MODERN WIRELESS

June.

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Vol. III. No. 1. Edited by JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E. June, 1924.

Vol. III.

No. 1

AN ST100 SET WITH TWO H.F. VALVES.

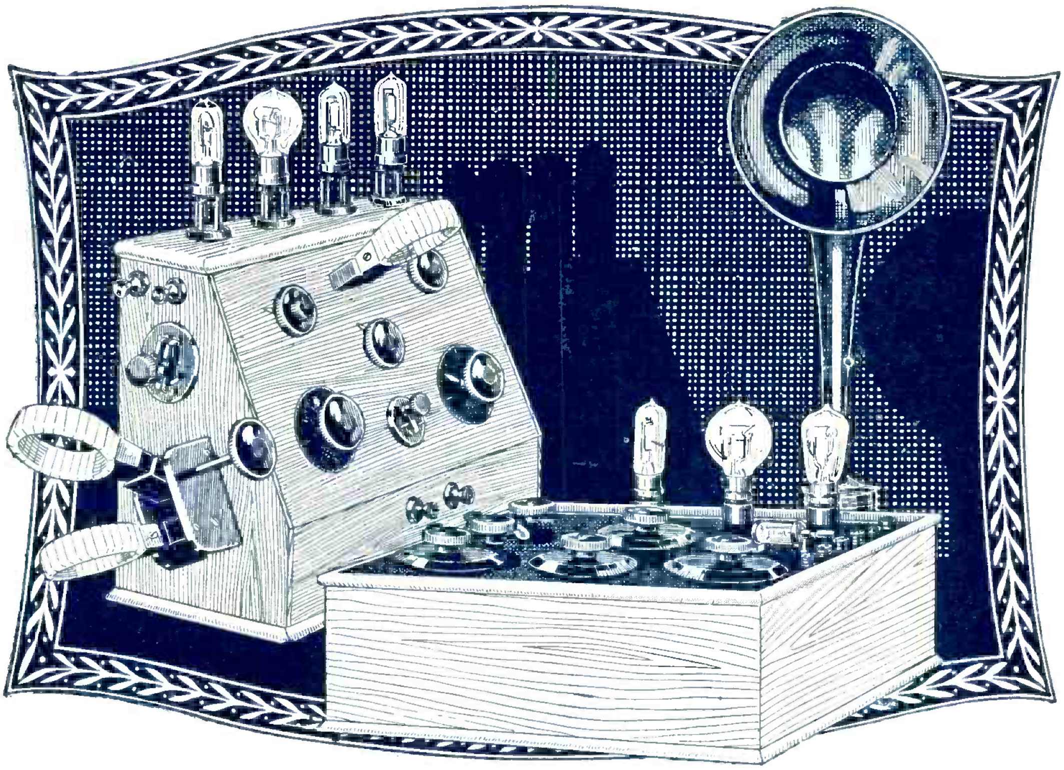
HOW TO BUILD A TWO-VALVE HIGH-TENSIONLESS RECEIVER.

A FIVE-VALVE LONG-DISTANCE RECEIVER. *By Percy W. Harris.*

HIGH-TENSIONLESS CIRCUITS EXPLAINED. *By John Scott-Taggart, F.Inst.P., A.M.I.E.E.*

UNUSUAL FAULTS. *By G. P. Kendall, B.Sc.*

How to Build : A New Crystal Set—A Single-valve Set—A Two-Valve Set.



No previous Radio experience needed.

EVERY Receiving Set described in this Book has been actually built by the Author and its performance thoroughly tested under various conditions.

The result is that any man wishing to make up a Set can read through the Book, study his local conditions, gauge his anticipated expenditure and make his choice. And when he gets down to the actual building he will find every item fully described just as if he were working side-by-side with the Author himself.

In addition, the Book also furnishes a complete course on set building—commencing with simple, inexpensive, yet thoroughly efficient, Crystal Sets and progressing to more ambitious multi-valve Receivers capable of spanning the Atlantic.

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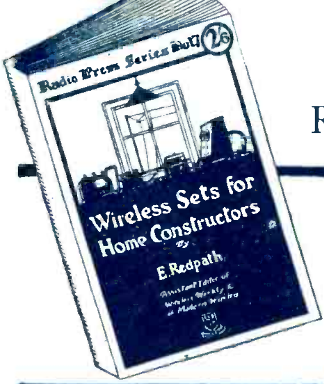
SHOWS HOW TO BUILD:

- Simple Crystal Receivers.
- An inductively-coupled Crystal Set.
- A two-valve Low frequency Amplifier.
- A two-valve Broadcast Receiver.
- A three-valve Regenerative Receiver.
- A single-valve Reflex Receiver.
- A three-valve Broadcast Receiver.
- A four-valve Universal Receiver.

Together with information as to the testing and operation of Receiving Sets.



RADIO PRESS LTD., DEVEREUX CT., STRAND, W.C.2

2/6

Wireless Sets for Home Constructors

By E. Redpath.

Radio Press Series No 17.

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Contents

MODERN WIRELESS

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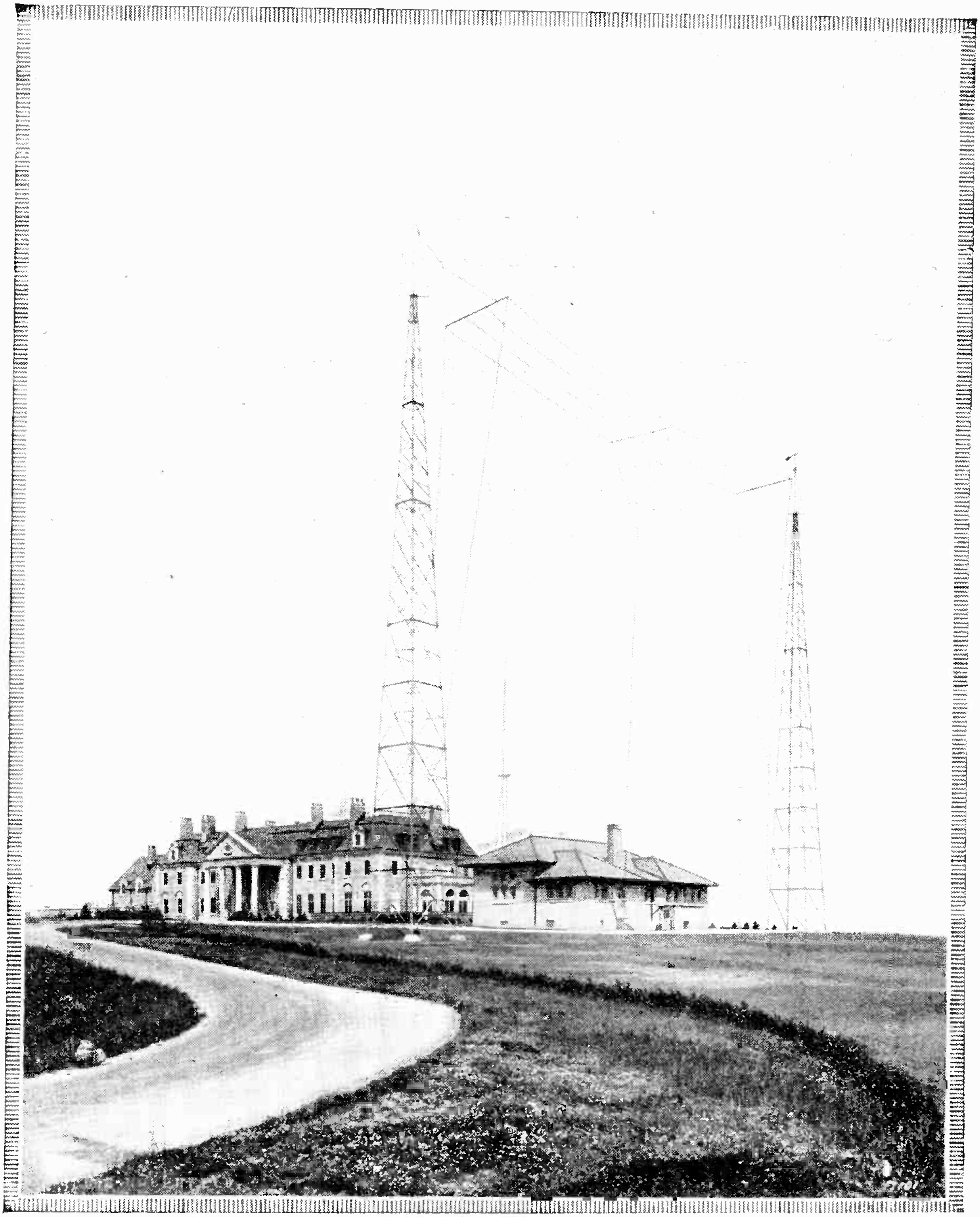
A Millionaire's Station.



This splendid aerial equipment, and the station beneath, are the property of an American millionaire, who possesses a broadcasting licence and sends out regular concert programmes for the benefit of listeners.

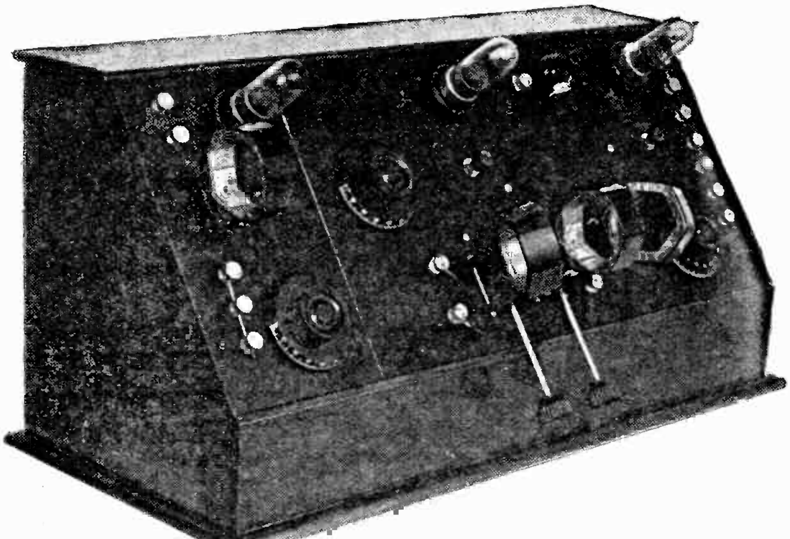


Fig. 1.—The set is built into the conventional sloping front cabinet.

Adding a High-Frequency Valve to the S.T. 100

A Highly Powerful Set Designed by THE EDITOR

To those who have tested the S.T. 100 circuit the following description of a set with an extra high-frequency amplifier will prove interesting. Those without experience of the S.T. 100 are advised to try that circuit first.

THE exceedingly large volume of sound obtainable from the S.T. 100 circuit has made the latter popular among those who like to have ample power to work a loud-speaker. This volume decreases fairly rapidly, however, at distances of over 50 miles from a broadcasting station, and many readers have expressed their desire for a circuit incorporating one more valve in order to bring in more distant stations with certainty at good strength.

The addition of a high-frequency amplifying valve will increase the range of the circuit and will make the reception of the distant stations an easier proposition.

The present set, a photograph of which is seen in Fig. 1, has been designed to give the maximum results, and the lay-out has been carefully considered, in order to prevent, as far as possible, any interaction between the parts. In the photograph a white line is shown drawn on the panel to indicate that on the left is the high-frequency amplifying portion, and on the right is the usual S.T. 100 with a modification, which will be discussed later.

A single-pole double throw switch serves to cut out the extra high-frequency valve if desired, the ordinary circuit being then in use. The terminals on the left are those controlling the aerial circuit, enabling constant aerial, series, or parallel tuning to be employed at will.

The condenser C_1 on the extreme left of Fig. 2 is the aerial tuning condenser, used when the high-frequency valve is working, while the condenser C_3 above the three-coil holder, to the left, is that tuning the secondary of a high-frequency transformer, coupling the first and second valves, which is formed by the coils L_2 and L_3, these being the left-hand movable socket, and fixed socket of the coil-holder, respectively. When the extra high-frequency valve is cut out by bringing the switch S_1 over to the X side, the extreme left-hand condenser C_1 and the coil L_1 are out of circuit, as is also the left-hand socket L_2 in the coil-holder, and this coil must either be withdrawn or moved well away from the other two; the condenser C_3 to the right of the white dividing-line now becomes the aerial tuning condenser. The right-hand socket L_4 of the coil-holder and the condenser C_4 on the extreme right of the receiver are those in the anode circuit of V_2, which is the first valve of the ordinary S.T. 100 circuit. The crystal detector is situated between the second and third valves of this receiver, and is of a particularly neat and efficient type, known as the "Eccentro."

Circuit Diagram

A diagram of the circuit arrangement of this receiver is given in Fig. 3, and it will be seen that the aerial circuit comprises the coil L_1 and the condenser C_1, the small fixed condenser C.A.T. being included in order that constant aerial tuning may be applied. The valve V_1 acts purely as a high-frequency amplifier, the amplified oscillations being passed on, *via* the coil L_3, which is closely coupled to L_2 in the anode circuit of V_1, to the grid of V_2. The high-frequency oscillations are further amplified by the valve V_2, and are then rectified by means of the crystal detector D. The rectified signals then pass through the transformer T_1T_2 back to the valve V_2, where they are magnified by this valve, and pass on to V_3 by means of the transformer T_3T_4, the low-frequency oscillations being thus further magnified. The receiver thus acts as a five-valve set, having two stages of high-frequency amplification, a rectifier, and two stages of note magnification, with the difference that the rectifier is a crystal, and one valve—namely, V_2—does the work of two. A great saving in valves and current is thus effected.

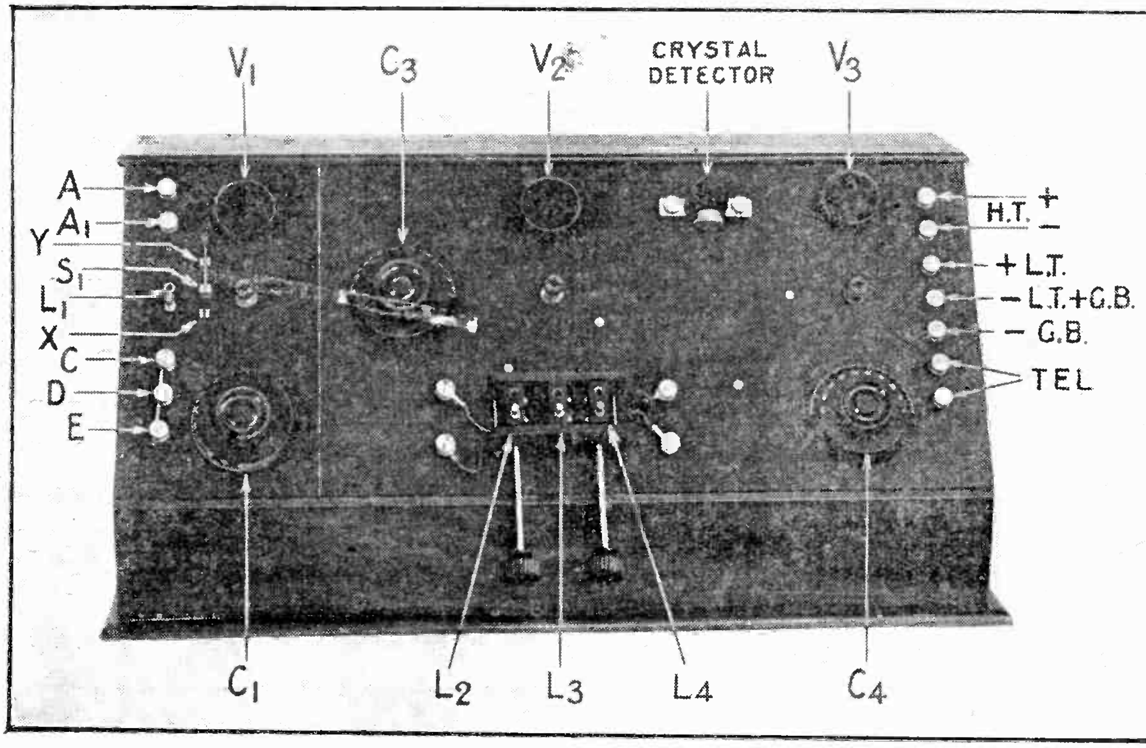


Fig. 2.—Front of the cabinet, with valves removed and the various components lettered.

Stabilising Resistance

It will be noticed that the stabilising resistance included in the usual design of S.T. 100 set has been omitted from this receiver. Should the constructor find that it is necessary, when using two valves only, to have this resistance, he may include a variable anode resistance of the order of 50,000 to 100,000 ohms by joining the grid of the second valve V_2 to one end and the positive of the low-tension battery to the other end of the resistance. A reliable make of fixed resistance may be used if desired, and in this case the value should be about 80,000 ohms.

Another modification of the original S.T. 100 circuit which has been introduced in this set is the condenser C_5, which is connected across the O.P. and O.S. of the low-frequency transformer T_3T_4. The object of this condenser is to increase the purity of the received signals, and it was found necessary with the transformer used that its value should be 0.001 μF. This value will vary with different transformers, and in some cases perhaps the condenser may be dispensed with altogether.

The method of coupling the extra high-frequency valve to the S.T. 100 circuit was suggested to us in April by Mr. H. L. Meyer, of Cavendish Square, who has obtained successful results with this type of circuit.

Reversal of Coils

It is desirable to reverse the direction of the coil L_2, in the anode circuit of V_1, in order to ascertain in which position the best results are obtained, and, in the set described, provision for such reversal has been made. Flexible rubber-covered leads join the socket of the coil-holder to two terminals on the panel, thus rendering the reversal of the coil a simple operation. Similar provision has been made in respect of the reaction coil L_4, in accordance with a practice frequently advocated in this journal.

Constant Aerial Tuning

Constant aerial tuning may be applied to the three-valve circuit by joining the aerial lead to terminal A, earth to E, and joining C, D, and E together by means of a piece of wire. The switch S_1 must be turned so as to make contact with the upper point Y. A circuit diagram showing the three valves in use with constant aerial tuning is given in Fig. 4.

Parallel tuning may be used instead of constant aerial tuning by joining the aerial lead to terminal A_1, leaving A free, earth to E, and

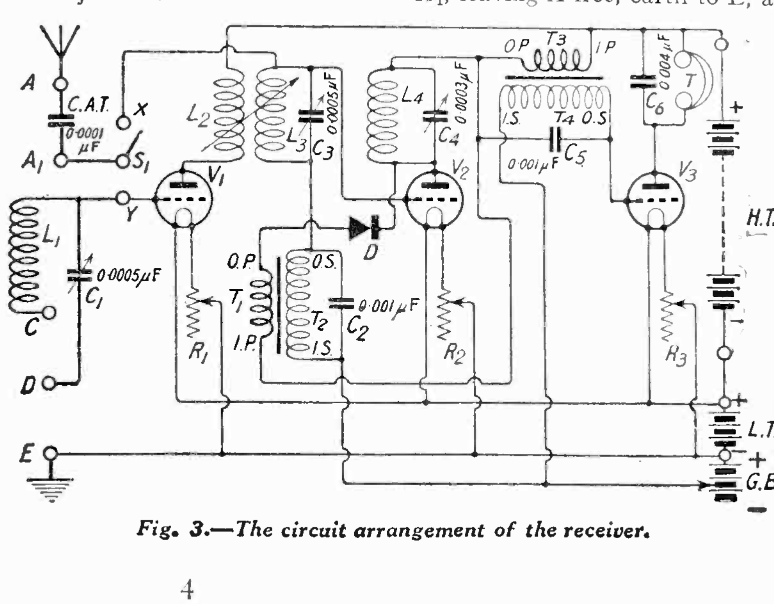


Fig. 3.—The circuit arrangement of the receiver.

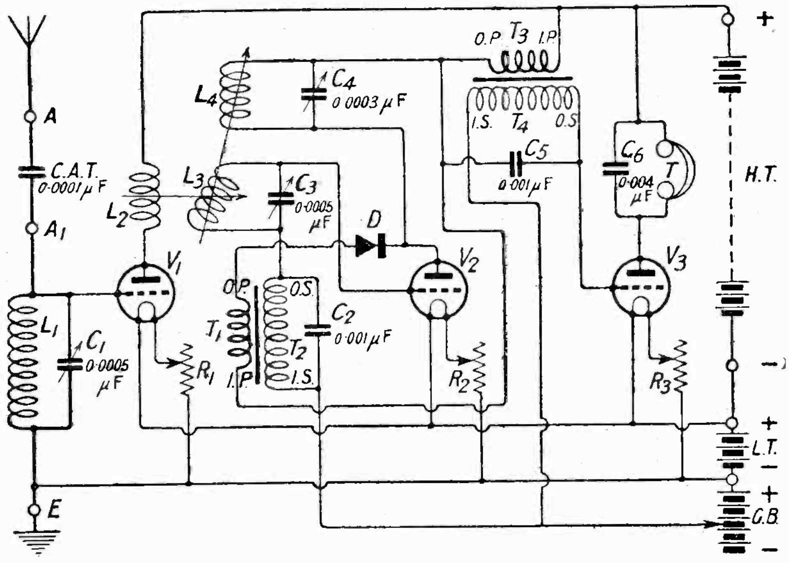


Fig. 4.—Showing how to connect up for three valves, using constant aerial tuning.

connecting C, D, and E together. S_1 must still remain in the upward position.

Series Tuning

Series tuning may be applied only when using the three-valve circuit, and is applied by joining the aerial lead to terminal D, earth to E, and connecting C to E, leaving both A and A_1 free. In the three cases given above, L_1 is the aerial tuning inductance and C_1 the aerial tuning condenser, all three valves being in use. When using the two-valve circuit, the switch S_1 is turned to make contact with the lower point X, and L_3 then becomes the aerial coil, and C_3 the aerial tuning condenser. In this case, only two forms of tuning are possible, namely, constant aerial or parallel tuning.

Constant aerial tuning is applied by joining the aerial to terminal A, leaving A_1, C and D free, and joining the earth to E. The aerial circuit is now tuned by means of the variable condenser C_3. If parallel tuning with the two-valve circuit is required, all that is necessary is to connect the aerial to A_1, earth to E, leaving A, C and D free, when the aerial circuit will be tuned by C_3 as before.

Components and Cost

A list of the parts necessary for the construction of this receiver, together with retail prices, will be found alongside. Although the constructor may already possess some pieces of apparatus which he would like to include, he is advised to adhere as closely as possible to the specification given, as a great deal of trouble may be experienced if unsuitable components are used. In any case no experimenter who has failed to get the full results from the S.T. 100 circuit should try to make this set.

The special valve holders used are of good design, there being no metal parts exposed, the capacity between the holders being small and the chance of leakage very remote. It is, moreover, practically impossible to short the filament of a valve across the high tension supply, when inserting the valve into its socket. When using Ediswan valves, however, care must be taken to ensure that good contact is made, as the pins on this type of valve are shortened, for safety, although this shortening is unnecessary when these holders are used.

