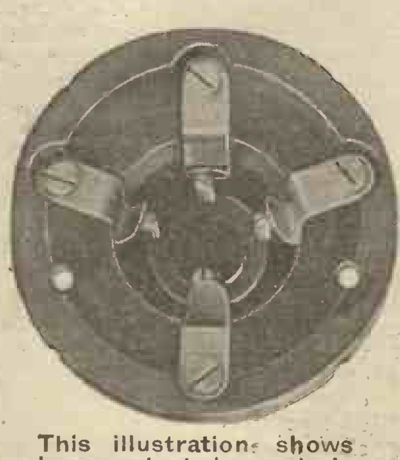
FROM Messrs. Burwood Electrical Supplies Co. (1924) we have received a sample of their "Anvil" coil-former, which is specifically intended for winding, at home, coils of the duo-lateral and honeycomb variety. This consists of a 1¾ in. diameter brass ring carrying two rows of radial screwed pins, 15 in each set and spaced ¾ in. apart, but "staggered," on which the wire is wound in the familiar zigzag manner, counting either six or nine pins on at each crossing. The finished coils, it is suggested, should be made rigid by means of cold lacquer before removal from the former. Suitable wire-sizes (commencing with No. 22 gauge) and turn-numbers are given in an accompanying pamphlet. The former is a well-finished substantial instrument; it is provided with a convenient wooden handle for use when winding; and the pins were firmly held, yet readily removable from the finished coil. It should prove well adapted for its purpose. Some question might conceivably arise in connection with the use of this apparatus for the construction of duolateral coils, in regard to possible patent infringements; however, it is evident that the same instrument can be used for making up a variety of low-capacity coils.



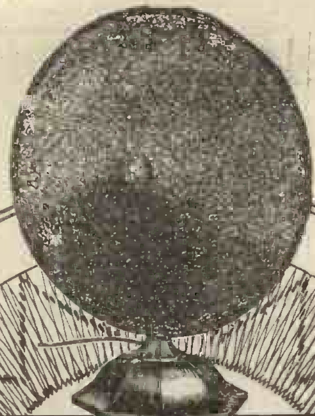
The "Anvil" Coil-Former, made by Messrs. Burwood Electrical Supplies Co. (1924).

"Interad" Low-Capacity Valve Socket

A VALVE-SOCKET of the low-capacity type, strongly recalling the American pattern for affixing on a base-board, and having four small terminal-screws arranged around a flanged base for connections, is the "Interad," a sample of which has been submitted by Messrs. Wholesale Wireless Co. The connections to the valve-legs are completed by four spring contact-fingers within the hollow base of moulded insulating material, a secure wiping contact resulting. Incidentally, it would be practically impossible to insert the valve in the wrong orientation in this socket, whilst casual capacities between terminals are evidently greatly diminished. The socket should lend itself to a very neat arrangement of wiring in a multi-valve receiver. Finish and insulation-resistance are both satisfactory.



This illustration shows how contact is made to the valve pins in the "Interad" valve holder.

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Radio Press News

THERE are many amateurs who are not content with simply knowing generally how to construct a set and how the set works. Particularly in view of the developments which are taking place nowadays, many enthusiastic experimenters desire to pursue the theory of wireless somewhat more deeply than they have previously done. While there are many text-books already on the market, these books are often either too mathematical or else deal in too great detail with certain aspects of the problem of the theory of wireless.

Filling a Need

It is to meet this need in wireless literature that the latest Radio Press book, "Modern Radio Communication," has been produced. This work, which has been prepared by Mr. J. H. Reyner, B.Sc. (Hons.), A.C.G.I., D.I.C., of the Radio Press staff, is designed specifically to appeal to the student who has a certain technical knowledge but who wishes to proceed somewhat farther. The book is written in non-mathematical vein, but at the same time sufficient calculations are introduced to enable the student to design his own circuits and apparatus.

A further advantage of the book is that many of the more advanced chapters have been written in such a way that they may be completely omitted on a first reading of the book, without in any way destroying the sense or the continuity of the arrangement.