The transformers used in this set have been found particularly suitable for this circuit, and may be used with every confidence. It is always very risky for an experimenter to vary the author's own design, especially in the case of a dual amplification circuit.

The Panel

The panel, which is of ebonite, measures 24 in. by 10 in., and may be ¼ in. thick, provided that additional support is given, in the middle of the longer sides, by means of fillets of wood fastened to the containing box. The panel used in this receiver is the same as that used in the three-valve dual receiver described in the April number of MODERN WIRELESS, the unwanted holes being filled in according to the method described in an article on page 747 of the May issue of MODERN WIRELESS entitled "Reclaiming Ebonite Panels." A fully dimensioned drilling diagram is given in Fig. 5, which shows the position of all the parts mounted on top of the panel. It must be pointed out in this connection that all dimensions are taken from the centre line of the panel, this being more accurate than dimensioning from one end. The positions of the various holes required should be marked on the panel by means of some sharp-pointed instrument, and a small indentation made where the hole is to be drilled, with a hammer and a centre punch, or, if the latter is not available, a nail may be used. The drill point is thus prevented from wandering, while no fear of cracking the panel need be entertained, provided that the punch is not given too heavy a blow. Drill all the holes of one size first, and then proceed to the next size, thereby saving much

COMPONENTS.	£	s.	d.
Cabinet (Wright and Palmer)	1	7	6
Panel 24 in. by 10 in. by ¼ in. (Paragon Rubber Co.) ..		15	0
2 0.0005 μF Variable Condensers (K. Raymond, new type) ..		11	10
1 0.0003 μF Variable Condenser (K. Raymond, new type) ..		5	3
1 Sonola L.F. Transformer (Ward and Goldstone)		17	6
1 Woodhall L.F. Transformer (Woodhall-Wireless Mfg. Co.) ..	1	3	6
1 Three-coil Holder (Goswell Engineering Co., Ltd.)		12	6
1 Coil Socket for panel mounting (Woodhall)		1	6
3 Lissenstat Minor Filament Resistances (Lissen, Ltd.) ..		10	6
3 Valve Holders (H.T.C. Electrical Co., Type A)		5	3
1 Eccentro Crystal Detector (W. Joanes)		8	0
1 0.0001 μF Dubilier Condenser		2	6
2 0.001 μF Dubilier Condensers		6	0
1 0.004 μF Dubilier Condenser		3	0
1 S.P.D.T. Switch, for panel mounting (K. Raymond)		1	3
18 4 B.A. W.O. Type Terminals (K. Raymond), 2 for 2½d., say		1	10
14 2 ft. lengths Bus Bar Wire (Sparks Radio Supplies)		2	4
Screws, rubber leads, etc.			6
Total	£7	15	9

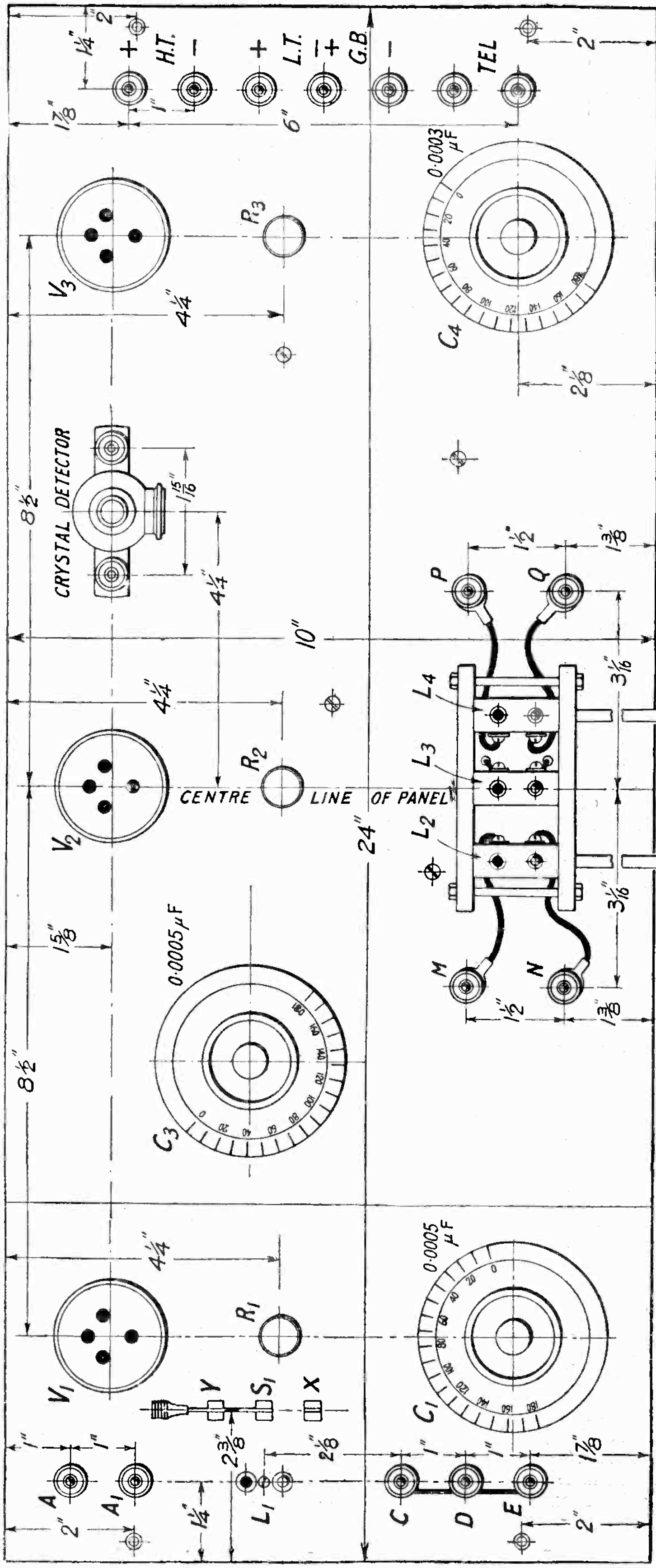


Fig. 5.—A scale drawing of the top of the panel, showing the positions of all the necessary holes.

time in changing drills. The holes shown are in the correct positions for the components used, but care must be taken, if parts other than those specified are employed, that the holes are drilled of the correct size for these parts. Four holes are drilled, two in each of the shorter sides, by means of which the panel is secured to the cabinet. The positions of these holes are seen in Fig. 5.

Mounting the Parts

When all holes have been drilled, the various parts should be mounted up, and it is recommended that they be placed in position according to weight. For example, start with the terminals, then proceed with the valve holders, filament resistances, and so on, leaving such parts as variable condensers and transformers until the last, thus keeping the weight down as much as possible while the panel is being turned about in the process of tightening nuts, and so on.

Wiring Up

Having mounted all the necessary parts, the constructor should proceed to tin thoroughly all points to which a wire has to be soldered, and then commence the actual wiring up of the receiver. The square-section wire used gives a very neat appearance to the back of the panel, and also there is less capacity between wires than when systoflex - covered wire is used. With a little care in bending the wire to fit exactly between the terminals, the constructor should find this wire almost as easy to work as the older method of thinner wire covered with insulated sleeving. The leads to the two movable coils on the coil-holder consist of rubber-covered flexible wire, secured under the screw-heads on the respective sockets, and terminating in spade tags, which are secured to the correct terminal on the panel. The leads to the fixed socket consist of the ordinary wire used for wiring up, pushed through holes in the panel immediately underneath this socket.

A wiring diagram is given in Fig. 7, and when this is consulted no difficulty should arise out of the wiring. Two photographs of the back of the panel are shown in Figs. 6 and 9, and give a good idea of the neatness of the wiring, besides helping to clear up any little points of uncertainty.

The Cabinet

The panel is mounted in a polished mahogany cabinet of the sloping front type, thus completing the handsome appearance of the

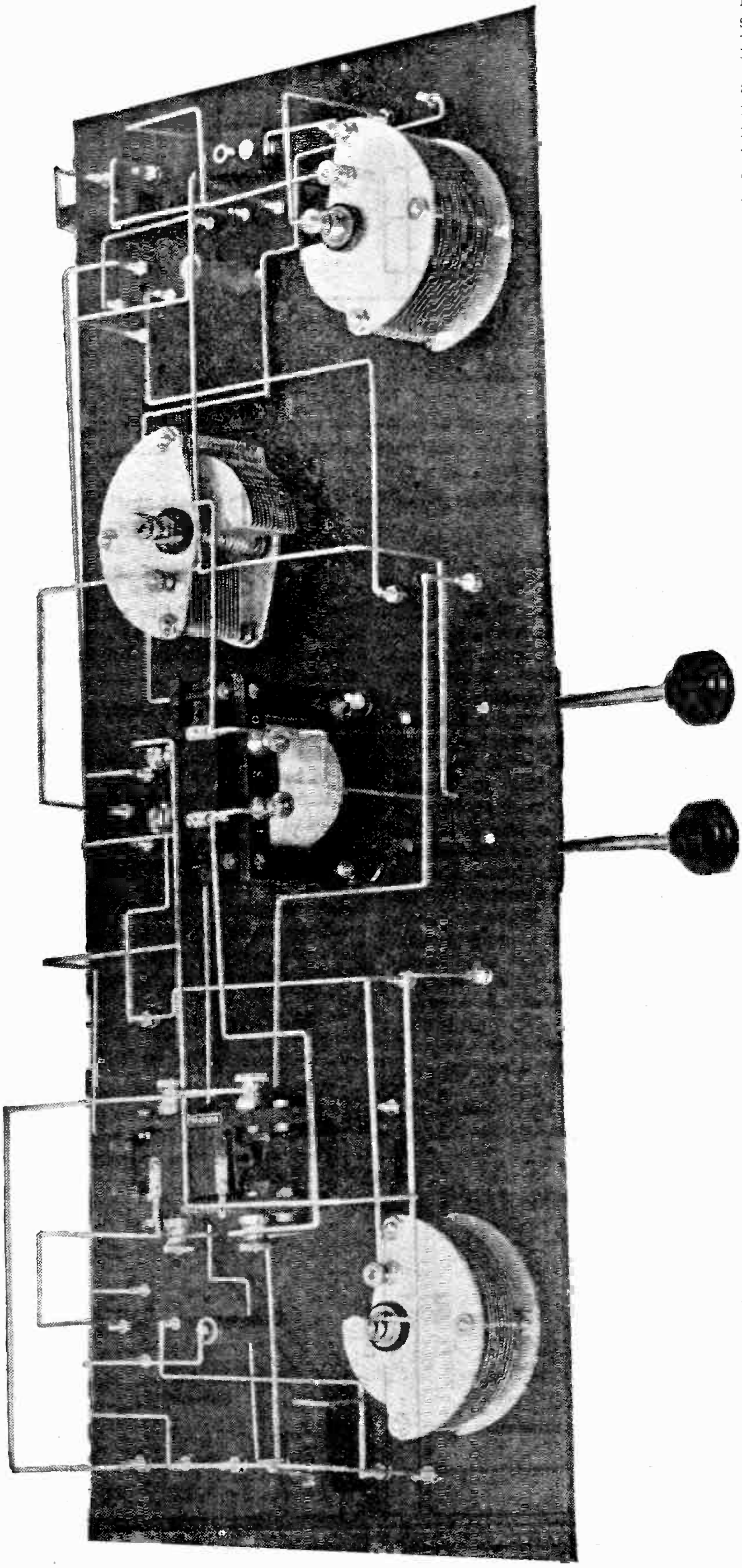


Fig. 6.—The underside of the panel, showing the wiring.

receiver. The cabinet, a dimensioned drawing of which is given in Fig. 8, was obtained from Messrs. Wright and Palmer, of Forest Gate, and is the same cabinet as was used in the Three-Valve Dual Receiver mentioned previously. For those who intend to make their own containing box the drawing given should furnish all the necessary information. The work is carried out in $\frac{3}{8}$ in. finished mahogany, the wood being cut according to the dimensions given. The two side pieces are best cut to size, $11\frac{5}{16}$ in. by $9\frac{3}{4}$ in., as a rectangle first, the bevel being cut off afterwards, with both the sides firmly clamped together, thus ensuring that the slope is the same on both pieces. As seen from the figure, small fillets of wood are secured to the inside of the front of the cabinet, to provide additional support for the panel, preventing the latter from sagging.

Coils and Valves

When using all three valves with the constant aerial tuning arrangement, the coil L_1 on the extreme left of the panel may be a Lissen No. 50 for broadcast wavelengths below 420 metres, above which a Lissen 75 may be used. The left-hand coil L_2 in the three-coil holder may be a Lissen 75, the fixed one L_3 a No. 50 (or a 75 may be tried for wavelengths over 420 metres), and the right-hand coil L_4 a 50 or a 75, according to whether the wavelength to be received is below or above 420 metres. When two valves only are in use, the middle socket on the coil-holder becomes the aerial coil, and when using constant aerial tuning, this should be either a No. 50 or 75, as explained above. The coil L_4 in the right-hand socket of the coil-holder remains a 50 or 75.

Any good make of valve may be used. Three Ediswan A.R. valves were used when the following Test Report was prepared.

Batteries

A high-tension battery of 100 volts should be used, in order to obtain the best results from the set, and this is connected, positive and negative respectively, to the top two terminals on the right-hand side of the receiver. The low-tension positive is connected to the third terminal from the top, and L.T. – to the fourth. A grid bias battery should be used, and its positive connected to the same terminal as the negative of the low-tension accumulator, the negative of the grid battery being connected to the fifth terminal in

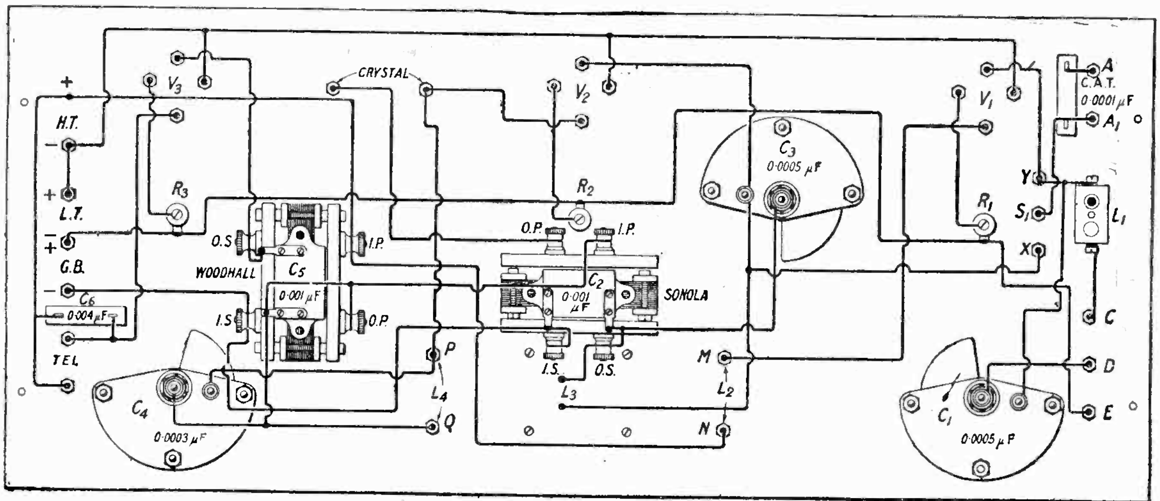


Fig. 7.—The wiring of the receiver. The lettering of the condensers, etc., corresponds with the circuit diagram.

the row. The loud-speaker is connected to the bottom two terminals in this row.

The grid battery, which appears to be somewhat of a mystery to some readers, may conveniently consist of a 15-volt high-tension unit, of the type in which tappings at every three or so volts are provided. Actually about 4½ volts negative grid bias is usually ample, and very often no extra grid bias is necessary, the terminals G.B. − and L.T. − G.B. + being shorted. The small Ever-Ready cell, size O, is eminently suitable for making up a grid bias battery, each cell having a voltage of 1.5 volts, thus allowing tappings to be taken from the battery at 1.5, 3, 4.5 and so on, providing a more or less even control of grid voltage. Ordinary flash-lamp batteries may conveniently be employed.

When using bright emitter valves, a 6-volt accumulator should be used, and it is advantageous to use an accumulator with dull emitter valves, as the discharge current is much more steady than is that of dry cells. In this case a 4-volt accumulator will be found satisfactory.

Testing the Set

When complete, the receiver may be connected up to the aerial and tested. The filament and high-tension batteries should be connected, as explained above, to their respective terminals. In order to test whether the S.T.100 part of the set is in correct working order, start testing with constant aerial tuning on the two-valve circuit when the local station is operating. Insert a 50 coil in the middle socket L_3 of the coil-holder, and a 50 in the right-hand socket. No coils are to be inserted in the sockets L_1 and L_2. Make sure that the cat-whisker is touching the crystal, and turn the single-pole switch S_1 so that it is pointing downward and making contact with the point X. The grid bias terminals G.B. + and G.B. − should be shorted when first using the set. Turn on the filaments of the valves V_2 and V_3, leaving V_1 switched off, and tune on the condensers C_3 and C_4, keeping the coil L_4 well away from L_3. The local station should be heard at good strength, and should become louder as the coil L_4 is brought closer up to the fixed coil L_3. If this is not the case, the leads to the moving coil should be reversed by changing over the connections to the terminals PQ.

Operating the Detector

The Eccentro is a totally enclosed crystal detector, the cat-whisker being brought up to the crystal by rotating a knob on the top of the barrel of the instrument, the crystal cup being inserted in the front of the barrel and being rotatable. The knob on the top has a red mark engraved upon it, and this mark must be brought as far away from the crystal cup as possible before the latter is rotated, or damage will result. The knob on the top of the detector should be slowly rotated until a sensitive spot on the crystal is found.

Testing the High-Frequency Amplifier

When the S.T.100 part of the receiver is operating efficiently, the

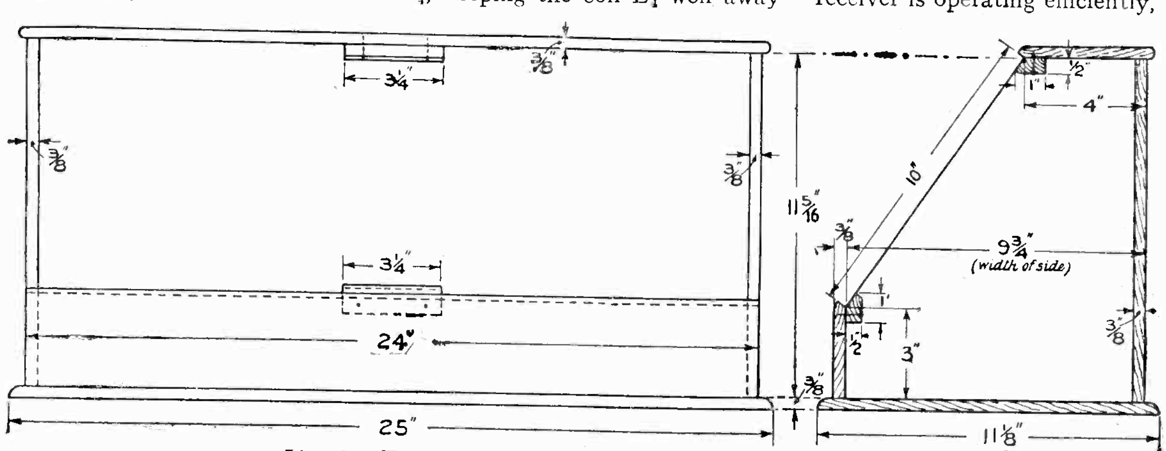


Fig. 8.—Two views of the cabinet, with full dimensions.

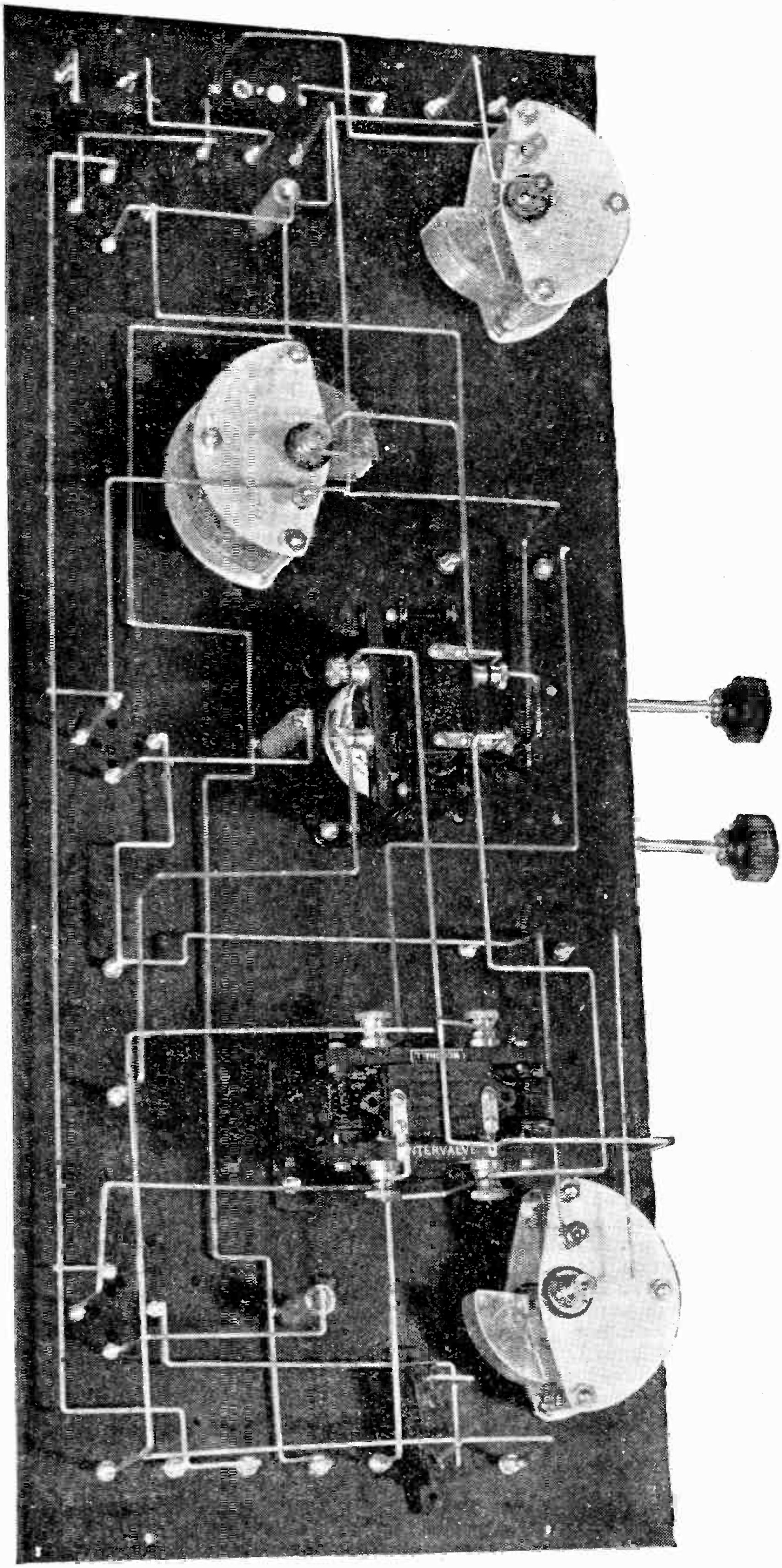


Fig. 7.—Another view of the wiring, looking from another angle. The dispositions of the parts are clearly seen.

extra high-frequency amplifier may be brought into circuit. Start testing with constant aerial tuning and the following coils in the sockets indicated :—

L_1: 50 below 420 metres, 75 above.

L_2: 75.

L_3: 50 below 420 metres, 75 may be tried above.

L_4: 50 below 420 metres, 75 above.

Turn the switch S_1 so that it makes contact with the upper point Y, and turn on the filaments of all three valves. The coil L_2 should be as close as possible to L_3, while L_4 is kept well away from L_3. Tune on C_1 and C_3, and it will be found that C_3 will be adjusted to a lower capacity than when using only two valves, for a given station. Keeping L_4 away from L_3, leave C_4 as it is, and tune on C_1. Bring L_4 close to L_3 and retune on C_4. A little practice will enable the experimenter to pick up the distant stations quite easily, but it must be pointed out that the coils L_4 and L_3 should not be coupled too tightly, or interference will be caused to near-by listeners.

Blue Prints

For the convenience of those readers who prefer working to full size drawings blue prints of the drilling diagram (No. 41A) and of the wiring (41B) have been prepared, and are obtainable from the Sales Dept. of Radio Press Ltd., price 1s. 6d. each, post free.

THE EDITOR'S TEST REPORT

The results with this set were very powerful, the H.F. stage carrying out its duties very effectively. The fullest loud-speaker results were obtainable ten miles away from 2 LO using only a 5 ft. aerial. A 10 ft. indoor aerial at seventeen miles from 2 LO also gave good loud-speaker signals. On a standard aerial at seventeen miles the results were far too loud for domestic purposes. The set was inclined to be buzzy without the 100,000 ohm resistance connected across the grid and positive of the filament accumulator. This resistance could be connected outside, if desired.

Distant stations are somewhat difficult to tune in on account of three variable condensers.

J. S.-T.

Unrest

THERE is considerable unrest in the world of wireless men at the present time. By this I do not mean that they are thinking of rebelling against the regulations or of tarring and feathering the Postmaster-General, or anything of that kind. I mean simply that about 99.9 per cent. of them are engaged in rebuilding their sets. Now rebuilding a set is not half such a simple business as the uninitiated might suppose. In fact, it brings out the quality of indecision which we noble males claim does not as a rule form part of our character. You know how we are accustomed to laugh quietly at our wives when they are in the throes of choosing new garments. "I can go to 'my' tailor's" say we, "and in the brief space of twenty minutes choose the cloth for three suits and be measured for them. Now you take a whole morning over buying a scarf or a pair of gloves." We rub in in rather a superior way the manner in which our wives will have a whole draper's store turned upside down for them, departing eventually with a winning smile and packet of pins whilst the salesman sinks groaning to the floor and cries aloud for first aid. But the indecision of a woman even when she is choosing a hat is as nothing to that displayed by the average man when he is endeavouring to select the ideal circuit for his new set. He comes home every evening with his pockets crammed full of wireless books and papers. He writes to every manufacturer for a catalogue. He visits all his friends and consults them. He makes up his mind three times a day and changes it as often. He fares forth and purchases an ebonite panel as big as a table top, marks it out, and then repents. With infinite labour and the use of vast quantities of emery paper he removes his scribed lines. Then he begins all over again. At last he has something which seems nearly perfect. He scratches with his scriber; he plies his trusty breast drill; he mounts up most of his components, only to find that unless he fixed the first L.F. transformer to the underside of the A.T.C. or something of that kind, there is no possibility of getting them all in.

A Soft Job

With a sign of resignation he decides that the spoilt ebonite will come in quite handy for making up small gadgets later on. Another monster slice is purchased, and this time he resolves that he will not rush at things. It is usually at about this time that he reads in the papers that in three days the finest wireless programme of the year will be put on, whilst his wife informs him that she has invited a dozen friends to come and hear it. In a frenzy he rushes to his workshop, flings things together almost anyhow, and probably produces a set that surpasses his fondest expectations by its performances. This, of course, is only a temporary affair which must come to pieces at once when its work has been done. You will find that most wireless enthusiasts have enormous supplies of ebonite for gadget making! Meantime the manufacturers of this beautiful insulating material prosper and wax fat and drive about the country in Rolls-Royce cars. A hard-up ebonite manufacturer is a rarer bird than a dead donkey. It has been calculated by Professor Goop that if all the panels discarded during the last twelve months were piled into one enormous heap, it would be nearly as tall as the stories told by our most enthusiastic receivers of trans-atlantic broadcasting.

A Friendship Severed

It is this troublesome business of choosing a new set which has been responsible for the terrible civil strife that is now raging in our little town. Two of the most prominent members of the wireless club are Rear-Admiral Whiskerton-Cuttle and General Blood Thunderby, who, until recently, have been the closest of cronies. There has always been as one might expect a friendly rivalry between the representatives of the fighting services, but the warrior and the salt formed a close alliance with the object of proving to the rest of us that mere civilians were simply nowhere. Naturally they both took up wireless in its early days. The Admiral is an expert at splicing ropes and hoisting spars and heaving ho and things like that, so that it was natural for him to help the General in the erection of his aerial. The soldier man, on the other hand, has more workshop skill than the other, and used always to do the sailor's little drilling jobs and so on. Whilst they were going through the early stages of radio-mania all was well.

Progress

They progressed in perfect amity from crystals to single valves, and then went on to make bigger and bigger straight circuits. The coming of the Armstrong and Flewelling circuits dealt their friendship rather a shrewd blow, for Blood Thunderby became a strong Armstrongite, whilst Whiskerton Cuttle pronounced emphatically in favour of Flewelling. Night after night they would meet in one or the other's sanctum to argue the matter out. They would demonstrate to each other the wonderful capabilities of their super sets, whilst the rest of us had to close down owing to the whistles and banshee wails with which the local ether was filled. And if the ether was filled with sound, so was the air later in the evening as they conducted their argument.

> And all night long the noise of
> battle rolled,
> From out the windows of the
> wireless den.

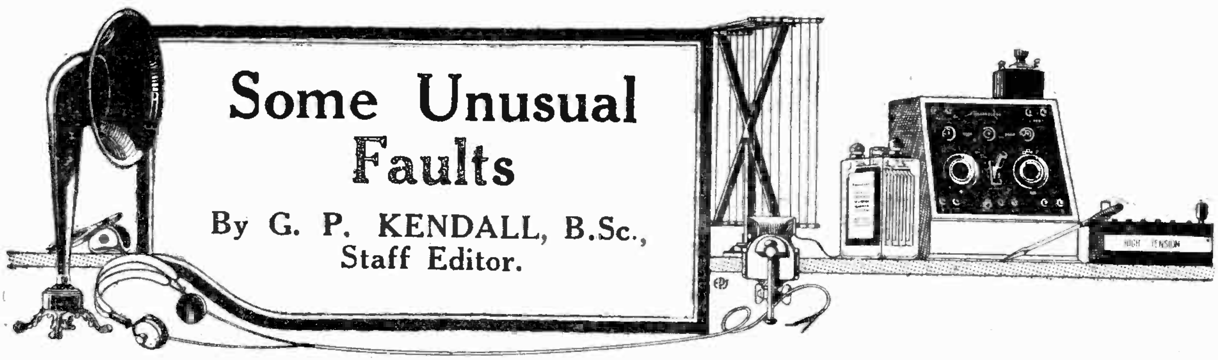
There was something like a reconciliation between the two when we had our little row at the wireless club, for then the two joined forces in attacking the committee, the General asserting loudly that the club was going to the dogs, and the Admiral urging us in what the newspapers call bluff breezy sailor talk to sack the lot. We thought for a time that they were going to patch it up for good and all, and I think that they might have done so had it not been for the flood of complicated circuits which were shortly afterwards let loose upon the world. Each of the pair began at once feverishly to redesign. Unable to make up his own mind the General determined to make up the Admiral's for him, whilst Whiskerton-Cuttle, equally undecided, left no stone unturned to convince the warrior that the indecision which he showed was unworthy of the traditionals of the army and that it was imperative that he should construct a colossal Super pliodyne. The rest of us strove to persuade them both to go in for something simpler, for we foresaw that the welkin-rending properties of untamed super circuits in the hands of fierce fighting men might well make it necessary for us to give up wireless altogether. Alas, it was of no avail. They both built these terrible things, and each has reported the other to the Postmaster-General as a violent and confirmed oscillator. The strife rages fiercely and there are no signs that peace is very likely to reign. They cut each other dead in the street, and at the club the General never misses the chance of referring scathingly to well-meaning but wooden-headed sailors, whilst the Admiral usually gets out something about the amazing lack of common-sense which he asserts is the hall-mark of the junior service.

For this Relief . . .

I am glad to say that the mania for super-supers did not last long, and we can now hear ourselves think once more when our sets are working. It has been succeeded by constructivitis in a very marked and satisfactory form. Each of the rivals is now so busy in building new sets and new gadgets that he has no time at all for "broad-catching." No set ever reaches completion; therefore we are safe. Just as the finishing touches are about to be added it occurs to the maker that it would be vastly improved by the addition of a switch here or a potentiometer there. He promptly pulls it to pieces and begins anew. General Blood Thunderby comes to the wireless club and tells us that he will have his set working on the following evening. Then we keep him talking whilst an emissary is sent to fetch Ponderby, who is always full of new ideas. Ponderby, who knows what is expected of him, strolls in quite casually and says, "Evening, General, how is the set getting on?" "Finished to-morrow," says the warrior proudly and proceeds to describe it. Ponderby listens intently until he pauses for want of breath. Then he adroitly says, "Ah, but had you not thought of fitting variable grid-leaks?" That does it. Blood Thunderby swears that variable gridleaks are no use, but we know that the seed has been sown and that it will bear fruit. On the morrow if you visit his workshop you will find him altering the positions of his components to make room for them, and drilling holes for their reception. He posts an order for them, and we have a respite of at least three days, during which time Ponderby thinks of something else to suggest.

The Problem of Whisker Cuttle

The Navy is a little more difficult to deal with, for somehow or other the admiral has got wind of our methods of keeping the General in order, and sympathises thoroughly with them. In fact, we have had several most valuable suggestions from him; one of them kept Blood Thunderby busy for nearly a fortnight. It consisted of an entirely unworkable addition to his circuit which took him a week to make, whilst he spent the best part of another trying to find out why it would not function. The way in which, metaphorically, of course, we sit upon the admiral's head is most effective, and if it is a little expensive at times, it is well worth it. He, I should explain, is what we may call a local patriot. He never buys things out of the town, but orders them always through the small electrical shop in the High Street. It was this habit of his which gave Gubbsworthy the inspiration which has delivered him into our hands. We formed a secret society, the S.K.R.A.B. — The Society for Keeping Rear-Admirals Busy. Our first step was to see that he was elected chairman of every possible organisation, from the parish council to the committee of boy scouts. This ensures that he has not more than two days a week to himself. Next we sent a deputation to the aforementioned electrician and hatched a conspiracy with him. If the admiral orders a panel 54 in. by 33 in.—"and, mind you, it must be exact because I have got the cabinet made"—it is delivered at the end of three days an inch too small all round. He takes this back livid with fury, and demands another in its stead. The second, when sent round, is found to be more diamond-shaped than rectangular. The S.K.R.A.B., of course, pays for the spoilt panels, which are cut up and divided amongst the members. In the same way, if he wants a .001 variable condenser, he gets a fixed one of three times that value, and the mistake cannot be rectified in less than a week. Sometimes he goes into the shop and actually sees the order written, so that he knows that it is right this time. When this happens he is horrified to hear some days later that the gadget he requires is out of stock, but that they are making him one, which he may expect to receive in about a month. Naturally he raves at the club about the stupidity of local tradesmen. When this happens, Ponderby, Gubbsworthy and General Blood Thunderby, who has been made a member of the S.K.R.A.B., urge him strongly to give up attempting to deal in the town and to purchase all his requirements by post. The very fact that Blood Thunderby supportt this suggestion is quite sufficiens to make the Admiral turn it down at once. Such is his local patriotism that he will go on buying from the shop in the High Street till the cows come home, and so long as he does so life is worth living for the rest of us. It is really great to be beckoned across the road by the Admiral, who whispers into your ear some perfectly fiendish new idea for his rival's set, and later on meet Blood Thunderby, who, after making the secret sign of the S.K.R.A.B., unfolds briefly his latest plan for interfering with the Navy's supplies of raw materials. It is sad, of course, that a long standing friendship should have been broken up, and when the first breach occurred, we all endeavoured to bring them together again. But now we glory in the strife, for we see in it the only way of ensuring peace and tranquillity for ourselves.



Some Unusual Faults

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

AMONG the things which sometimes deter the beginner, and sometimes even the more experienced experimenter, from starting upon the construction of a new set perhaps the most serious is a feeling that there is always a chance that the set won't work when finished. The constructor usually knows, either from his own painful experience or that of one of his friends, that it is quite possible to follow a perfectly reliable design with entire accuracy, using materials of good quality, and yet find oneself possessed of a set with some obscure fault at the end of one's work. Skill in fault-finding being an accomplishment usually possessed only by the fairly experienced constructor, it is not surprising that the relative novice occasionally hesitates to start building a set, very naturally disliking the possibility of placing himself in the humiliating position of having to make a set and being unable to find out why it doesn't work.

No doubt experience alone can give that confident feeling possessed by the old hand, of being able to locate and clear any fault, however obscure, but a few hints on the general methods of trouble-tracing do a good deal to remove the sensation of helplessness which afflicts the novice in a difficult case. It is outside the scope of the present contribution to consider methods of fault-finding in detail, and it must suffice to say that there are four chief classes of faults :—

(1) An error in wiring.
(2) A defective connection (a badly soldered one, for example).
(3) A defective component.
(4) A defective accessory, such as a valve, tuning coil, 'phones, etc.

The location of the first type is usually easy, being merely a matter of comparison with the original wiring diagram, but the second usually calls for special methods of testing, one of the most useful of which I propose to detail later. The fault can often be located by anyone possessing sufficient knowledge to recognise the symptoms to which it gives rise, but lacking such experience systematic testing is the only course.

Similarly, with a case of trouble in a component part, such as a "shorted" fixed condenser, or a break in the windings of a low-frequency transformer, tests are usually necessary, although the alternative method of systematic substitution of parts *known* to be in order for those under suspicion may sometimes be preferable. This latter method is probably the best to adopt in the case of the fourth type of fault, since such accessories as valves are almost impossible for the user to test, and by far the best plan is to substitute others known to be in working order.

The purpose of this contribution is really to give a series of examples of the more difficult type of fault, all these cases being ones which I have actually met with recently, since a study of typical cases is of the greatest assistance to anyone who is faced with a difficulty, and I propose to explain in each case the methods which led to the detection of the fault. In order to do this, however, it is first necessary to explain one of the simple methods of testing which I employ—namely, the 'phones and dry cell method.

Testing with Dry Cell and 'Phones

This method of testing is chiefly of use in detecting broken connections and short circuits, but other applications will present themselves to the user. It is probably the simplest and easiest method of testing a defective set, and a little ingenuity enables one to locate all sorts of faults by its aid. The reader will be aware that if the tags of a pair of telephones are joined across a dry cell strong clicks will be heard on making and breaking the circuit, and this is the indication which we use in testing. One tag of the 'phones is permanently connected to one terminal of the dry cell, and the other is left free. The free tag and a wire from the other terminal of the dry cell can then be touched upon all the points in the circuit which *ought* to be joined together, and clicks should be obtained. If no breaks are found in the wiring, one then proceeds to test all the points which ought *not* to be joined together; a click (other than a faint one) in this case denotes a short circuit. This understood, we can proceed to consider

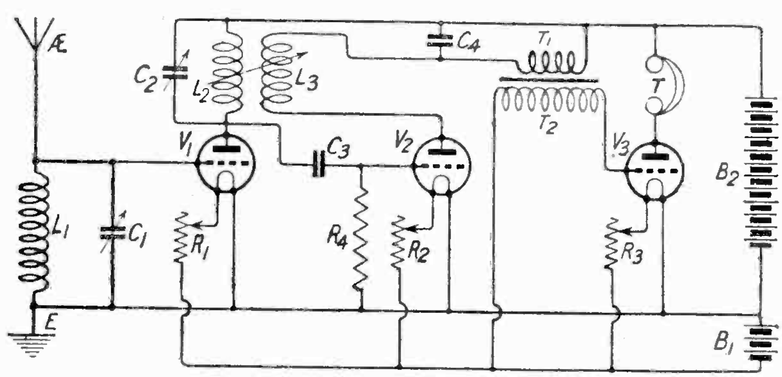


Fig. 1.—A circuit in which a break in the aerial circuit may produce very peculiar symptoms,

some instructive and unusual faults.

Case No. 1

About a month ago a three-valve set closely resembling the "all-concert" set was brought to me which presented some very peculiar symptoms. Signals were weak, and the set was apt to oscillate in an uncontrollable manner, but the most curious phenomena were observed in the aerial circuit, where it was observed that it was quite immaterial what size of coil was used. Further, it was presently discovered that no difference was made by removing the coil altogether! The only effect produced by varying the aerial condenser was to weaken signals as the capacity was increased, the strongest signals being obtained at the zero end of the scale, irrespective of the size of coil in use.

Since the trouble was evidently located in the aerial circuit the first step was to test this circuit for continuity, and the dry cell and pair of 'phones were brought into action. A coil was inserted in the aerial socket to complete the circuit, and the free 'phone tag was touched upon the aerial terminal and the wire from the dry cell upon the earth. Dead silence, indicating a break. The panel was then taken off and detailed tests were made of each part of the wiring of the aerial circuit.

The circuit of this set is given in Fig. 1, while the wiring of the aerial circuit is illustrated in Fig. 2.

The first test was between the aerial terminal (A in Fig. 2) and the grid (G) of the first valve, a good click being obtained. Tests between A and the point B (fixed plates of aerial condenser), between the earth terminal (E) and the moving plates (C), and between E and the point F (one pole of the coil socket) were then made, and showed no fault. When the test was applied between A and the point D (other pole of aerial coil socket), however, it was found that no click could be obtained and break in the circuit being thereby indicated. Examination of the soldered joints showed them to be O.K., and therefore attention was directed to the coil socket, and here the trouble was found: the screw under whose head the wire was fastened was so short that by the time it had been withdrawn far enough to permit of the insertion of the wire its inner end no longer made contact with the metal part of the coil socket, but merely gripped in the ebonite.

Case No. 2

This example will illustrate the fact that the combination of two perfectly simple faults may produce phenomena which are so exceedingly puzzling that they may set one looking for exceedingly improbable defects, unless one possesses some simple means of testing. The receiver in question employs practically the same circuit as the one which we have just been considering, and the following symptoms were observed. There was a total absence of signals, but a continuous rushing and crackling noise was heard. This, in itself, was puzzling, since those faults which usually result in crackling noises are not in themselves sufficient to entirely prevent the reception of signals. Common causes of such noises, for example are a defective high-tension battery, bad insulation at some point upon the panel or in the valve sockets, a defective grid leak, or a partial break in the windings of either the telephone receivers or a low-frequency transformer.

Substitution of other valves, coils, high - tension battery and telephone receivers showed that the trouble was in the set itself, and therefore the wiring was slightly altered so as to cut out the low-frequency valve, leaving only the high-frequency and rectifier in circuit. The noise continued, and therefore the low - frequency circuits were exonerated.

The telephones and dry cell test was then applied over the whole of the circuit, without the slightest indication of a break or a short circuit at any point, and the matter became more puzzling than ever. The next step, obviously, was to try in a rather haphazard manner eliminating some of the possibilities which might be giving rise to the noise. Eventually the grid leak was removed from circuit, and then it was found that the noise entirely ceased, indicating that one of the quite common faults was present in combination with some other which was responsible for the absence of signals. Since there was no break of any point in the circuit, as indicated by the telephone test, and none of the condensers were shorted, it was evident that some fault must be present of a type whose presence would not be revealed by the telephone test. Practically the only point at which such a fault could exist were the various condensers, since the telephone would only reveal here a shorted component. They do not indicate a break between the external terminals of the condensers and the plates within, and therefore the experiment was tried of replacing the grid condenser which was the most likely to be giving trouble, with a condenser which was known to be in order, and signals were immediately received as well as could be expected without a grid leak. The insertion of a good leak was then sufficient to enable the set to give the results which had been hoped for. Cases so involved as this one, of course, are not very common, but it is well to be prepared for them.

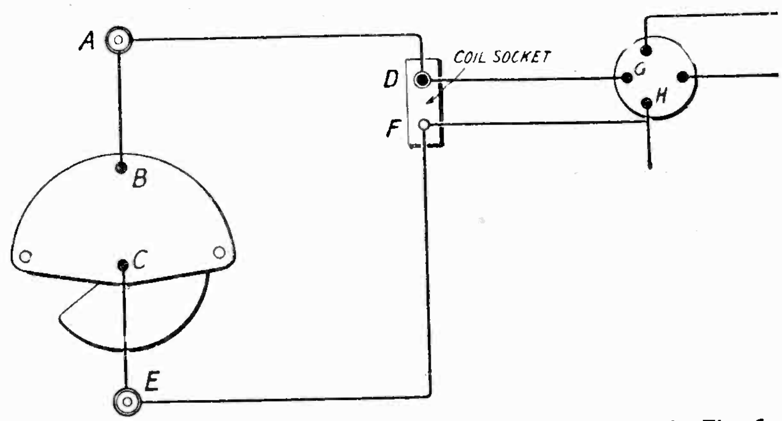


Fig. 2.—Part of the wiring of the set whose circuit is given in Fig. 1.

Case No 3

This case is perhaps scarcely correctly included under the heading of "Some Unusual Faults," but it has such a valuable and obvious moral. The subject was a reflex receiver employing three valves, the first being a combined high- and low-frequency amplifier, and the second a rectifier. The set was giving very poor signals, and the owner was very much perturbed by the fact that he had discovered that he could turn out the filament of the rectifying valve without making the slightest difference to the signals. He imagined that there must be some very serious mistake in his wiring to produce such a state of affairs, but the trouble was really very much simpler. The cause was actually rectification on the part of the first valve, so that little or no high-frequency amplification was obtained, and the set was simply functioning as a poor rectifier, followed by one stage of low - frequency amplification, this latter being given by the third valve. Questions elicited the fact that ordinary all-purpose receiving valves were being used, with a plate potential of 60 volts, and that a negative bias of about 5 volts was being applied to the first valve, and this might, and indeed has been known to, give rise to just such effects as this. Increasing the H.T. voltage to 120 volts completely removed the trouble.