Elementary Conceptions

The book falls naturally into several sections. In the first section the elementary conception of an electric current is considered and the properties of capacity, inductance and resistance are dealt with in detail. The question of alternating and oscillating currents is then considered, and the mathematics of this portion of the subject is dealt with at some length. This is important, because it conveys a very clear idea of what is actually happening in a wireless transmitter or receiver, and a clear understanding of the elementary mathematics of the various processes is of considerable utility in some of the more complex applications of wireless. Resonant circuits and tuning, including the important subject of coupled circuits, are dealt with as a corollary to this section.

Wireless Transmission

The second section of the book commences with a very lucid description of the elementary principles of radio communication, illustrating how a wireless wave is generated and propagated from point to point. This is all done from a non-mathematical point of view. The principal types of spark transmitters in use to-day are then described, and a chapter on the reception of spark signals follows, in which the general principles underlying wireless reception are laid down.

The Valve

The thermionic valve is then discussed in some detail, the characteristics and the use of a valve as an amplifier, detector and an oscillator being outlined. This naturally leads to the use of continuous waves for radio communication, and after a brief description of the continuous wave system the various forms of continuous wave transmitters, valve, arc and high frequency alternator are described.

Advanced Knowledge

The third section of the book deals with miscellaneous application of the art. A considerable space is devoted to the design and operation of valve amplifiers, and the question of radio telephony is discussed. Chapters follow on the use of frame aerials and direction finding equipment generally, losses in conductors, radio-frequency measurements, elimination of interference, high speed telegraphy, aerials and masts, and finally a short and somewhat more technical consideration of the propagation of the electric wave around the surface of the earth. In order to assist the serious student in obtaining some idea of the values used in practice, a series of examples is given at the end of the book, together with the necessary answers.

On the whole we think that this book will be extremely valuable to the great majority of wireless amateurs. It is written in such a way that the mathematics are very unobtrusive and can even be omitted if desired, but they are there when they are required.

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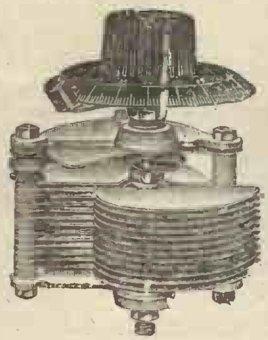

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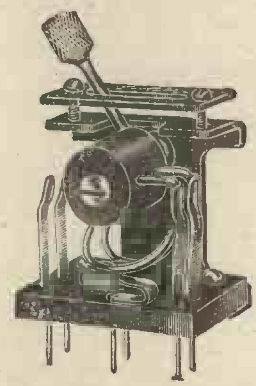

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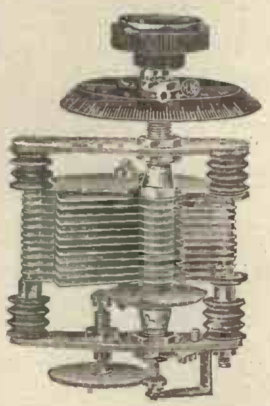

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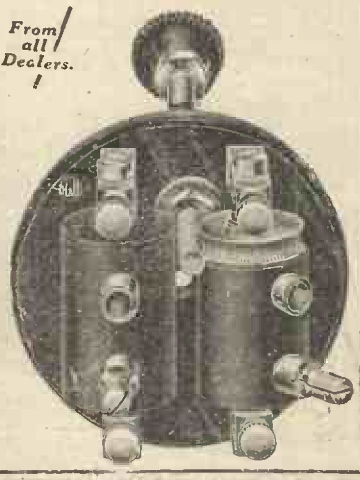

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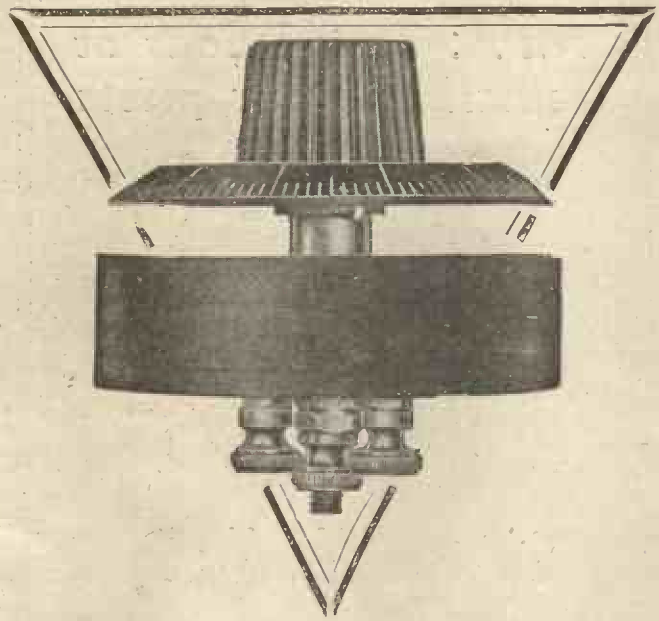