Another case in which just the same phenomena were observed was the result of the employment of a soft Dutch valve as the first combined high- and low-frequency amplifier, together with an unsuitable plate voltage.

Case No. 4

This receiver was one possessing only two valves, one detector with reaction and one low-frequency amplifier. Although only one stage of low - frequency amplification was used most persistent low-frequency howling was occurring. It should perhaps be explained at this stage how it was decided that the howling was taking place in the low-frequency circuits, since this discrimination is one which often has to be made.

The discrimination is made by bringing the reaction coil right out from the aerial coil, and observing whether alterations of filament current of the low - frequency valve make any difference in the pitch of the note. If the howling is taking place at low-frequency such variations in pitch will usually take place, and, further, alterations of aerial tuning will leave it quite unaffected.

The particular fault which was present in this case is one which it is exceedingly difficult to locate by means of any system of testing, but it is one which having once been experienced is never forgotten. I had previously discovered that the use of a very high internal resistance high-tension battery will produce just this effect in a circuit of this type, and therefore the first accessory which I investigated was this battery. The method of testing was quite simple, but unfortunately one which is not usually possible to the experimenter. Measurement of the high-tension voltage was first made by means of a volt-meter of very high internal resistance. The result was practically the full reading which might have been expected from a number of cells in use. Upon a further reading being taken with a comparatively low internal resistance volt-meter (this being simply one of the cheap types sold at 7s. 6d.) scarcely any deflection at all was observed. The obvious inference was a high internal resistance in the battery, but its location proved unusually difficult.

The battery consisted of an assembly of separate flash-lamp refills, connected together by means of some of the patent strip connectors now upon the market. Each individual refill tested out quite satisfactorily by means of a small flash-lamp bulb, and it therefore seemed that the trouble must be in one of the connections. The trouble was ultimately found by the use of another low resistance volt-meter, reading up to 12 volts, applied across the ends of two of the refills at a time, the expected readings being 9 volts. A pair was ultimately found which gave scarcely any reading at all upon this volt-meter, although their individual readings were quite up to standard. Closer examination then revealed the fact that there was a patch of verdegris immediately beneath the clamping screw of one of the connecting strips, and upon the removal of this the fault was cleared.

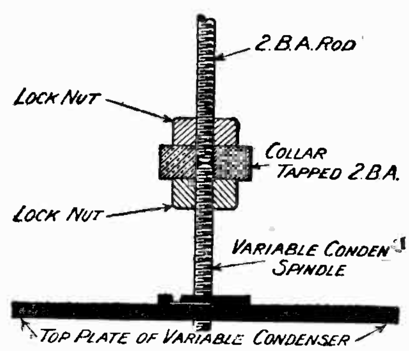
Case No. 5

The receiver in this instance was the Transatlantic 5-valve set, employing two high-frequency valves, a rectifier and one or two stages (optionally) of low-frequency amplification. The set was being used in the Midlands, and the owner found that he could receive Aberdeen, Glasgow, Newcastle, and Birmingham quite satisfactorily, but only the weakest of signals could be obtained from London, Cardiff and Manchester. Upon these shorter wavelengths, also, tuning was exceedingly flat, and no reaction could be obtained.

Correspondence revealed the fact that all his good results were obtained by means of a home-made basket-coil of 50 turns, but that for shorter wavelengths he used a No. 35 of a make which shall be nameless. The substitution of this No. 35 coil being the only change which was made to receive the shorter wavelengths, I asked the experimenter to send me his No. 35 coil, and found that it did actually give in any set with which I could try it only the very poorest of results. Its windings were continuous, as indicated by the telephone test, and therefore suspicion fell upon the quality of the insulation of its plug. The coil was removed from the plug, and the plug itself was placed in series between the telephones and a high-tension battery. Quite loud clicks were obtained between the two metal parts, thus showing that the insulation of the material was exceedingly low. Remounting the coil upon another plug restored the coil to normal functioning.

Extending the Spindles of Variable Condensers

It is often desirable for various reasons to extend the moving plate spindle of a variable condenser. A very simple method of doing this is shown in the diagram given below. A further length of 2 B.A. rod is secured to the 2 B.A. spindle by means of a brass collar which is tapped 2 B.A. A 2 B.A. nut is then tightly clamped on either side of the collar, as shown.

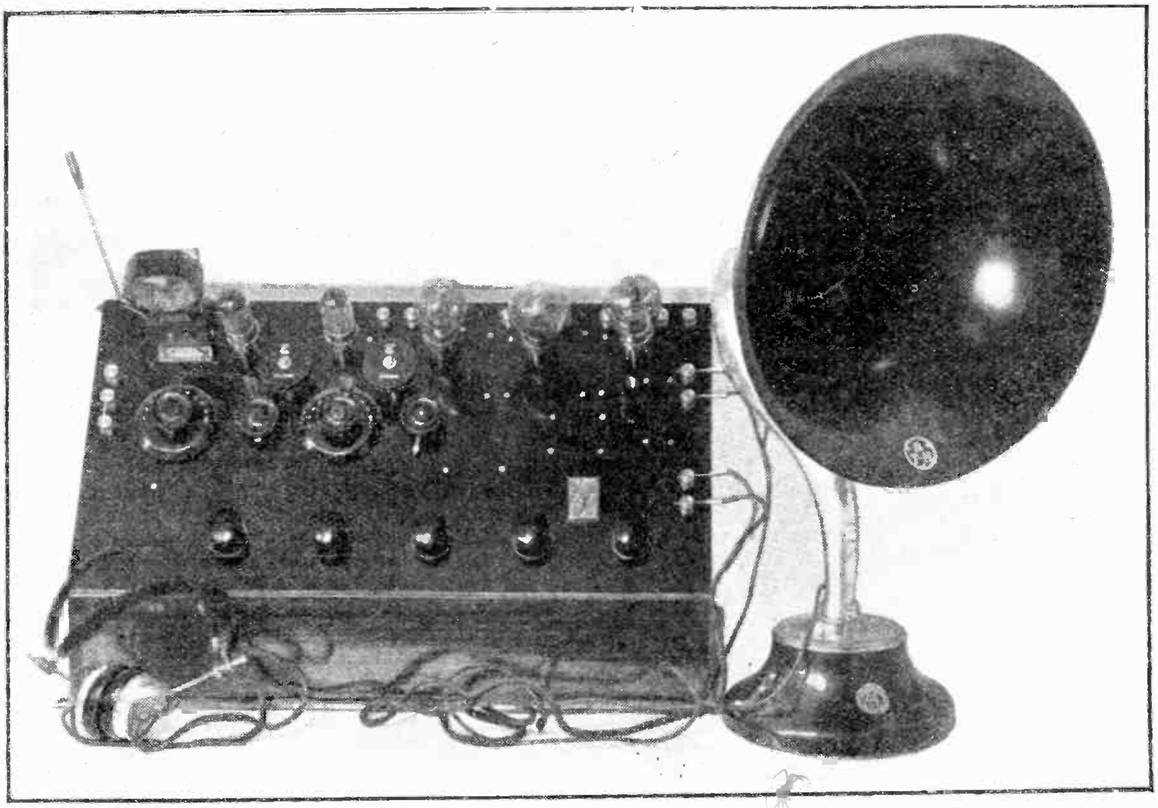


These nuts, acting as lock nuts, firmly grip the two lengths of rod, and there is no possibility of them becoming loosened with use.

H. B.

TO NEWSAGENTS

Radio Press are preparing a complete list of blue prints. Send a post-card if you have received enquiries.



The "Transatlantic Five"—A Multi-Valve Set with Range and Volume

By PERCY W. HARRIS, Assistant Editor.

This Receiver is a modification of the original "Transatlantic" design, and includes the Note Magnifiers on the same panel.

IN November last, following a large number of requests for such a set, I described in these pages a three-valve wireless receiver containing two stages of high-frequency and a detector valve. The set in question, as many readers will remember, was designed to use the tubular types of valve known as the V. 24 and Q.X., whilst the tuning of the two stages of high-frequency—always rather a difficult matter—was simplified by the use of a double condenser. Largely owing to the fact that up to this time no simple set with two stages of high-frequency had been described for home construction, the "Transatlantic" receiver, as it was called, was built in large numbers, and I am pleased to know excellent results have been obtained with it in all parts of the country. In the following month (December) I described a two-valve amplifier which could be attached to the "Transatlantic" as making with the previous unit a five-valve receiver of high efficiency.

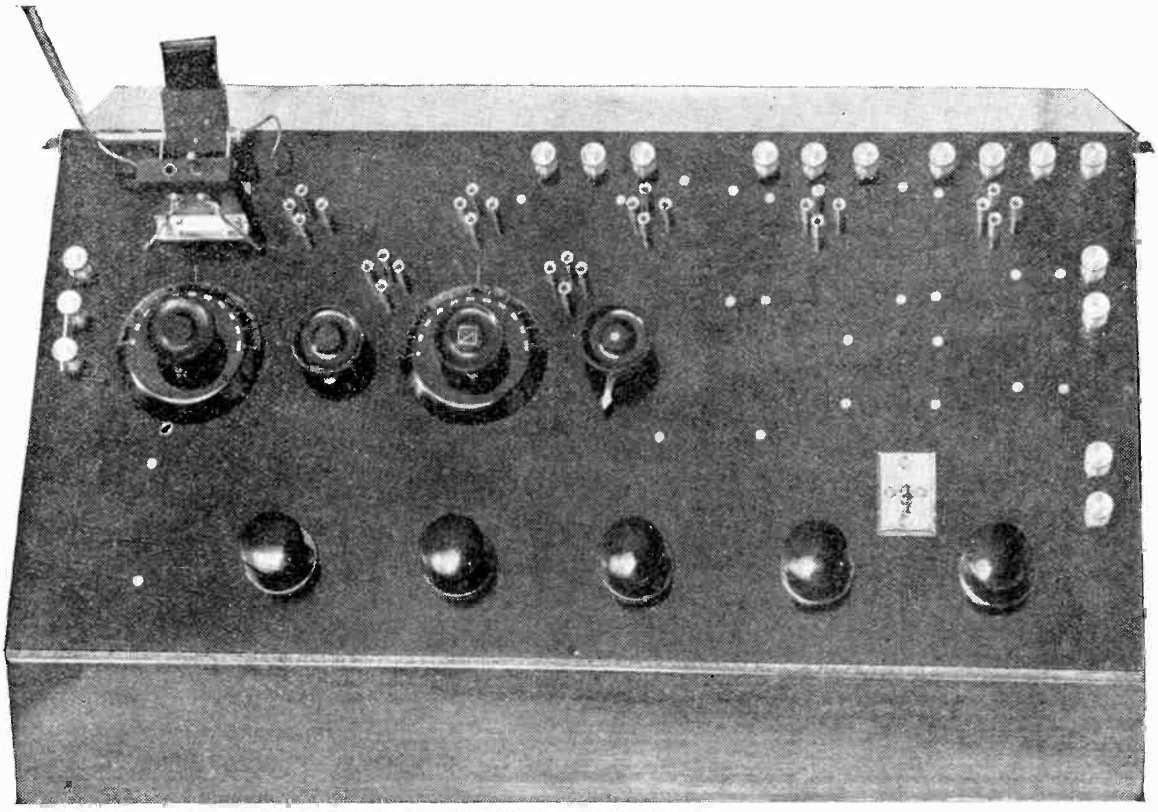
The design of a good set with two stages of high-frequency is not a particularly simple matter, owing to the fact that unless we take great precautions there will be interaction between the stages of tuned high-frequency, and self oscillation will be set up on the slightest provocation. It was in order to reduce the interstage coupling to the lowest limit that the tubular low capacity type of valve was used. Incidentally, it may be remarked that the new Myers valves work admirably in the Transatlantic set. Many readers, however, have asked whether it is possible to make up the set with the ordinary four pin valves which are more readily obtainable and, incidentally, are only half the price of the V.24 and Q.X. Further, the very low consumption dull emitters are only obtainable in the four-pin type, and many people are so situated that such valves are highly useful to them.

The present set is a re-designed "Transatlantic" receiver with a number of improvements which have suggested themselves since last November. I have found it possible, by taking certain precautions which will be explained later in the article, to utilise the four-pin valve in this set, thus giving the reader a very wide choice in the valves he may use.

Let us examine first of all the particular features of the present set, to see wherein it resembles, and in what it differs from, the original Transatlantic design. Here are the chief features tabulated :—

1. Four-pin valves are used throughout in low capacity mountings.

2. Double filament resistances



Reaction on to the aerial coil is rarely needed, as sufficient reaction control is generally obtainable on the potentiometer. If, however, with very poor aerials magnetic reaction is found necessary, the shorting plug in the reaction socket is replaced by a small coil.

are used to enable the reader to use bright or dull emitters in any of the sockets.

3. An original form of switching is incorporated so that in one position we may listen on three valves (two high-frequency and a detector) in the telephones, whilst in the other position of the switch we listen on five valves (two high-frequency, detector and two note magnifiers) on the loud-speaker. Telephones and loud-speakers are kept permanently connected to their respective terminals so that having tuned-in in comfort on the telephones we can change in a moment to the loud-speaker without touching any leads. The switch also controls the lighting of the filaments of the last two valves.

4. Terminals are provided so that four volts L.T. can be used on the first three valves (for dull emitters) and six volts on the last two valves (for power valves or bright emitters), using one accumulator throughout.

5. Four high-tension terminals are provided, giving us an opportunity to use one voltage of high tension on the first three valves, a different voltage on the first note-magnifying valve, and a still higher voltage on the last valve. Thus power valves may be used in the last two sockets.

6. Separate grid bias terminals are provided for each of the two stages of note magnifying so that we can adjust the particular valves used to the best working positions.

7. Resistance capacity coupling is adopted for the note magnifying stages.

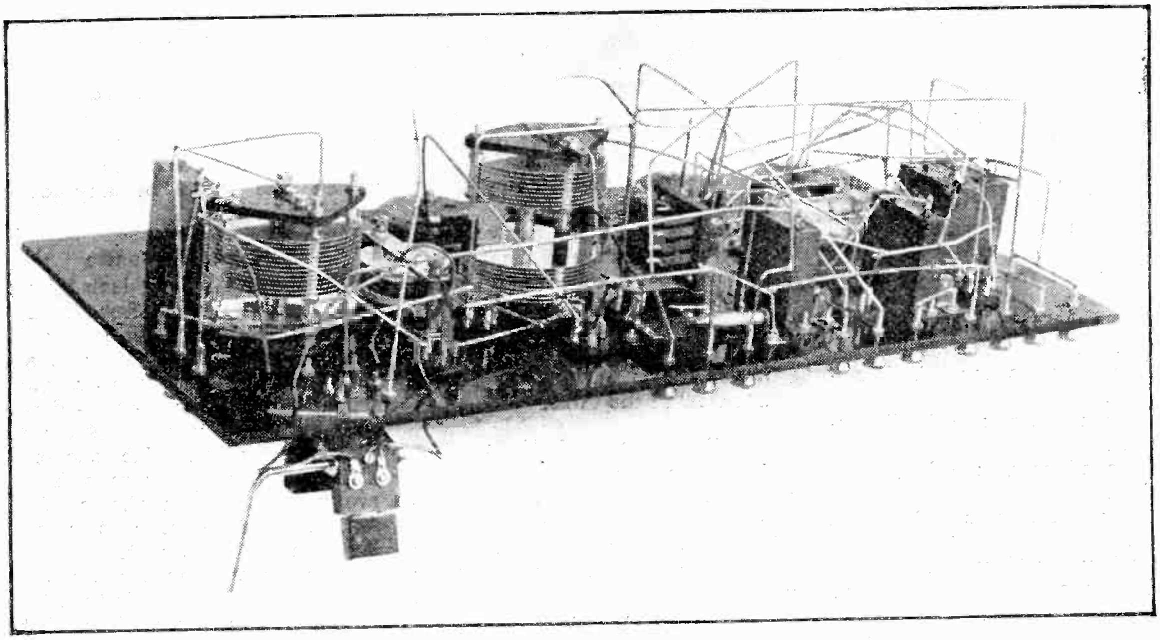
This form of coupling has come into prominence in the last few months owing to the fact that for telephony it gives remarkable purity. There are arguments both for and against resistance coupling. In the main they are as follows.

For:—Great purity is obtainable—a purity only equalled by the best of intervalve transformers correctly used. The cost of the coupling is low so that, excluding valves, we may say roughly that the two stage resistance amplifier costs no more than a single stage transformer amplifier. There is much less risk of interaction between stages and consequent howling.

Against:—The amplification per valve is not so great as with transformer coupling. The difference may be roughly stated to be that with three stages of resistance amplification no greater magnification is obtainable than would be possible with two stages of transformer amplification.

About 50 per cent. higher plate voltage is required with resistance coupling.

One of the reasons for choosing resistance coupling in the present receiver was that experience with the original Transatlantic set and its two note magnifiers showed that only very rarely indeed was it necessary to use the second stage of note magnification to bring in practically any station on the loud-speaker. Furthermore, many readers have commented on the remarkable purity of signals obtainable with the original Transatlantic, and it was thought that there would be less difficulty for many to retain this purity when amplifying if resistance coupling were used. Others, however, may desire to use transformer amplification in the present set, and provided they are satisfied with the transformers they are at present using there is no reason why they should not give just as good results.



This photograph shows how the various components stand in relation to one another.

What Cannot be Done with This Set

It should be pointed out at once that the man who wants a set with every possible switching combination and who desires to perform "stunts" with his receiver will not find the present apparatus to his liking. As I have pointed out on many occasions, efficiency in high-frequency stages is very largely dependent upon the shortest and most careful wiring. If we were to introduce a switch so that either one or two stages of high-frequency could be used, not only would the wiring be complicated, but the efficiency would drop quite a considerable degree. In any case, it will be found for local work that on switching off one or both of the high-frequency valve filaments sufficient energy will get through to the detector valve to give good signals. It will also be noticed that we are bound to use both of the stages of note magnification or none at all. Again, there are reasons for this. Two stages of high-frequency amplification and a detector valve will bring in practically anything in comfortable telephonic strength, particularly when reaction is carefully controlled. Amplification added to this by the two stages of note magnification will work the loud-speaker. In the great majority of cases it will be found that one stage of note magnification will give signals too strong to be comfortable in the telephones, but not quite strong enough to work a loud-speaker. Last, but not least, if all kinds of change-over arrangements are desired, it is far better to lay out the apparatus on an experimental bench, so that every possible arrangement can be tried. The present instrument is designed to give good reliable results *all the time and every time* with the minimum of adjustment and trouble. I do not think it will be found to fail in this respect.

General Arrangement

The whole of the apparatus is mounted on a single ebonite panel measuring 22 in. by 11 in. The actual instrument described uses a sloping front cabinet of conventional design, but many readers will desire to build the panel into a bureau or some special box. The fact that everything is mounted on a panel makes it quite a simple matter to fit it in any convenient position either vertically or horizontally. Many readers may think the construction of a five-valve set of this type is both an ambitious and an expensive proceeding. It will be found, however, that if the set is built up from components of good quality throughout, using a bought french-polished mahogany cabinet of the correct size, the total cost will not exceed £12, excluding, of course, valves and batteries, telephones and loud-speaker. This figure is not high when it is considered what can be done with the receiver.

Components Required

The list of components is given below. In accordance with the usual practice in this magazine, the actual make used by the author is given in brackets, but of course any similar component of good quality may be utilised.

The use of square law condensers is recommended in this set, for they greatly facilitate the calibration of the instrument and, furthermore, give much greater ease in tuning. The ordinary type of condenser has a congestion of wavelengths in the first portion of the scale, and the reverse at the upper end. In a square law condenser the wavelengths are equally distributed throughout the whole scale. This means that if we plot a "curve" with wavelengths on a vertical scale and condenser degrees on a horizontal scale, then the line joining the points of intersection of the different condenser readings and the different wavelengths corresponding will be straight. In practice the effect of this is that if we pick up any two different stations, the wavelengths of which we know, then the two points of the chart can be joined with a ruler and the line extended right across the chart. We can then find the position of any other wavelengths by noticing the points of intersection. Those readers who desire to use the ordinary form of condenser will not find the signal strength any different. The sole and very important difference between the two forms of condenser lies in the explanation given above.

We need, then :—

1 variable condenser, .0005 μF (Bowyer-Lowe square law).

1 double condenser, the two halves

of which are each .0003 μF. (Bowyer-Lowe square law). NOTE.—Experience with the instrument has shown me that the two halves of .0002 μF. would be quite big enough for the broadcast band of wavelengths, as if the set is made exactly as described it will be found that the plug-in transformers rated as from 300 to 600 metres will actually run from 235 to about 750 metres.

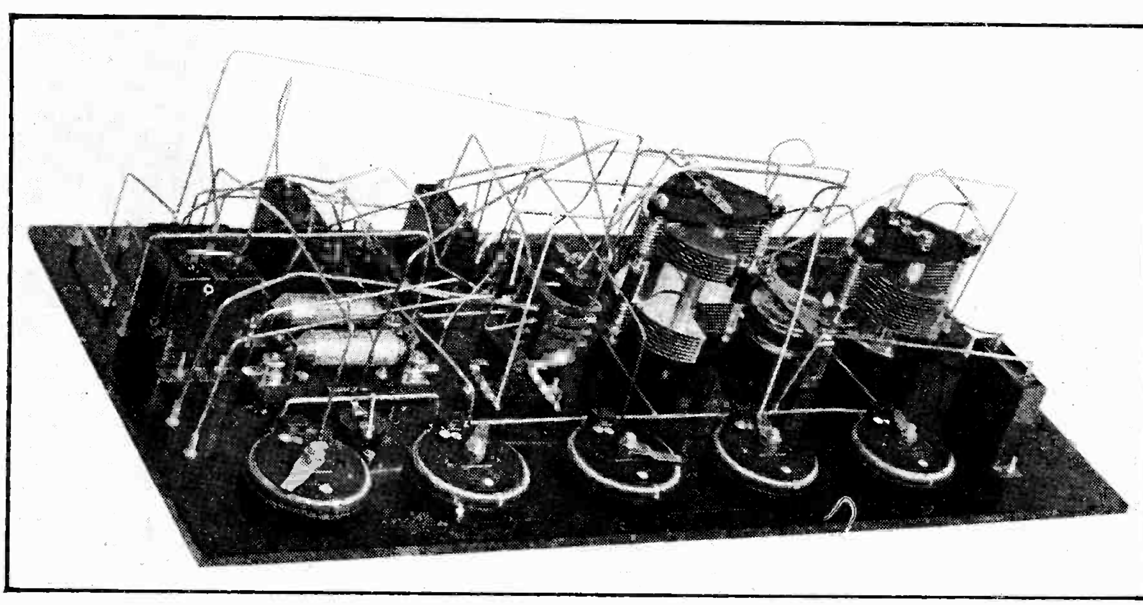
2 fixed condensers, .0003 μF. (Dubilier).
3 fixed condensers, .25 μF. (Mansbridge).
1 fixed condenser, 1 μF. (Mansbridge).
1 fixed condenser, 2 μF. (Mansbridge).
5 filament resistances (Burndept dual).
1 potentiometer (Igranic).
3 grid leaks, 2 megohms (Dubilier).
14 terminals, 4 B.A.
7 sets of valve sockets. (See note below.)
1 two-coil holder (Burne-Jones Magnum).
Matched plug-in H.F. transformers. (I have several makes of these at hand, and have used McMichael, Bowyer-Lowe and Ediswan, which are all good. Gent's also make this type.)
1 4-pole double-throw anticapacity switch (Utility).
2 80,000 ohm anode resistances (Dubilier large type).
3 sets of grid leak clips.
1 panel-mounting on-and-off switch (Connecticut).
Ebonite panel, 11 in. by 22 in. by ¼ in.
Suitable cabinet (that shown was made by Wright and Palmer).
Quantity of No. 16 square tinned-copper bus-bar wire (this is sold by a number of firms, including Sparks Radio and Bowyer-Lowe).
Suitable plug-in coils for the ranges it is desired to receive. Those readers who do not know which coils to buy should consult the MODERN WIRELESS coil table published in our last issue. Only one set of coils will be needed, those required being indicated under the heading "Aerial Socket" in the table.

Constructional Work

I have endeavoured to make the constructional work as simple as possible, and it will be found that with the solitary exception of the hole in the panel necessary for the particular type of on and off switch everything else can be mounted by means of ordinary drilled holes. Fortunately, the manufacturers are gradually adopting the wise policy of supplying with the component parts suitable drilling templates. Thus, the condensers, double filament resistances, and the potentiometer are all provided with paper drilling templates. Blue prints are available for both front and back of this receiver, so that the laying out of parts will not be found at all difficult. The largest drill required will be ⅜ in. diameter for the central spindle of the condensers, filament resistances and potentiometer, as well as the hole for the single hole mounting Utility switch. I hope the Igranic Company will forgive me for changing the knob of their potentiometer. The reason for this was that it did not match the knob of the Utility switch, which is a standard knob, whereas the Igranic use a special knob of their own which does not match the knob of any other manufacturer.

A Note on Ebonite

We are still in the dark ages as far as ebonite is concerned. This material varies enormously in quality, and in the main is still manufactured in a manner which, whilst satisfactory for pre-wireless uses, is quite unsuitable for the present purpose. The sheets of ebonite during their manufacture are rolled between sheets of tin foil. As the ebonite is a combination of rubber with sulphur this latter substance attacks the tin foil and the result is that there remains upon the surface of the ebonite an invisible compound of tin foil and sulphur which is more or less of a conductor. If then we mount our component parts on the ebonite as bought there will be a great deal of surface leakage, and we may lose all our signals, or at least part of them, and hear at the same time a very disagreeable frying noise. It is for this reason that I always recommend readers to remove the surface of the ebonite with emery paper, rubbing carefully so as to give a good matt surface. There is no virtue in a matt surface as such, and if only the manufacturers would make the ebonite in such a way as to avoid surface leakage, then we could use it with



Another helpful view showing the five resistances controlling the filament current.

its original polished surface. In the United States, such highly polished panels entirely free from surface leakage are available at any dealers. In this country practically all the ebonite sold has a leaky surface. There are, however, some kinds of ebonite available which are guaranteed free from surface leakage. Unless you can obtain such a guarantee with your ebonite remove the surface with emery paper.

At first glance the wiring of the set looks a very complex matter, but further examination will show that the complexity is entirely confined to the audio-frequency side, the wiring of the radio-frequency side being exceedingly simple. Be sure in wiring up to make your leads as short as possible on the high-frequency side. The complication on the audio-frequency half is due to the introduction of four-pole two-way switch. Those readers who find it difficult to use square wire and to bend it accurately on this part of the receiver may care to use the thinner tinned copper wire and insulating sleeving. This, however, should not be used on the radio-frequency side, but only *after* the detector.

Some readers may wonder what is the object of the .25 μF. condenser on the radio-frequency side of the instrument. This is shunted across the active portion of the potentiometer so that the radio-frequency currents do not pass through any inductive windings here. A much smaller condenser would have done here (say .001 μF.), but a spare .25μF. was handy and was accordingly used. The size is not a critical matter and any condenser of a capacity of .001 or larger will do. Indeed, if it was omitted no great difference would be noticed.

The Connecticut on and off switch will require a 1 in. hole in the panel. This can be cut either with a fretsaw or by scribing a circle of 1 in. diameter, and drilling a number of holes round the circumference until the centre piece drops out. The hole can then be smoothed off with a file. This particular switch will carry if necessary 10 amperes, and as we may desire to use bright emitters throughout this set which may average over half an ampere each, it will be seen that a switch with good current carrying capacity is required. I do not recommend the use of a cheap switch here. In any case the Connecticut is not dear.

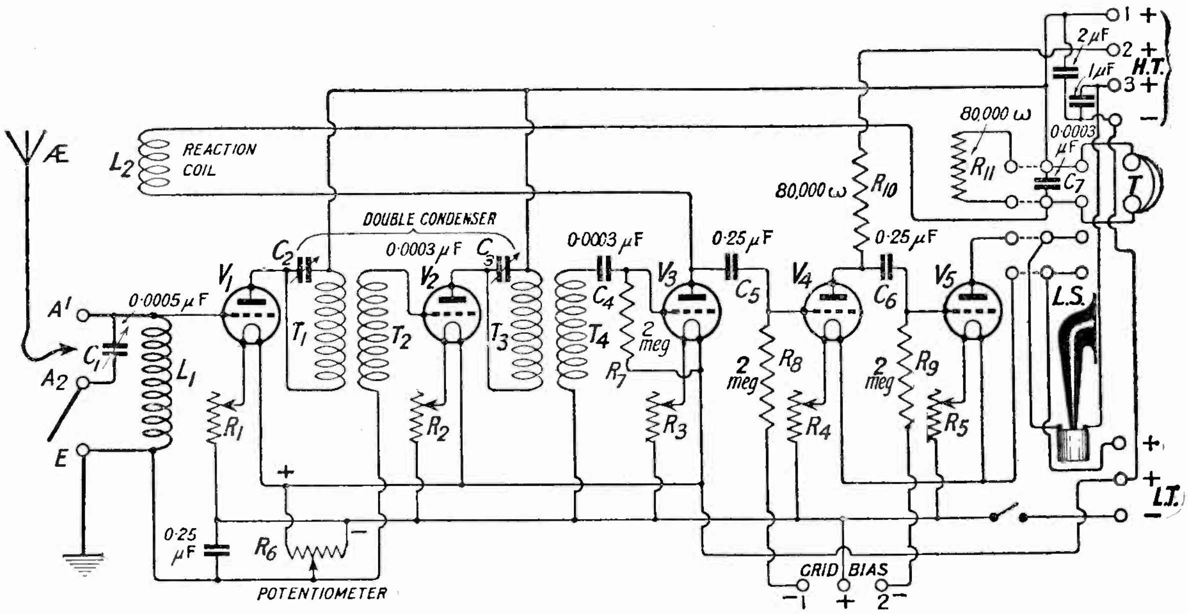
The Dubilier anode resistances are supplied complete with clips mounted on an ebonite strip. This ebonite strip has two holes so that it can be attached to a panel with ordinary metal screws and nuts. I do not recommend the reader to take the clips off the ebonite strip to which they are attached. The whole strip should be mounted on the underside of the panel.

Special Note on Valve Sockets

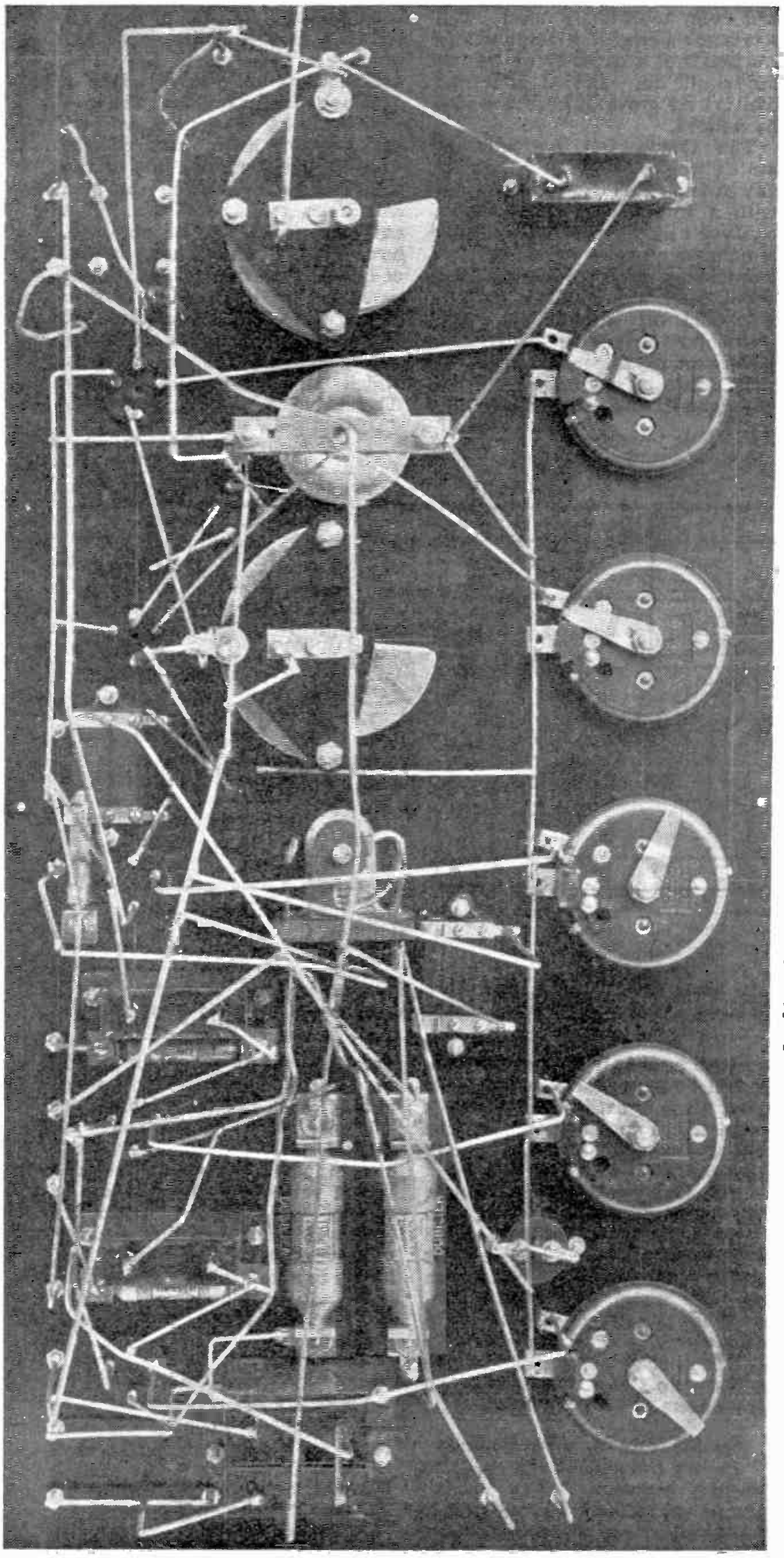
In this instrument the ordinary ebonite sheathed valve socket should *not* be used. These sockets have a very large capacity between pins, and this is a capacity which is most detrimental in high-frequency amplification. In the present receiver I used separate valve legs which are attached to the panel without nuts or washers. This is done by drilling clearance holes with a template for the four valve pins and screwing them into ebonite discs on the opposite side of the panel, these discs being threaded with holes to take the pins. Just as good results can be obtained, however, by threading holes instead of making clearance holes for the valve pins in the panel. If then the separate legs are screwed into the threaded holes (4 B.A.) we can dispense with nuts and washers, which all add to the capacity. The valve legs used should not have flanges and should be as thin as possible, as it is upon small details such as this that the efficiency of a high-frequency set depends. Do not therefore use the conventional composition or ebonite sheath valve socket and expect to get the same results. There are already several good low capacity valve sockets on the market, and in the future I think there will be more, when the importance of low capacity in valve sockets is fully realised.

Wiring Up

When all the components have been mounted remove the tops of all brass screws and points that have to be soldered with a fine smooth file, and carefully tin each point before the wiring up is commenced. Wiring up with stiff wire is quite a simple matter when you get the



The theoretical diagram. The twelve white dots near R_{11} and C_7 represent the switch contacts. The blades are shown as full lines on the right. They can be changed over to the dotted positions on the left.



Looking from above, the wiring is not difficult to follow

knack of it, and success largely depends upon bending each piece of wire to its shape before attempting to solder it. If you try to bend the wire after you have soldered one end you will find that it will probably break off the soldered connection. In wiring up follow the diagram carefully and see that each piece of wire is clear of any other where it crosses. I admit that the wiring up of the switch is not so easy as the other parts, but it is worth taking a little trouble with. Do not attempt to "rush" your wiring in an endeavour to get the set finished rapidly. Go steadily with the work and you will find that the extra pains will well be repaid.

The enquiring reader may wonder why the grid leak of the detector circuit is not placed directly across the .0003 μF condenser as it is transformer coupling. The reason for this is that later the reader may desire to use resistance coupling on the high-frequency side for longer waves, and if the leak is wired up as shown it will be possible to use the plug-in resistance capacity units recently described in these pages for use with the original Transatlantic design.

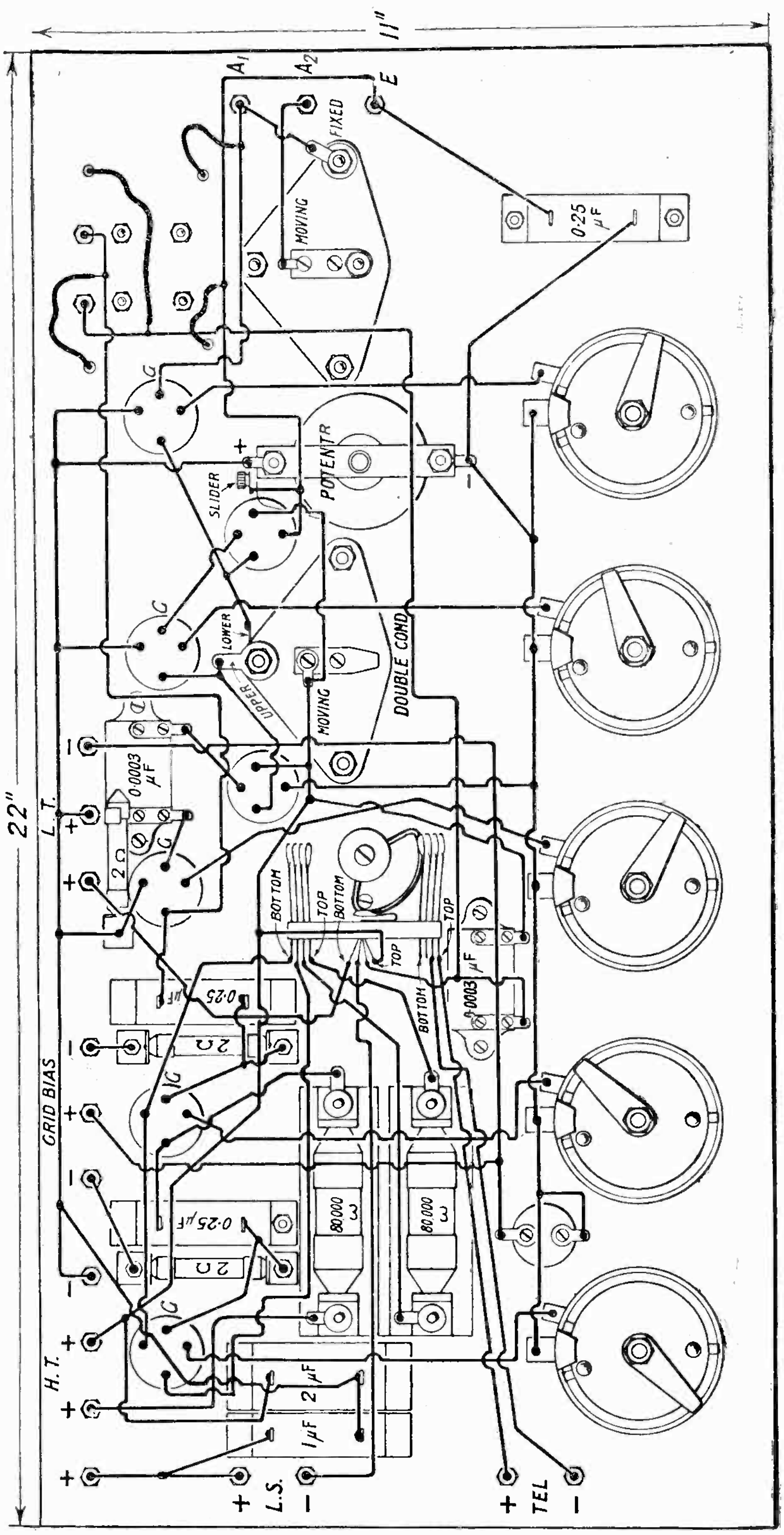
Some Special Points

With the particular form of coil holder used it is necessary to bring flexible leads from the front of the panel to the back. Long flexible leads are always a nuisance and to avoid any trouble in this regard I have introduced into the panel two 6-B.A. metal screws secured with nuts. To these screws are soldered the leads which normally would go to the reaction coil. This secures the stiff wires firmly in place. The flexible wires in front of the panel are now brought through and soldered to the stiff wires at the back thus enabling the shortest possible flexible leads to be used.

It will be noticed that there are two large condensers across the high tension. It might be thought that only one would be necessary. The reason for using two is that in using different high tension tappings it is impossible to make one condenser serve for all. We therefore have a 2 μF condenser shunted across the high-tension battery which supplies the first three valves and 1 μF shunted across the portion of the battery which supplies the last valve. It has not been found necessary to add one across the second high-tension tapping.

Note on the Switch

The appearance of the wiring to the switch may at first confuse



Complete wiring diagram. A full-sized blue print of this is available. (Ask for No. 43B).

the new constructor, but if the diagram is carefully examined it will be found a comparatively easy matter to wire up. The switch in question is sold for panel mounting in the one hole fixing manner. There is a vertical plate on the switch carrying twelve projecting soldering lugs, already tinned for soldering. On the drawing I have marked top and bottom for each of the rows. "Top" in this case is the uppermost lug when the panel is laid face downwards on the table. The moving portions of the switch are not drawn in detail and therefore the reader is not advised to pay too much attention to them. If this part of the switch had been drawn very fully it would have given more complication to the drawing without elucidating any points.

Testing and Joining Up

When the set is finished and you have carefully tested it to see that all leads are free of one another place the panel in its cabinet and examine the front. You will see on the left hand side of the front panel drawing three terminals marked respectively A_1 A_2 and E. These are to enable you to use the aerial tuning condenser either in series or in parallel. Parallel connection is recommended in most cases save where the aerial is extremely large or where it is desired to receive very short wavelengths. For parallel join A_2 and E with a link or piece of wire, joining aerial to A_1, and earth to E. For series connection open up the link, join aerial to A_2, leaving earth as before. The condenser will now be in series. You will also see that there are three terminals for the low-tension, marked negative (common), positive (valves 1, 2, and 3) and positive (valves 4 and 5). The reason for having the terminals so marked is that many readers may desire, from the point of view of current economy, to use dull emitters in some parts of the circuit if not everywhere. You may, for example, use three .06 ampere valves in the first three sockets for high-frequency and detecting. To operate these valves you require only 4 volts from an accumulator or dry cells. To get really loud and powerful signals when using the note magnifying stages it is often desirable to use bright emitters or even power valves. These with the filament resistances supplied will require 6 volts. Say, for example, we put three dull emitters in the first socket, say an R valve in the first note magnifying socket, and an $L.S._5$ power valve in the last socket. We can now use a 6 volt accumulator of say 40 ampere hour capacity, joining the negative to the common negative terminal, taking a tapping from 4 volts to the positive for the first three valves and the 6 volt terminal to the positive terminal for the last two valves. We shall then get 4 volts on the first three and 6 on the last two. If, however, we desire to use bright emitters throughout then the two positive L.T. terminals can be joined by a wire and taken to the 6 volt terminal of the accumulator. The filament resistances of the dual type are so arranged that when we turn the knob clockwise we first of all run over a sector of the resistance of a wire of suitable size to cut down the voltage on the dull emitters. We then pass on to a section of thicker wire which will pass enough current to the bright emitters. Therefore, when using dull emitters the first half of the resistance is used and with bright emitters the second half.

High Tension Terminals

There are four terminals for the high tension. The first is negative (marked common) the second is the positive for the first three valves, the third the positive for the first note magnifying valve and the last the positive for the final valve. These are used as follows. If, for example, we desire to use .06 ampere valves in the first three sockets we take a tapped high tension battery and join its negative to the common negative terminal. We then take a tapping at 40 volts (say) to the first positive terminal. We will perhaps use an ordinary bright emitter "R" valve in the first note magnifying stage. We can then take for this a tapping at say 70 or 80 volts. Finally, if we use a power valve, we may desire to use as high as 200 volts, whereupon we shall take the tappings from the correct socket for this. If we are using ordinary bright emitters throughout, say 5 valves of the "R" type, then we can use say 70 volts for the first three and 100 for the last two, in this case the last two terminals being joined together by a wire and taken to the 100 volt tapping. It would, of course, be an added refinement to add a separate tapping for the detector valve, but in practice we must stop somewhere in complications, and it was not found necessary to add this terminal.