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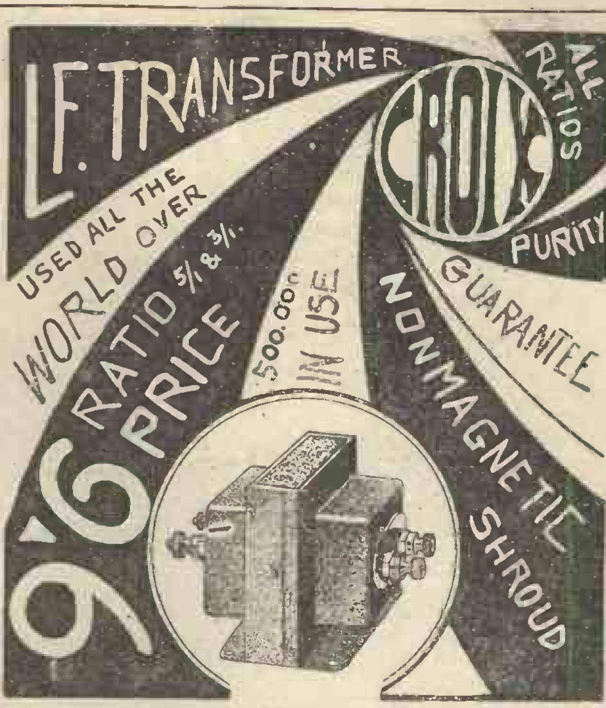

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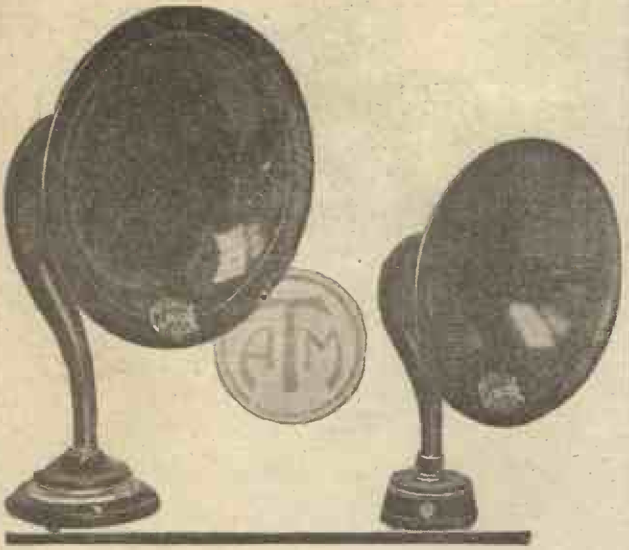

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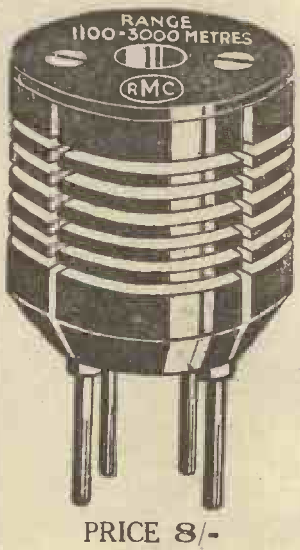

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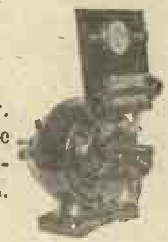

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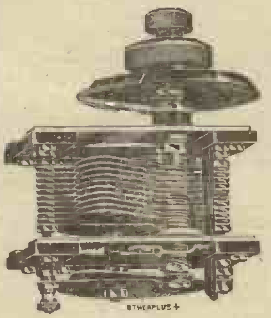