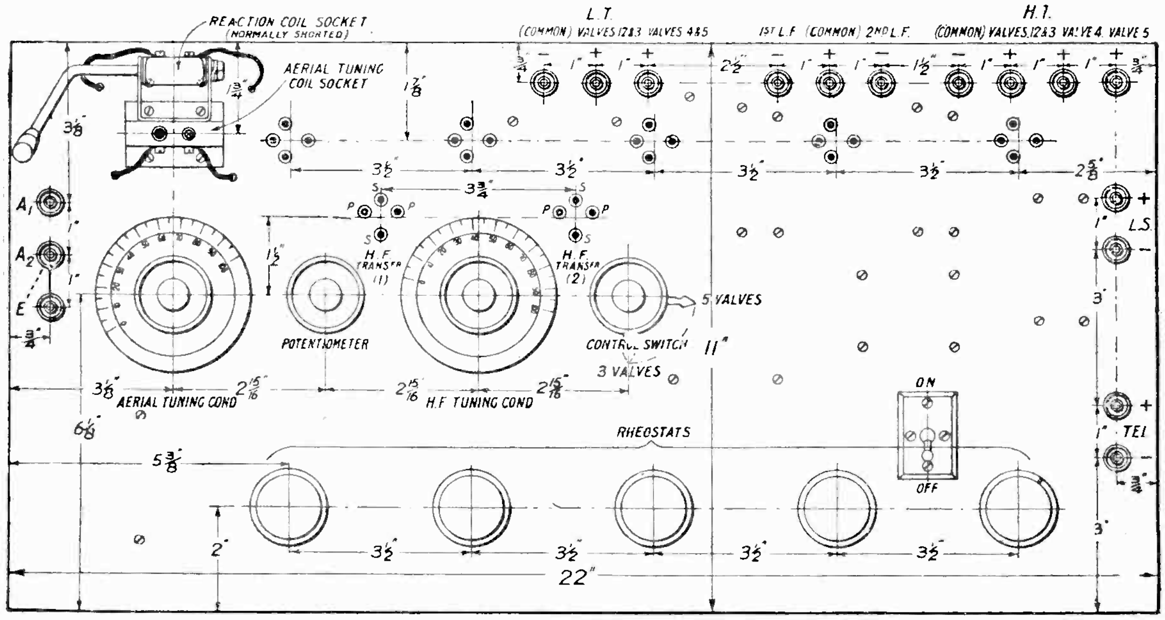
Grid Bias

Three terminals are provided, as will be seen, for grid bias. The centre terminal is the positive from the grid bias battery. This may be one of the ordinary tapped high tension batteries if power valves are used. Let us imagine we have a tapped battery of say 30 volts. The positive end is connected to the middle positive terminal. If we are using say 100 volts on an "R" valve in the first note magnifying socket, then about 4 volts grid bias will probably suit. To obtain this we take a tapping at 4 or 4½ volts and connect this to the negative terminal marked "first L.F." valve. If we are using say 200 volts on an L.S.5 for the last valve, then we shall require about 16 volts grid bias, to obtain which we take a tapping at 16 volts (or the nearest voltage to this) to the grid bias negative terminal marked for the last valve. If of course we use the same type of valve in the last two sockets with the same high tension, then the two negatives can be linked by a wire and taken down to the tapping which happens to suit.

Starting Up

When you have thoroughly mastered the terminal arrangements you can place a short-circuiting plug into the reaction coil socket (you will rarely need to use reaction with this set) and you can place in the aerial tuning coil socket a suitable coil for your local broadcast station. Turn the switch to the 3-valve position, turn off your filament resistances all along, turn on the filament switch and then light each of the first three valves by turning the filament resistances to the right until the correct degree of brightness is obtained for the valves you are using. The potentiometer should now be turned anti-clockwise as far as it will go. Now plug into the transformer sockets a pair of matched transformers to cover the wave-length range you desire, and turn the high-frequency tuning condenser to about the halfway position. Now on the aerial tuning condenser turn this backwards and forwards until you hear your local station at the best strength, whereupon you can further increase the strength by moving the high-frequency tuning condenser to its best position—which will be readily found. If you are fairly close to

(Continued on page 74.)



A full-sized blue-print of this panel is available (No. 43A).

High-Tensionless Receivers

By JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

Author of "Thermionic Tubes in Radio Telegraphy and Telephony," "Elementary Textbook on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," "Radio Valves and How to Use Them," "Practical Wireless Valve Circuits," "More Practical Valve Circuits," etc., etc.

This article reviews the whole position of the possibility of eliminating the high-tension battery, and numerous new circuits are given for this purpose.

A GREAT deal of interest has been aroused recently by the publication of accounts in the general Press suggesting that high-tension batteries are now things of the past, and that we might expect the whole technique of radio to change.

After allowing for the enthusiastic extravagance which usually attaches to Press reports when dealing with technical subjects, there is sufficient basis for an investigation into the matter from a dispassionate point of view.

At first sight the words "No More High-tension Batteries," "Amazing Invention," "Revolutionary Development," etc., might not only cause manufacturers to shake in their shoes, but also create some concern to experimenters and constructors. As for the high-tension battery manufacturers, one's sympathies are only tempered by recollecting their astonishing lack of enterprise.

I think it is desirable to calm the fears of those interested by rashly prophesying that the high-tension battery industry will not be abolished, and that radio technique will not undergo a revolutionary change.

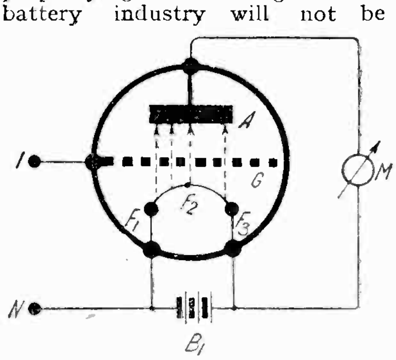


Fig. 1.—How the filament battery acts as an H.T. battery.

It would be as well, before discussing the technical prospects, to examine the fundamental question of whether the high-tension battery *may* be eliminated.

Messrs. G. V. Dowding and K. D. Rogers have not confined themselves to their own interesting example of a high-tensionless receiver, but have made such sweeping statements that they invite friendly correction.

They state that, "according to the accepted theory of wireless reception," the elimination of the high-tension battery is impossible. The fact that wireless receivers without high-tension batteries have in the past been employed is probably the best reply to this, but nevertheless there are certain fundamental facts in connection with valves which no invention, however amazing, can confound.

The Article in Brief.

The following conclusions are arrived at by the author of this article :—

1.—That high-tensionless receivers are not new in themselves. Fullest results are given of his own work, for which no particular credit is claimed, but which indicates the successful results obtained without high-tension. References to publications three years old are given.

2.—That present design will not undergo modification as a result of the interesting circuit developed by various investigators, but that these circuits form an addition to the already innumerable circuits available to the experimenter.

3.—That, in his opinion, the high-tension battery circuits will give better results than one using no high-tension battery, and that after the first valve the disparity becomes greater and greater with the addition of every extra valve.

4.—That high-tensionless circuits are of chief interest in the case of portable sets.

5.—That, in his opinion, standard broadcast apparatus will not be modified and that there is nothing to justify any alteration.

6.—That any existing sets, commercial or otherwise, may be converted to high-tensionless receivers at the expense of signal strength. Suggestions are given.

7.—That, ultimately, the interest which has been shown in high-tensionless receivers may lead valve manufacturers to design valves requiring a smaller amount of high-tension voltage.

8.—That the expression "high-tensionless" is really a misnomer because some high-tension voltage is essential for the proper working of a valve, although this voltage may come from the filament battery. The problem of reducing the value of the high-tension voltage is exactly the same as the problem of the so-called elimination of the high-tension battery.

9.—That high-tension batteries will not be abolished.

The object of a high-tension battery in a wireless receiver is fundamentally to draw electrons, which are shot off from the filament of a valve, to an anode, and produce what is called the anode current. The strength of the anode current affects the signal strength obtained with a receiver, or, rather, the variation of the anode current affects the signal strength. If there is a small anode current and an incoming signal varies it between zero and maximum, a certain signal strength will be obtained. If, now, we increase the anode current and also vary it between zero and maximum, the signal strength will increase. It is, of course, not possible to obtain something out of nothing, and the same applies to wireless valves. We cannot obtain signals unless we have an anode current of varying amplitude. If the total current flowing through a valve is only a small fraction of a milliampere, it is theoretically, and practically, impossible to get adequate signal strength. The average current flowing in the anode circuit of a valve may be said to be modulated by the potentials applied to the grid. When the grid is made positive the anode current increases, and when the grid is made negative the anode current decreases.

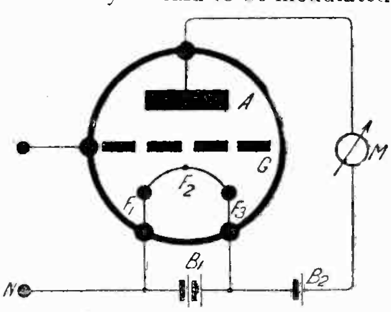


Fig. 2.—The previous circuit re-arranged.

To establish the normal anode current it is necessary to give the anode a substantial voltage. To produce an average current of, say, 3 milliamperes, it may be necessary to have 100 volts on the anode of the valve. Positive impulses on the grid, if sufficiently large, may increase this average current momentarily to 6 milliamperes, while negative impulses on the grid might reduce it to zero. Such variations would produce very loud results in a loud-speaker. If the steady anode

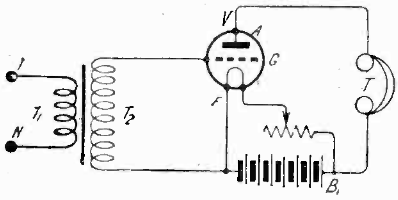


Fig. 3.—An L. F. Amplifier circuit without H.T.

current were much smaller, by using a lower anode voltage, for example, the maximum output obtainable would naturally be smaller.

It is therefore essential to have some anode voltage to produce a real flow of electrons from the filament to the anode, although the amount of this voltage will depend upon the type of valve used.

The question naturally arises, "Why is a large anode voltage necessary?" The reason, briefly, is that the resistance of the valve is so high, or, to use a better expression—since we shall be dealing with fluctuations of current—the impedance of the valve is so great. If we reduce the impedance of the valve, we shall be able to use a

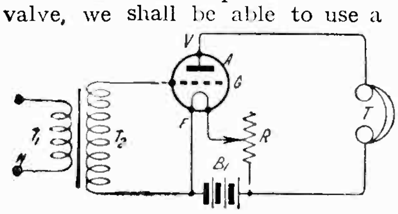


Fig. 4.—An arrangement for ordinary valves.

much lower anode voltage. The resistance, or impedance, of a valve is due, not to the fact that there is a vacuum, but to an effect due to what is termed the "space-charge." A vacuum is an ideal medium for the passage of electrons from the filament to the anode, and we might therefore at first think that a very low anode voltage would be sufficient to draw up a large number of electrons shot off from the filament. To explain why this is not so we must examine closely the effect of a space-charge.

When a stream of electrons is flowing from the filament to the anode the space between these two electrodes is filled with a cloud of negative particles of electricity. This cloud acts exactly in the same way as any other negative charge, except that, instead of the charge being on a body, it is a charge in space, and it is therefore called a space-charge. This space-charge, since it possesses the properties of any other negative charge, will tend to repel the electrons emitted from the filament.

Now the number of electrons emitted by the filament depends solely, in the case of a given valve, on the temperature of the filament. Except by altering the temperature of the filament, we cannot alter the number of electrons given off per second, but we can alter the number of electrons which pass to the anode. When an electron is shot off from the filament on account of the internal vibrations in the filament, two influences affect it. One influence is the electrostatic field produced by the anode; the anode being positive with respect to the filament, the electron, which is a negative charge, tends to move from the filament to the anode according to the ordinary laws of electricity. The other force is one due to the repulsion exercised by the mass of electrons which exist between the newly emitted electron and the anode. The large total negative charge in the space between the filament and anode, due to the electrons on their way to the anode, makes it difficult for the newly emitted electrons to emerge from the neighbourhood of the filament and to join in the main stream to the anode. The electron does one of two things; it either goes back again to the filament, or joins in the main stream to the anode. When the anode voltage is small the majority of electrons remain near the filament, but as the anode voltage is increased more of them pass to the anode.

The reason for this is that the electrons are not all emitted from the filament at the same speed; some of them are shot off at high speed and travel a further distance than others, in spite of the repulsion of the space-charge, while others come out of the filament at a relatively low speed and are unable to overcome the repulsion of the space-charge. The effect of the space-charge varies at different distances from the filament; close to the filament the space-charge repulsion on a newly emitted electron is greatest. Moreover, near the filament the attractive force of the anode is weakest. The newly emitted electron experiences a strong repulsion from the negative charge very close to it, and an attraction, due to a larger positive charge at the anode, which is situated, however, at a very much greater distance from it. Under ordinary conditions, the slower moving electrons find the repulsion of the space-charge greater than the attraction of the anode, and they are consequently

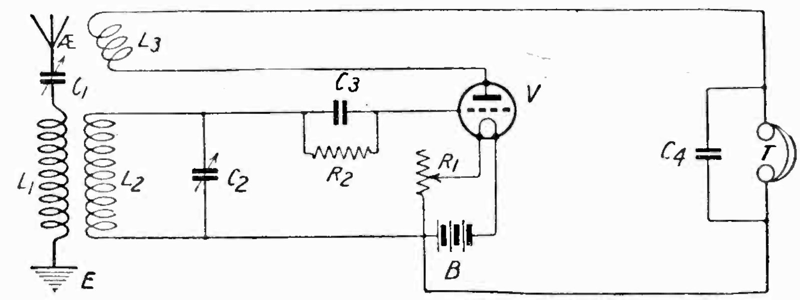


Fig. 5.—An arrangement introduced by the General Electric Co. of America.

made to return again to the filament. Speedier electrons, however, are shot out a further distance, since their additional speed enables them to penetrate the heavy space-charge cloud surrounding the filament and to enter a zone where the attractive force of the anode is greater than the repulsion exercised by the space-charge. Once they get through this cloud they are all right, and they are able to proceed to the anode.

This is so for two reasons; firstly, they approach the anode and so come under its attractive influence more; and secondly, once they have proceeded some distance towards the anode they are helped on their way by the negative space-charge *behind* them, which tends to push them on towards the anode; moreover, the space-charge ahead of them gradually gets weaker and weaker. It is almost as though the electron were like a person travelling to a certain place through a thick fog, which is very thick at first but gradually gets clearer. Once he is out of the heaviest part of the fog he can proceed on his way.

Another comparison which may

help the reader a little is one which considers a rifle bullet being fired through a thick plank of wood at a target ahead. If the bullet is shot from the gun at a slow velocity it will not pass through the wood. If, however, the bullet leaves the gun at a high speed it will pass through the wooden plank, and, once through, will pass on and hit the target. The gun may be compared to the filament, the wooden plank to the space-charge and the target to the anode of the valve.

These comparisons, of course, do

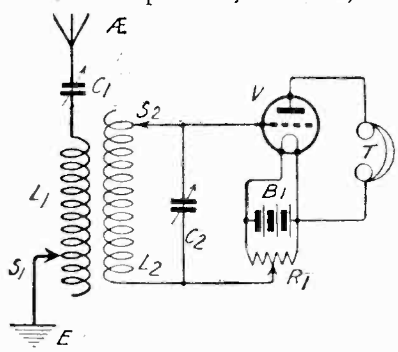


Fig. 6.—The successful 1918 high-tensionless circuit.

not show the whole picture, but they may be of assistance.

If we desire to obtain a substantial anode current with a low anode voltage, we have to reduce the space-charge effect. The ordinary way of overcoming the space-charge effect is to increase the high-tension voltage, but since we are assuming that we are to use a very low anode voltage, we must adopt some means of reducing the space-charge. One method of doing this is to reduce the diameter of the anode and grid, but mechanical considerations limit the size of the anode, because in any case the grid has to come between the filament and the anode if the normal construction of the valve is adhered to. It might be mentioned here, incidentally, that this defect has been overcome by having the grid in the form of a flat plate on one side of the filament, and the anode on the other side, both electrodes being very close to the filament. With such an arrangement quite good results have been obtained in Germany, using only a few volts on the anode. It will be remembered that details of this arrangement were published in the *Radio Review* a long time before that publication was discontinued.

The best example, probably, of a valve designed to operate without a high-tension battery is that produced by the General Electric Company of America in 1918. A very small anode was employed, and the voltage of the accumulator which lit the filament was used to supply the anode of the valve. The actual circuit was similar to that illustrated in Fig. 6. No attempt was made to overcome the space-charge effect in the valve by giving the grid a positive potential; the effect is obtained solely by reducing the diameters of the anode and grid.

Even before this an effective arrangement was produced by myself; a description of it appears later.

Another method of attacking the problem consists in providing a separate grid in the valve, and connecting this grid to the positive terminal of the filament battery, the object being to introduce a positive potential of about +six volts very close to the filament in the particular zone where the space-charge exists, and thereby counteracting, to a considerable extent, its effect. The principle of this solution dates back, I believe, to the middle of 1914, and it has been regularly employed on the Continent, particularly in Holland and France, where double-grid valves for this purpose have been manufactured for a considerable period.

Before actually describing different specific arrangements, I should like to consider a few preliminary matters in connection with the expression "high-tensionless." There is, in fact, no such thing as a high-tensionless receiver, or a valve capable of amplifying which does not require some high-tension E.M.F. The term "high-tension," of course, becomes even more ridiculous when considering only a few volts, but it is used as conveying the E.M.F. which is applied to the anode of a valve. This E.M.F. is absolutely essential to the operation of an amplifying valve. To get the maximum results out of an ordinary valve, a substantial anode voltage, or high-tension battery, is required, but the actual value depends largely upon :—

(1) The purpose for which the valve is used, *i.e.*, rectifying or amplifying.

(2) The size of the electrodes in the valve.

(3) The potentials applied to the grid.

(4) The specific means adopted for reducing the space-charge effect.

A valve, for example, while giving quite good results as a detector for working telephone receivers, would be totally incapable of producing the output currents necessary to operate a large loud-speaker. For the reception of weak signals requiring only a feeble or moderate output, a small steady anode current is all that is needed. When dealing, however, with a substantial degree of amplification, substantial anode currents are necessary.

An attempt has been made to suggest that the elimination of the high-tension battery is a different problem from its reduction. This, however, is not so. The problem of "eliminating" the high-tension battery is exactly the same as that of reducing the high-tension battery. No set yet produced will work without a high-tension battery; all that is being done is to reduce its size to about six volts, and to use the high-tension battery to pass a current through the filament for the purpose of heating it. In other words, the filament battery is used both for heating the filament and providing the high-tension, or anode, voltage.

This may be explained by reference to Fig. 1. This figure shows an ordinary three-electrode valve in which a milliammeter, or microammeter, M is included in the anode circuit of the valve between the anode and the positive terminal of the six-volt accumulator B_1. The anode will now have a potential of +six volts with respect to the filament. Speaking a little more accurately, we should say that the anode has a potential of +six volts with respect to the end F_1 of the filament, while the potential with respect to the end F_3 is zero. With respect to the middle point, F_2, the potential of the anode is

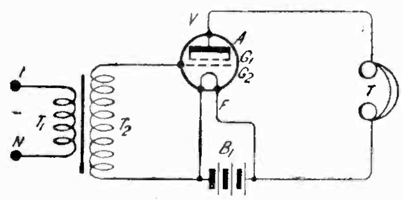


Fig. 7.—A circuit using a special valve used by the author.

+three volts. The result of this is that electrons will flow from the negative end of the filament, *i.e.*, the end nearest F_1, through the grid G to the anode A, and round through the milliammeter M. This steady anode current may be controlled by varying the potential applied to the grid G of the valve, with the result that the valve will act as an amplifier, but it must be realised that the anode current, being very small, will not give much in the way of output currents.

Fig. 2 shows the exact equivalent of the Fig. 1 circuit, but this time, it will be noticed, there is an obvious high-tension battery B_2. It will be noticed that B_1 is now a four-volt accumulator, and the extra two-volt cell is outside the filament circuit; the anode is now at a positive potential of +six volts with respect to the end F_1 of the

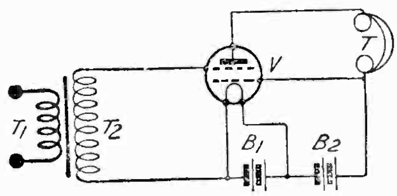


Fig. 8.—A year-old circuit of French origin.

filament, and at a potential of + two volts with respect to the end F_3. If the filament of the valve, in both cases, will operate effectively off four volts, the insertion of a rheostat in the positive lead in Fig. 1 will turn that circuit into the exact equivalent of Fig. 2, and the results will be identical. It matters little, therefore, whether the high-tension battery is included in the filament circuit as well, a rheostat being provided, or whether a portion of it is included outside the circuit.

Fig. 3 shows an actual low-frequency amplifier circuit which might be said to dispense with a high-tension battery. It will be seen that an accumulator B_1, having a number of cells, is used to supply both the anode voltage and the filament current. In some sets the accumulator B_1 gives as much as 24 volts, and this kind of circuit has actually been used by large commerical wireless companies, but few would dare to suggest that Fig. 3 was a high-tensionless circuit. It is, however, only a question of degree which separates the Fig. 3 circuit from the circuit of Fig. 1. To speak about a high-tensionless receiver is really, therefore, technically incorrect, and

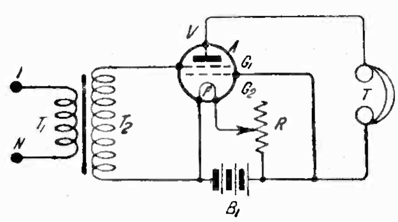


Fig. 9.—A modification of the above.

what we really mean is a receiver which uses only a small anode voltage, which voltage is derived from the accumulator.

Having decided to use our accumulator as the high-tension battery, the next problem is to use it in the most effective way.

In the case of an ordinary valve the most effective way is that illustrated in Fig. 4. It will be seen that the filament rheostat R is included in the positive lead, and this is a very important point in all so-called high-tensionless receivers. If the valve filament operates off $3\frac{1}{2}$ volts effectively, a rheostat R will obviously be necessary, not only to obtain the best adjustment, but also to cut down the six volts from the accumulator B_1. The six volts from B_1 is distributed over the filament itself to the extent of $3\frac{1}{2}$ volts, the left-hand side of the filament being negative and the right-hand side positive, and the other $2\frac{1}{2}$ volts appears across the used portion of the rheostat R, the slider being negative and the foot of the rheostat positive. The result is that the $2\frac{1}{2}$ volts across the rheostat R acts in series with the $3\frac{1}{2}$ volts across the filament to give the anode a positive potential of +six volts with respect to the negative end of the filament. If the rheostat R were included in the negative lead to the filament, the anode voltage would be only $+3\frac{1}{2}$ volts.

The experiments of Messrs. G. V. Dowding and K. D. Rogers have focussed attention on the problem of reducing the high-tension voltage necessary to operate a valve, but some really startling statements have been made which require friendly correction.

The quite pleasing results which are obtainable by using the filament accumulator as a high-tension battery have stimulated their enthusiasm for "an amazing invention" which is to result in "No more H.T." They state: "The point we wish again to stress is that, although innumerable attempts have been made to reduce H.T. to a minimum, no one, previously to ourselves, seems to have endeavoured to eliminate the H.T. battery altogether."

Owing to the very wide publicity which has been given in the general Press to opinions of this nature, it is, perhaps, desirable to throw a little light on the subject for the benefit of those who have, perhaps, neither the opportunity nor the inclination to examine what has been done in the past.