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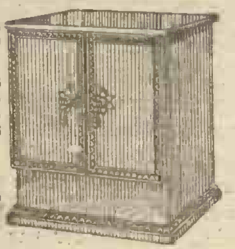

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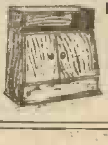

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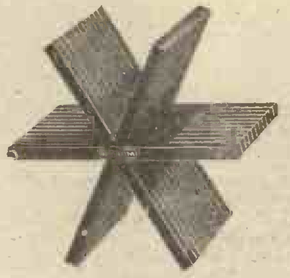

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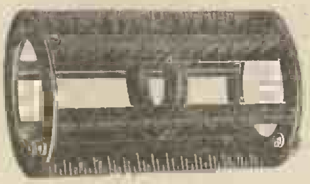

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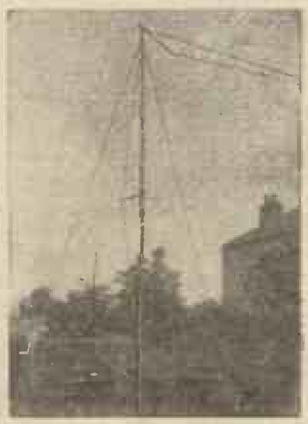

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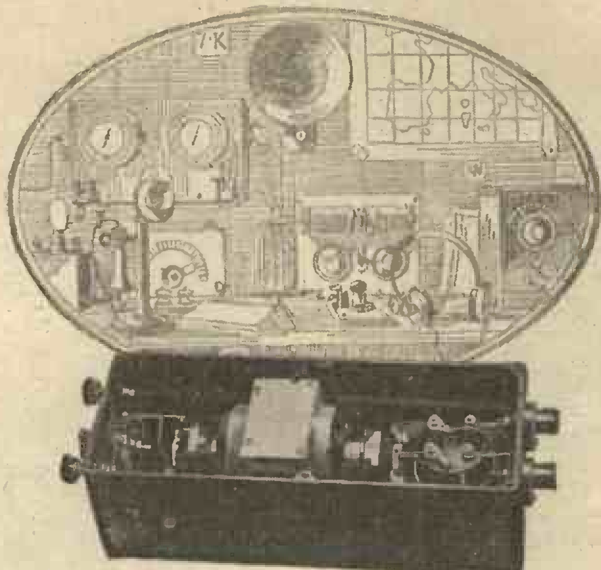

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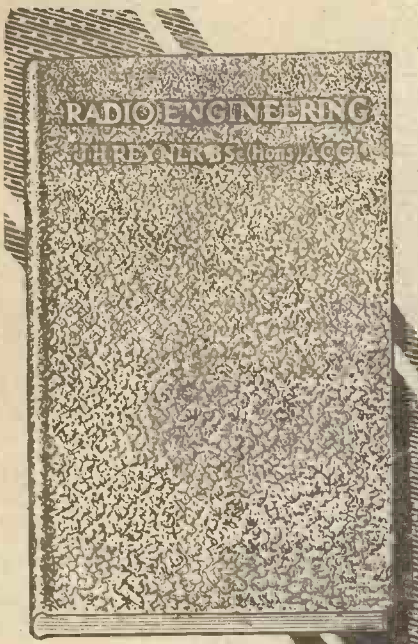

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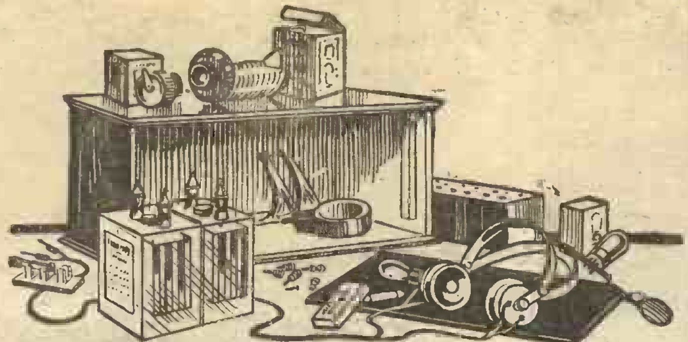

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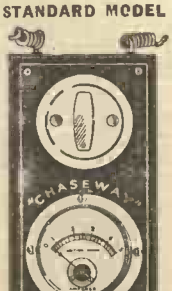

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