In the beginning of 1918 the trench sets supplied to the British Expeditionary Force were of the crystal type, and, desiring to improve the range and constancy of these sets, I converted a considerable number in the 1st Army area to a circuit illustrated in Fig. 5. This arrangement eliminated the high-tension battery, to use the present popular expression, and so did away with the disadvantages of a piece of apparatus particularly inconvenient on active service. It is interesting to note that no grid condenser or leak is employed in this arrangement, which proved so effective that Lt.-Col. Trew, who was the officer in charge of wireless in the British Expeditionary Force, informed me that, just before the conclusion of the armistice, he had arranged to convert the whole of the trench sets in the British Expeditionary Force so that they could employ this circuit. The sets proved particularly effective during the battles of Festubert and Givenchy, when the Germans opened their offensive on April 9th, 1918. It will be recalled that on this occasion the 55th Division was, according to official records, the only one on the whole Allied front which held its front intact, and was personally thanked by Sir Douglas Haig and the President of France. Almost the whole of the communications on the first, and critical, day were carried out between front and rear by the wireless sets fitted with this arrangement, owing to the fact that a very heavy bombardment had cut all the ordinary lines of communication.

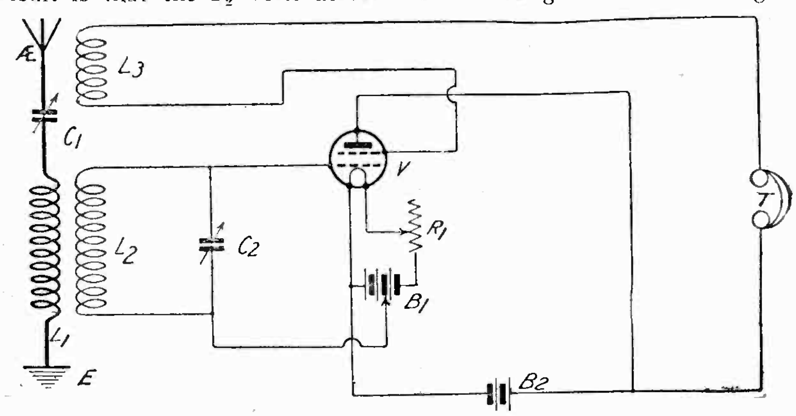


Fig. 10.—A further French circuit in which one grid is used for reaction.

The interest of this occasion lies simply, as far as this article is concerned, in the fact that high-tensionless receivers were being extensively used for vital communication work. No particular merit is claimed for the idea, which was subsequently published in my book "Thermionic Tubes in Radio Telegraphy and Telephony," the first edition of which appeared in July, 1921. The circuit is reproduced on page 114, and the following passages appear :—

"The anode circuit includes the telephones T, but there is no anode battery," and "Very loud signals have been obtained with this arrangement."

Fig. 6 shows a subsequent arrangement introduced by the General Electric Company of America, and this is really an ordinary receiving circuit in which the accumulator serves as the high-tension battery.

I could refer to a number of other cases, but I think I have indicated clearly that any novelty that may exist must be confined to particular circuital arrangements. The problem of eliminating the high-tension battery, and also its solution, are both old, and there is nothing amazing in regard to the matter to those in possession of the facts.

Coming now to specific arrangements, the most successful for general purposes is probably that which employs a valve using a grid kept at a positive potential for the purpose of lessening the space-charge in the valve.

The new Cowper single-valve circuit, using an ordinary valve, is, however, excellent and better than any arrangement we have yet tried: details were given recently in *Wireless Weekly*, and some particulars are in this issue; a double-grid valve amplifier may be added to the circuit.

A particular form of valve in which the space-charge is reduced is described in my British Patent 154,364, of September 8th, 1918. In this case a grid electrode, connected to the anode so as to form one structure, surrounds the filament, and this arrangement may be used as a rectifier, or an additional grid may be introduced so as to obtain a three-electrode valve effect, at the same time reducing the space-charge in the valve by the extra grid. A suitable circuit for such a valve is shown in Fig. 7. Long before this, however, a grid electrode at fixed positive potential was used to reduce the space-charge in a valve, and the most interesting facts in connection with the whole matter are concerned with arrangements in quite common use in France and Holland, which have not attained any popularity in this country for the very simple reason that suitable British valves have not been available. Double-grid valves have certainly been made, but their price has been

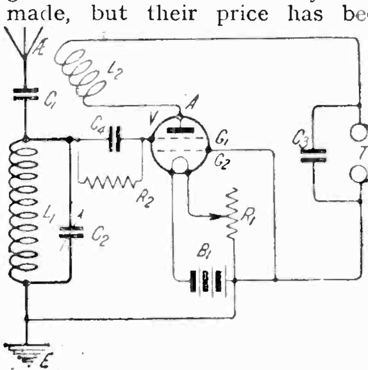


Fig. 11.—A simple circuit for four electrode valves.

prohibitive to the ordinary experimenter. The French and Dutch have a considerable number of circuits using double-grid valves in which the high-tension battery is either altogether missing or else consists of two or three dry cells.

Fig. 8 shows a circuit which is taken out of a French valve manufacturer's catalogue of a year ago. It will be seen that the inner grid of the valve, V, is given a positive potential by means of a battery B_2, consisting of two or three volts, and the accumulator B_1. The two batteries may, of course, be connected together and constitute the filament battery of the valve, a rheostat being used in the positive lead. The actual valves have been on sale for a long period for the very purpose we are concerned with.

Fig. 9 shows the arrangement in which the very small high-tension

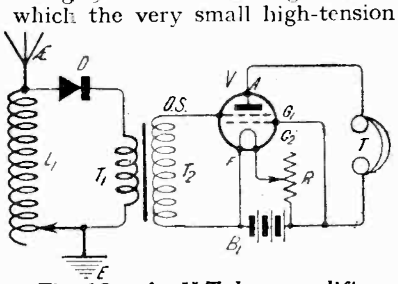


Fig. 12.—An H.T.-less amplifier with crystal receiver.

battery and accumulator are joined into one, a six-volt accumulator B_1 being now employed, and also a rheostat R in the positive lead.

Fig. 10 is another circuit published in the catalogue, and it will be seen that one of the grids is now used as an anode for the purpose of producing reaction. This circuit does not appeal to me particularly, but it indicates the line on which experiments have been carried out.

The Dutch experimenter has also been working on very similar lines, and in the experiments which we have carried out ourselves we have employed Dutch double-grid valves made by Phillips and supplied by Leslie Dixon and Co.

Fig. 11 shows a circuit which the average experimenter will want to try out with one of these double-grid valves. The condenser C_1 is a 0.0001 μF fixed condenser, for constant aerial tuning, while the inductance L_1 is, say, a No. 50 Lissen plug-in coil shunted by a variable condenser C_2 of .0005 μF capacity. This will enable any of the British broadcast wavelengths to be received, although for wavelengths over about 430 metres the coil L_1 may be a No. 75. The usual grid condenser and leak is provided, while in the anode circuit is a reaction coil L_2, which is a No. 75. The telephones are shunted by a condenser C_3 of 0.002 μF, while the inner grid G_2 is connected to the positive terminal of the six-volt accumulator B_1, and the rheostat R, which is of the Lissenstat minor type (an ordinary rheostat has not sufficient resistance), is included in the positive lead; particular care should be taken to see that this is done.

The circuit will give surprising results, and will enable audible signals to be obtained on a loud-speaker at 10 miles from a broadcasting station, although the results will be weak. With 'phones, however, excellent signals are obtainable even on a 5 ft. aerial.

Fig. 12 shows the use of a crystal detector and a high-tensionless low-frequency amplifying valve, while Fig. 11 is simply Fig. 11 with a stage of low-frequency amplification added. With this circuit good loud-speaker results are obtainable up to about 20 miles from a broadcasting station, but results are not equal to those obtained with a set using a high-tension battery. This raises a point which will be discussed subsequently.

If any difficulty is met with in any H.T.-less circuit as regards reaction, try tuning the reaction coil (*e.g.*, a No. 50 shunted by a 0.0005 μF variable condenser).

I have worked an S.T. 100 receiver without a high-tension battery by connecting the rheostats in the positive leads of a six-volt accumulator and, using double-grid valves, connecting the inner grids to the

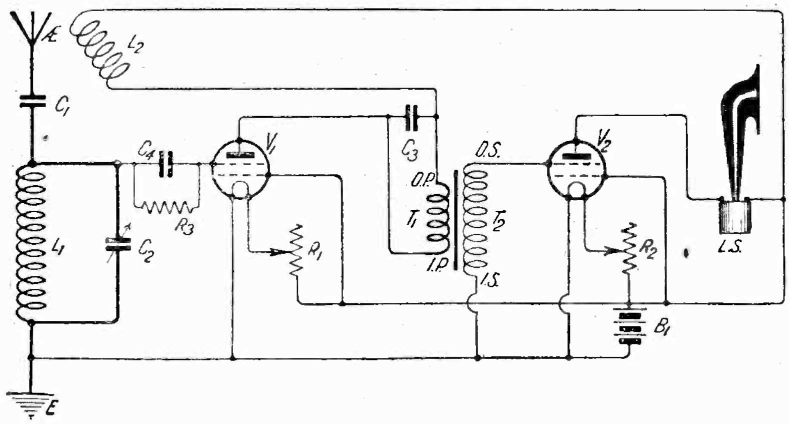


Fig. 13.—A two-valve H.T.-less Receiver.

positive terminal of the accumulator.

It is, in fact, possible to convert any set using ordinary valves into a high-tensionless receiver by connecting the rheostats in the positive leads using double-grid valves, and connecting the inner grids to the positive terminal of the filament accumulator.

It is only fair, however, to state that, while surprisingly good results are obtainable, yet they are not comparable with the results obtained with a properly designed receiver using a high-tension battery. Particularly is this the case where volume is required. The single valve experimenter will be better pleased than the multi-valve man who wishes to cut out his high-tension battery. The latter, and even the former to a large extent, are up against hard, cold, incontrovertible facts.

The difference between the new Cowper circuit and the ordinary non-reflex set is not so marked as when comparing two- or three-valve sets.

The H.T. battery is a great improvement on two valves, so that one might as well use H.T. on both valves.

To state that the results obtainable without a high-tension battery are inferior to those obtained with such a battery does not mean that high-tensionless receivers are uninteresting. There are, no doubt, many who are ready to sacrifice signal strength for convenience.

It is quite possible, moreover, that the general interest aroused by the discussion may lead to the design of valves using lower anode voltages. The Dutch and French valves using double-grids seem to work best when an additional six volts is used as high-tension battery, although they work perfectly well with simply the six volts of the accumulator. Any voltage over the extra six volts will not result in an increase in signal strength, but the ordinary valve using proper high-tension voltage has it every time when actual comparison is made. It may, however, be that in time a very low impedance valve will be produced giving the full amount of amplification, but even if this is so, we shall still use high-tension batteries, or their equivalent, even if they are smaller, and we will still be able to use, and probably will use, all the circuits now employed.

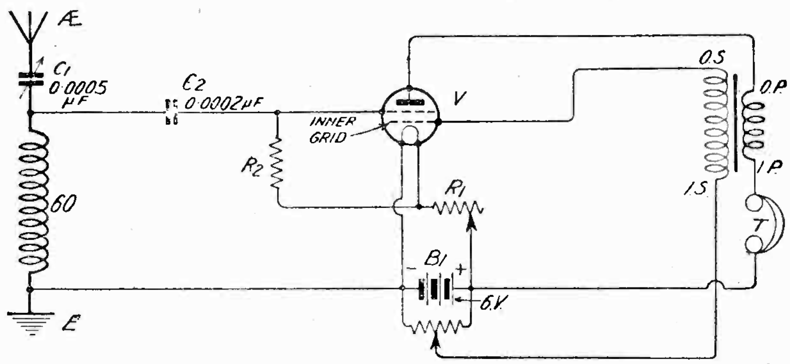


Fig. 14.—A circuit of experimental interest.

An interesting effect of the discussion will be to draw attention to double-grid valves, and if these can be turned out at, say, 15s. each by British manufacturers, a host of new circuits will be available to experimenters both with ordinary, or medium, high-tension voltages and with very small anode voltages. Many such circuits have already been published, but owing to the expense of the valves, few have been able to try them.

Commencing with the issue of June 3rd, *Wireless Weekly* will be giving a series of articles dealing with high-tensionless circuits of special design and also special double-grid circuits.

A few further circuits are given here to illustrate the article, which have been extracted from issues of *Wireless Weekly*, in which numerous details have already been published, including a full description of the first high-tensionless loud-speaker set. *Wireless Weekly*, incidentally, was the first periodical to publish high-tensionless receiver circuits.

I can only say, in conclusion, that it is hoped that readers of MODERN WIRELESS will calm the rather hysterical anxiety of their non-technical friends, who, I am told, are holding off buying sets, in many cases, because high-tension batteries have been abolished, and any set using them must be out of date. We have had the aerial-less set, the high-tensionless set, the accumulator-less set, and I have even used a receiver in which there was neither a loud-speaker nor telephone receivers. I forget the last-named arrangement because it was

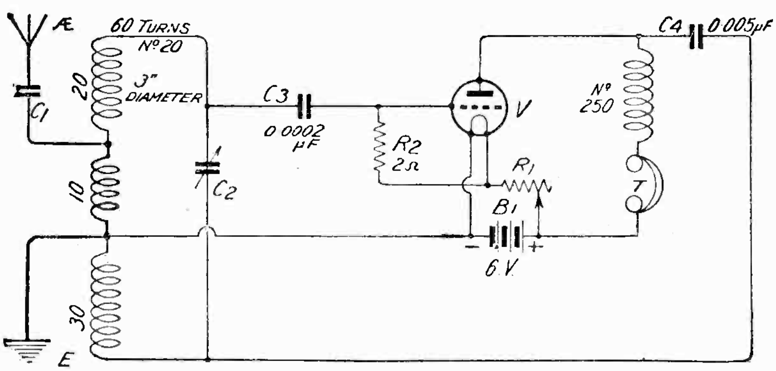


Fig. 15.—Another circuit given by Mr. Cowper.

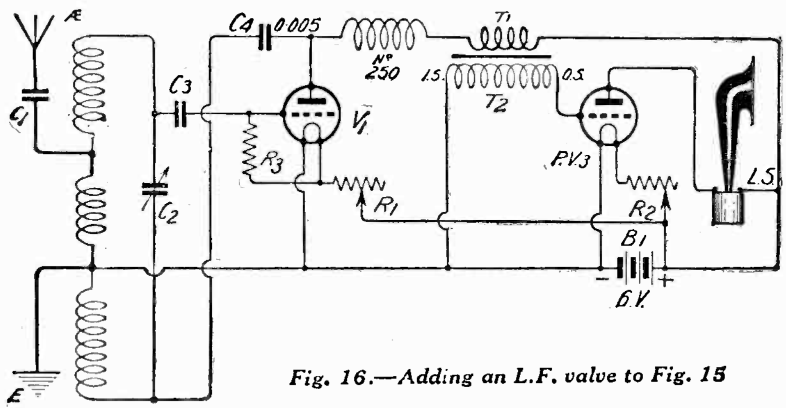


Fig. 16.—Adding an L.F. valve to Fig. 15

some time ago, but I believe that electro-magnetic vibrations were caused to vibrate the teeth. Nevertheless, at the risk of being considered behind the times, I continue to use these inconvenient accessories to wireless reception.

More Readers' Views

M.W. Modifications of the Grebe C.R. 13

To the Editor of MODERN WIRELESS.

SIR,—The following experiences of the above may be of interest to your readers. They are the results of a month's working on the circuit which is used with a transformer coupled audio-frequency amplifier of 2 L.S.5 valves. The set has been used here and in the north-east corner of Wales.

The amplification per valve is very high. The set is very stable when tuned, and while the initial tuning was difficult it is now possible to go round all the broadcasting stations by using known condenser readings.

Here I have received at loud-speaker strength both the Sheffield and Plymouth relay stations.

The set is equally good for wavelengths down to 300 as for wavelengths up to 2,800. I have not tried above or below these limits.

The selectivity is extraordinary. Here no difficulty is experienced between London, Cardiff and Manchester. Cardiff can be obtained without a trace of London and *vice versa*.

The background is very silent and absence from distortion is very marked. Broadcasting stations up to 50 miles come in strongly without much loss of strength, with either the earth wire fastened to the aerial terminal and no aerial or with an aerial and no earth.

After many trials I have found that it is best to use a much larger coil in the first anode coupling than in the second.

For wavelengths from 350 to 600 I use for the couplings the following coils :—

1st coupling	Anode.	Rimar 7.
	Grid	Lissen 75.
2nd coupling	Anode	Lissen 100.
	Grid	Lissen 75.

The No. 7 Rimar is, I believe, about a 200 coil.

Were I building the set again I should have a Vernier condenser for the first tuning grid condenser. The other condensers do not require it.

Adding reaction increases signal strength slightly but makes the potentiometer control very critical.

The set has been used very successfully with a loosely coupled double circuit tuner with tuned aerial and tuned secondary circuits, but owing to the sets selectivity with the single tuned aerial circuit I do not think there is much advantage.

The set has been used very successfully as the second half of the supersonic heterodyne method of reception. In N.E. Wales 2LO, which is very troublesome to find when 2ZY is at work, was easily got by this method, the 2LO wave being heterodyned up to 2,000 metres and received on the M.W. Grebe C.R.13 on 2,000; a loosely coupled dual circuit tuner was of course used for the M.W. Grebe C.R.13.

Yours faithfully,
C. R. BATES.
Market Harborough.

Choke Circuits

DEAR SIR,—Your article in a recent issue of MODERN WIRELESS re choke circuits is very interesting. I thought you would like to hear I have been using a similiar circuit for over two years, I consider I get very good results, as I have no difficulty in getting any of the B.B.C. stations, Paris, Brussels, Berlin, Airways, North Goodwin, and I have also had "W.G.Y." on 3 valves.

I am not using leaks on grids as I found these made no difference. The chokes are taken from "Ford" coils, also the last condenser. The first two condensers are home made. I usually listen to 2 LO using 4 valves and I get full strength compared with several transformer coupled sets I have heard. The set is very quiet and free from the noises usually heard when using transformers. It operates the loud speaker quite well on 3 valves when tuned to 2 LO and I can get fairly good results when using only 2 valves and speaker.

I use French "R" valves, 4 volts on filament, 60 volts H.T. and 120 ohms 'phones.

Yours faithfully,
S. W. HULL.
Audley Road, Colchester.

A Two-Valve Cabinet Receiver

By STANLEY G. RATTEE, Member I.R.E. Staff Editor.

A Broadcast receiver which, in addition to being of easy construction, permits tuning over a multiplicity of wavelengths.

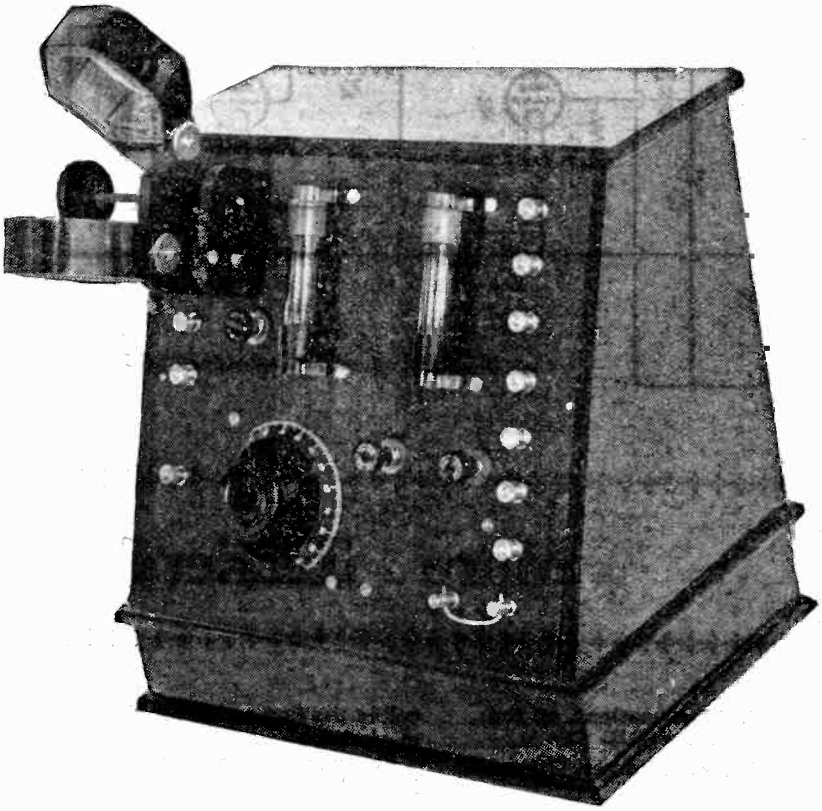


Fig. 1.—The general appearance of the receiver may be gathered from this photograph. Note that the two terminals for grid cells are short-circuited; when used they should be connected positive on the right, with negative on the left, the short-circuiting wire being removed.

THOUGH the circuit employed in the receiver about to be described is a well-known straight two-valve arrangement, the results obtained go to show that with careful construction and thoughtful disposition of components in relation to each other, the reception of most, if not all, of the British Broadcasting stations is possible upon the simplest two-valve circuit.

With the receiver as illustrated in the photographs, 2LO at a distance of ten miles is easily audible on a loud-speaker, using an indoor aerial. On the same aerial, Cardiff, Bournemouth and Birmingham can also be heard at good telephony strength on telephones. With a moderately good outside aerial all the B.B.C. stations, in addition to Radiola, are easily tuned.

General Considerations

In designing this two-valve receiver, it was intended to make the operation of tuning as simple as possible, and for that reason, a single-valve reaction circuit, coupled to a single stage of low-frequency amplification, was chosen in preference to one stage of high-frequency, followed by the detector with the concomitant tuning of two condensers instead of one. It was further desired to arrange the set in such a manner so as to permit the use of either one or two valves, and also to allow of either bright or dull emitter valves being used.

In order to obtain the maximum efficiency from the combination of a detector and a single stage of low-frequency amplification, an arrangement was decided upon whereupon a higher plate voltage could be applied to the low-frequency valve than in the case of the detector valve. Such an arrangement affords two distinct advantages over the usual method of applying a common H.T. voltage to all valves, in that, by keeping the detector plate voltage as low as possible, the set is less liable to oscillate unintentionally; and, secondly, applying the maximum voltage to the low-frequency valve for loud signals, in the usual manner of a common battery often makes the plate voltage of the detector valve too high for clear detection.

Components

For the guidance of those readers who intend constructing this receiver, the names of the manufacturers are given in addition to the components incorporated in the set, and though there is actually no obligation in the choice of components, to obtain results similar to those possible with the receiver illustrated, the values given must be adhered to :—

- One ebonite panel measuring 10 in. by 9⅛ in. by ¼ in.
- One variable condenser of 0.0005μF. capacity (Radio Instruments, Ltd.).
- One two-coil holder (Radio Communication Co., Ltd.).
- One Lissen "push-pull" switch (Lissen, Ltd.).
- Two Lissenstat minors (Lissen, Ltd.).
- One grid condenser 0.0002μF. capacity (Dubilier).
- One fixed condenser of 0.0001μF. capacity (Dubilier).
- One grid-leak, 2 megohms (Dubilier).
- One fixed condenser 0.001μF. capacity (Dubilier).
- One similar condenser, 0.002μF. capacity (Dubilier).
- One low-frequency transformer (Woodhall).
- Twelve brass terminals.

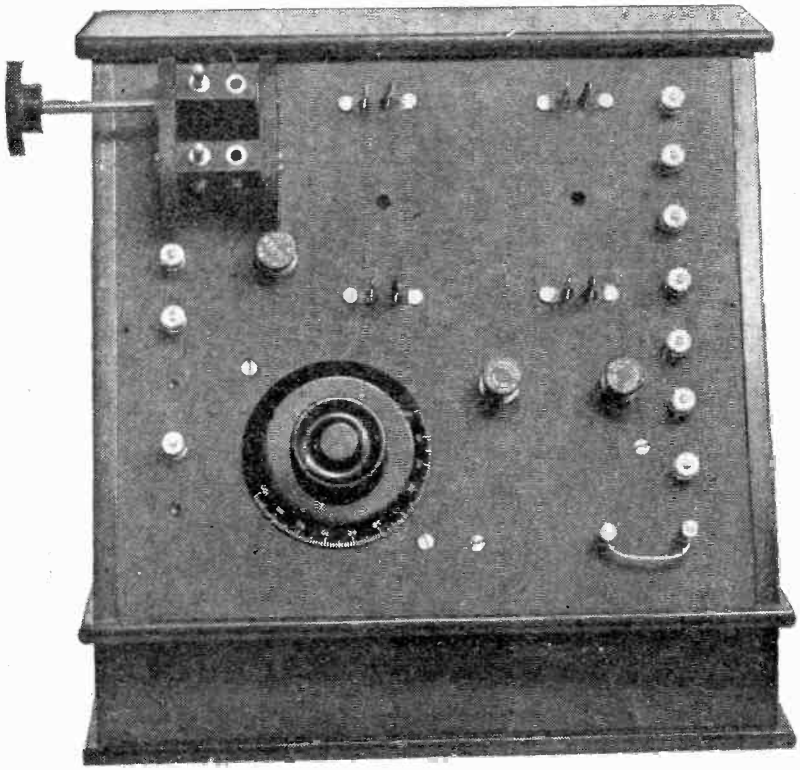


Fig. 2.—The front of the panel with valves and coils removed. Fig. 4 indicates the purpose served by the various terminals.

Two Myers' valves (bright or dull emitter type).
Set of plug-in coils for the wave-lengths desired.
One fixed condenser of 0.05μF. capacity (Dubilier).
One accumulator (for bright emitter valves 6 volts 40 amperes actual, for dull-emitter valves 4 volts 40 amperes actual).
One H.T. battery up to 70 or 100 volts.
One pair of 2,000 or 4,000 ohm. telephones.
Quantity of No. 16 tinned-copper or "square" wire for connecting purposes.

The Circuit

A simple theoretical arrangement of the circuit is shown in Fig. 6, in which L_1 is the aerial inductance tuned by the condenser C_2. L_2 is the reaction coil, C_3 R_3 the grid condenser and leak; R_1 and R_2 the filament resistances; V_1 the detector valve; IP. OP., IS.OS the low-frequency transformer with the condenser C_4 shunted across the primary winding, and T the telephones. C_5 and C_6 are fixed condensers shunted across the telephones and H.T. respectively. The circuit actually employed in the receiver is shown in the next figure, which introduces the switch S for cutting out the second valve,

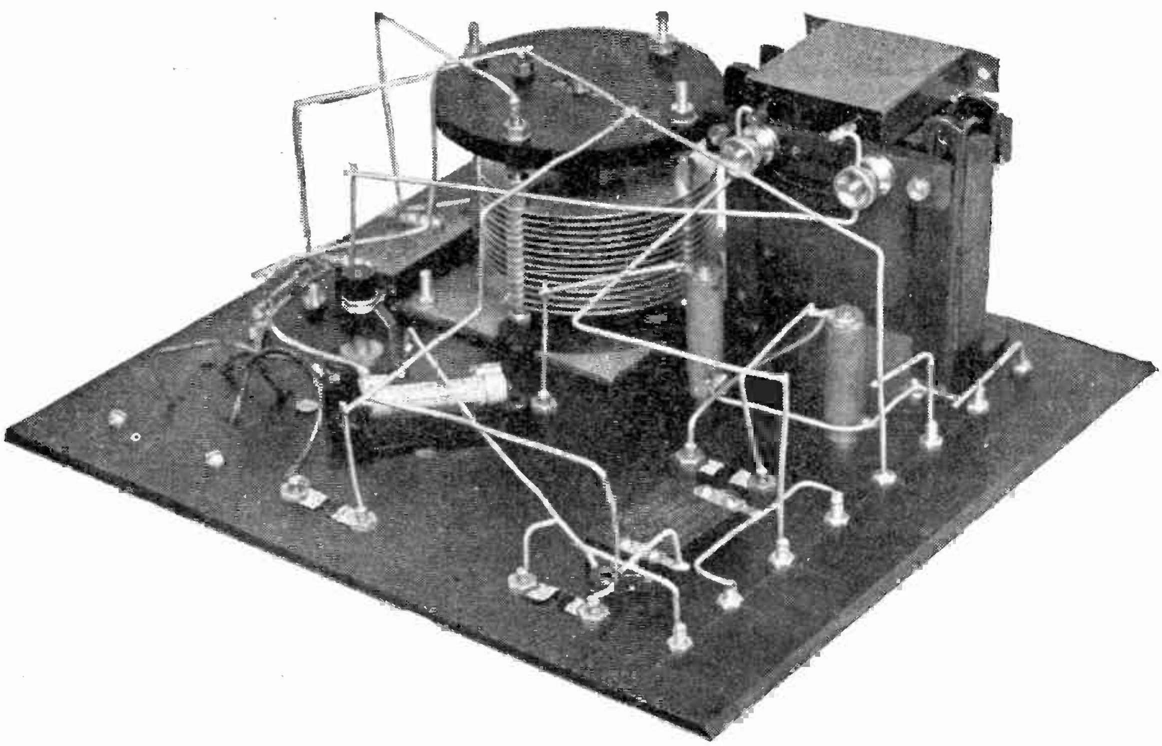


Fig. 3.—A view of the underside of the panel showing the wiring and disposition of the components; the terminals seen to the right of this photograph correspond with those seen to the right of the previous illustrations.

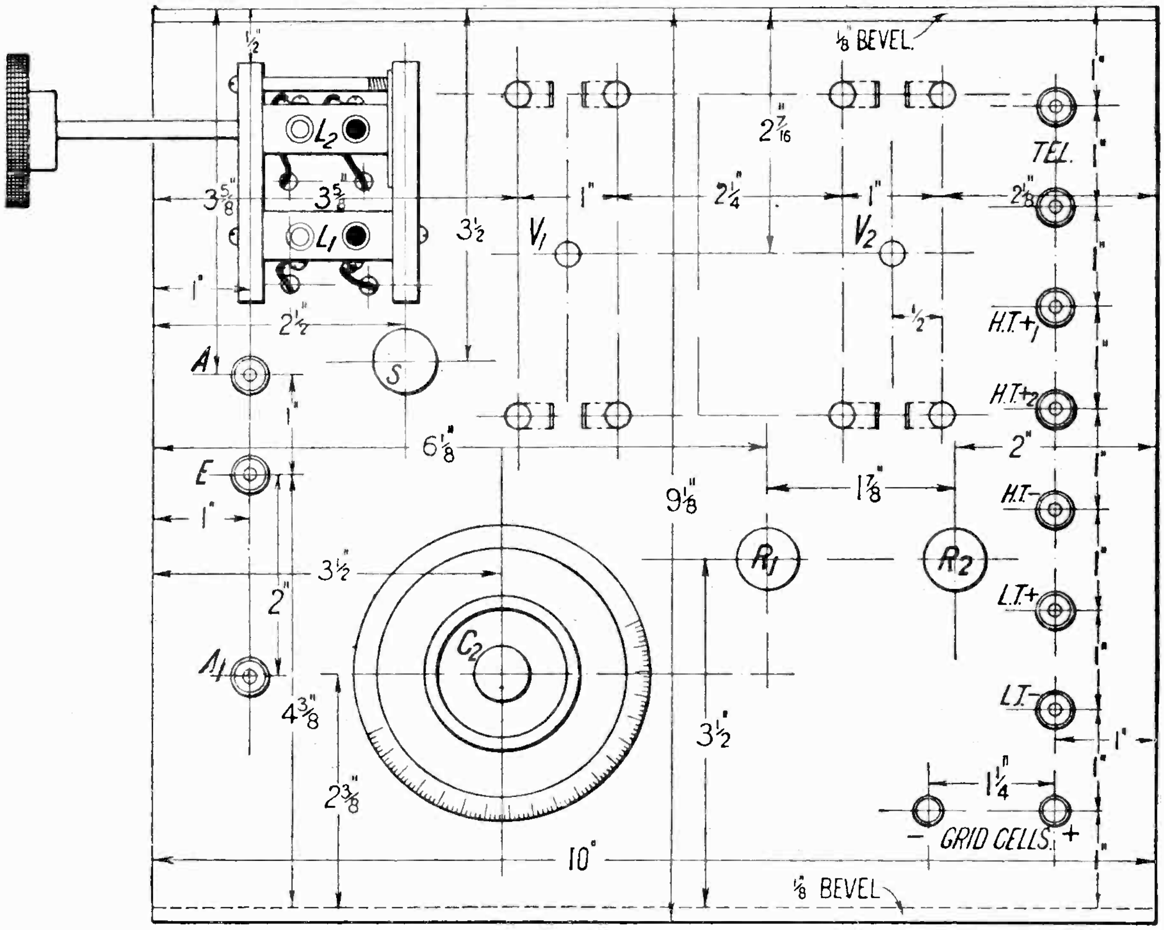


Fig. 4.—The layout of the panel, blueprint No. 44a.

and also shows the arrangement of H.T. battery connections. It will also be seen that constant aerial tuning is employed.

The Panel

This is drilled in accordance with the dimensions given in the figure illustrating the lay-out, after which the panel should be treated on both sides with a careful rubbing of fine emery paper in order to remove all traces of the glossy surface. Certain manufacturers are now marketing a specially finished ebonite, which has a highly-polished surface, guaranteed to be non-conductive, and in cases where readers are assured that the material purchased is of this type, the removing of the surface skin is not in any way necessary.

Wiring the Receiver

The method of wiring can be gathered from the photograph showing the underneath of the panel, whilst the actual work of wiring the components may be followed by a careful study of the wiring diagram. All connections must be soldered, and leads must be kept as short as possible, particularly so in the grid circuits.

Grid Cells

Should the reader decide to use dull-emitter valves with this receiver, then the incorporation of a grid biassing battery is advocated, and in order that such an addition may be made, two separate terminals are provided. A battery of about 4½ volts made up from flash-lamp cells is sufficient for grid bias, the inclusion of which will eliminate the gruff woolly speech which is sometimes experienced when using dull-emitter valves for low-frequency amplification. Should the battery not be used, or should the cells become exhausted, then the two terminals across which the battery would normally be connected should be short-circuited as shown in the photographs.

The H.T. Connections

The two terminals shown in the wiring diagram, H.T. + 1 and H.T. + 2, provide the plates of the two valves with the separate voltages referred to in an earlier paragraph. The terminal H.T. + 1 should be connected to the socket of the H.T. battery labelled 50 or about that figure, according to the valves in use, whilst the terminal H.T. + 2 should be connected to the 70 or 75 socket or higher, according to the results obtained; the H.T. negative of the battery is connected in the normal way to the H.T. negative terminal of the set.

This arrangement permits an adjustable voltage of 50 volts or more to be applied to the plate of the detector valve, and 75 to 100 volts upon the plate of the note-magnifier. By switching over to the single-valve circuit the higher voltage is applied to the plate of the detector automatically.

Constant Aerial Tuning

In order to simplify the tuning arrangements, the receiver is fitted with constant aerial tuning, the virtues of which were fully described

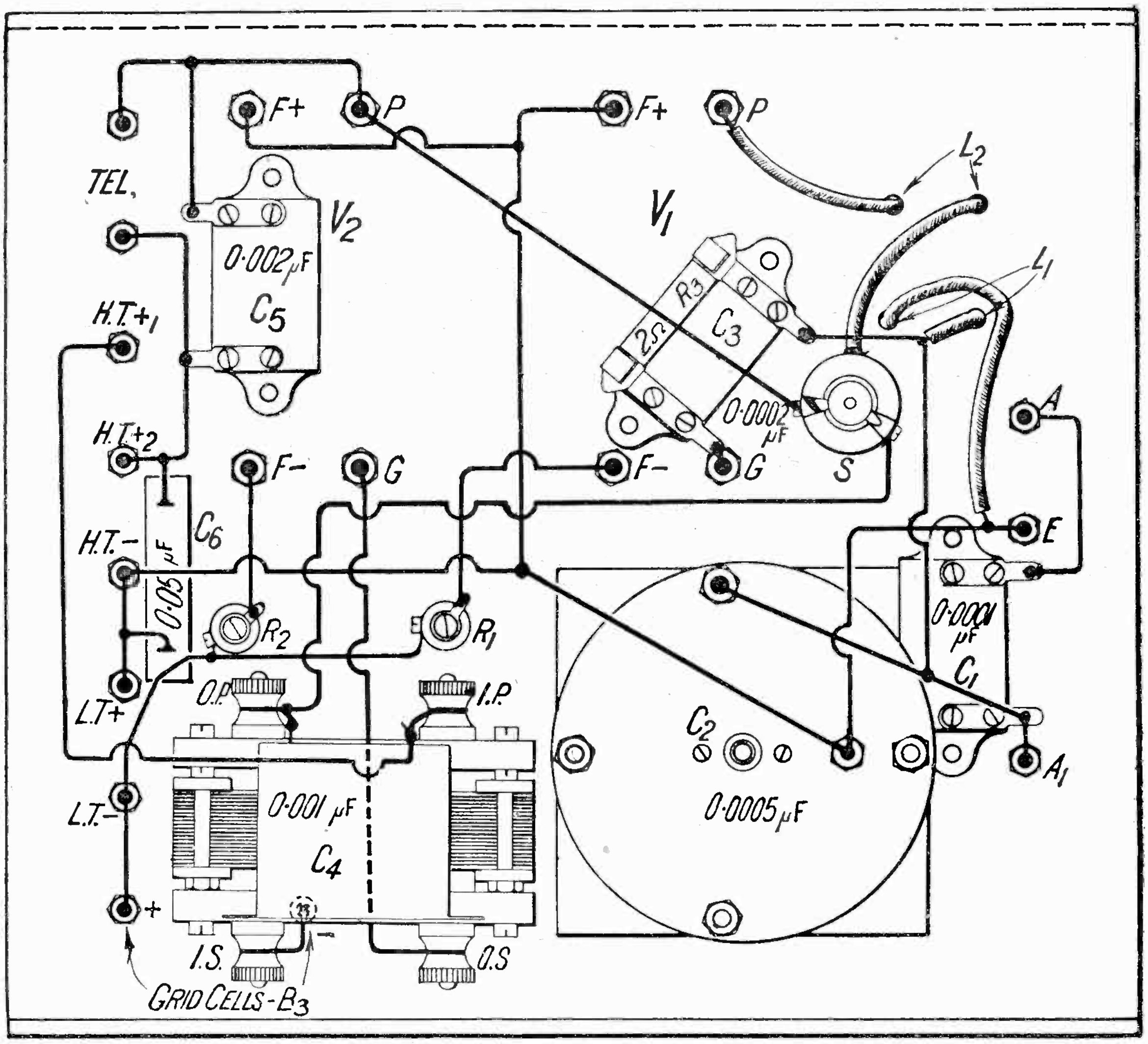


Fig. 5.—Practical wiring diagram, blueprint No. 44b.

in the columns of this journal in the February and March issues of this year.

By means of this arrangement it is possible to cover the whole of the B.B.C. wavelengths with two coils for aerial tuning—namely a No. 50 for the lower waveband and a No. 75 for the higher.

When tuning to the longer wavelengths, say 600 metres and upwards, the aerial should be disconnected from the C.A.T. terminal A (see Fig. 7) and connected to the top of the inductance L_1—namely, terminal A_1, the terminal A being left free; the earth connection remaining as hitherto.

Switching

The purpose served by the switch S is to permit the use of either one or two valves. With the switch "in," the detector valve only is in circuit when the filament resistance R_1 should be used for filament lighting, the resistance R_2 being in the "off" position.

With the switch "out" both valves are in circuit, when both the filament resistances R_1 and R_2 should be used for filament lighting.

It should be noted by readers that this switching in or out of the last valve changes the position of the telephones in the circuit, at the same time increasing the plate voltage applied to the detector valve in the case of single-valve reception, and decreasing it in the case of the two-valve circuit; the higher voltage then being applied to the low-frequency valve.

When switching over from one valve to two, it may be found necessary to readjust the position of the reaction coil and condenser C_2 on account of the smaller H.T. voltage, which is then applied to the detector valve. Similarly when changing over from two valves to the single-valve arrangement, the reaction coil and aerial condenser may again need readjustment.

Operating the Receiver

For the reception of the B.B.C. stations with wavelengths between 300 and 400 metres, connect the aerial to the C.A.T. terminal A, leaving the A_1 terminal free, and the earth to E, when a plug-in coil No. 50 should be inserted in the aerial socket and a No. 50 or 75 in the reaction coil socket. The two coils should be turned at right-angles to each other, the H.T. connections made and the filament current applied. Turn the condenser very slowly, at the same time bringing the reaction coil nearer the aerial coil, taking extreme care whilst so doing that the set is not made to oscillate. When the desired signal has been picked up, leave the reaction coil in position and obtain the best results by varying the condenser slightly. With the best possible results obtained by this means again adjust the reaction coil, making further slight alterations to the condenser.

(*Continued on page* 37.)

Above & below the Broadcast Wavelengths

Give a Dog a Bad Name.

FOR high-frequency amplification for the shorter waves there is, I suppose, no method of coupling to equal for efficiency the tuned anode. Unfortunately this circuit has obtained rather a bad reputation for instability and for proneness to causing self-oscillation in the receiving set. Most amateurs can and do use one tuned anode, but if you suggest the addition of a second high-frequency valve coupled in the same way they are as likely as not to hold up their hands in horror and to tell you that to do such a thing is next door to impossible with any kind of comfort. Now this attitude I believe is due chiefly to the way we have of accepting as gospel everything that is said three times. Various writers have condemned any circuit containing more than one tuned anode as unpractical, and the world of wireless men seems to have accepted their verdict without question. It is a case of "give a dog a bad name and hang him." As a matter of fact, a pair of tuned anodes can be used for quite short wave reception—certainly down to 300 metres—with no more trouble than any other kind of high-frequency coupling, provided that pains are taken in the design and construction of the set. Put together carelessly a circuit of this kind and you will find that you cannot go near it without its howling at you, and besides being a nuisance to yourself it will also interfere with all your neighbours, for it is capable of causing the aerial to radiate strongly. But take a little trouble over the details and you can have an exceedingly efficient high-frequency amplifier.

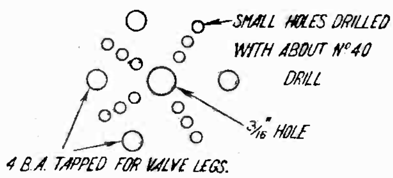


Fig. 1.—A useful method of reducing capacity in valve sockets.

Unwanted Capacity.

The first thing to do in designing a receiver containing a pair of tuned plates is to take every possible step for the elimination of unwanted capacity. The way in which wiring is done is of the utmost importance, for any capacity between the leads on the high-frequency side of the set will lead to instability. The bare wiring method should always be employed. When wiring is done in this way all leads which must cross should do so at right angles. Wires should be separated from one another by at least ½ in., and this distance should be doubled if they run parallel for any length. Heavy wire or square rod should be used throughout so as to offer the smallest high-frequency resistance by providing a large surface area.

The most efficient valves for high-frequency work are those of anti-capacity type, such as the Mullard Ora B, S3 and S7, the M.O. V24 and QX, with their dull emitter counterparts DEV and DEQ, or the Myers's Universal. If these are mounted directly on to the panel by means of clips inter-electrode capacity is very small indeed; but their good qualities are to a great extent neutralised by placing them, as so many of us do, in adapters made to fit ordinary four-socket valve holders. But it is not absolutely necessary to use special valves of this type, for stability can be obtained with any valve of good design if care is taken over the mounting. I have, for example, used the Mullard Ora with complete success in a double tuned anode set for all broadcast reception. For 4-pin valves never use a moulded holder with sockets embedded for their whole length in ebonite. By far the better method is to employ separate valve sockets and to shorten them as much as possible; they can be cut down to about one-third of an inch in length without in any way impairing their grip upon the valve pins. Valve legs should always be tapped in, for then there is no need to use nuts on their shanks. If nuts are used they must of necessity lie very close together on the underside of the panel with a consequent increase in capacity. A useful tip for reducing the capacity of valve holders is shown in Fig. 1. When the tapped holes for the legs have been made, drill at the centre of the circle upon which they lie a 3-16 in. hole; then make three or four small holes very close together between each pair of valve legs, as shown. A drill of about No. 40 gauge is suitable for the purpose. If a small, fine file is available, or if a fretsaw blade can reach the position, still better results will be obtained in the way shown in Fig. 2. Here cuts are made between the pairs of valve legs so that there is a considerable air space between them. Ebonite has a higher dielectric co-efficient than air, and therefore produces a greater capacity when it separates current-carrying conductors. On the other hand, its dielectric efficiency is lower than that of air, hence it causes larger hysteresis losses. By drilling holes or making cuts between the legs we decrease the capacity and improve the insulation of the holder without unduly weakening the ebonite. If a Morris template is used there

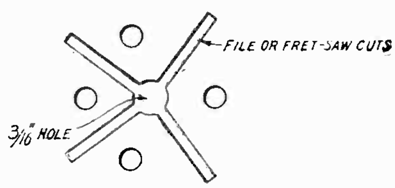


Fig. 2.—An alternative method.

will be no difficulty about finding the place at which the 3-16 in. hole should be drilled, for it is provided with a central hole.

Inductances.

The question of ind -tances for tuned anode circuits is one that has not received sufficient attention. The instability of most double tuned anode circuits can be traced very largely to cross coupling between the coils in the tuned circuits. Where this occurs oscillation is bound to take place when sharp tuning is approached in both circuits. Now, when you come to think of it, we do not require in the tuned anode inductances quite the same qualities that we want in are those of wide, shallow form, such as the Igranic or the Lissen inductances. When these are placed at right angles 4 in. apart, there appears to be practically no coupling at all between them on the short wavelengths. It will not as a rule be found desirable to use a double circuit tuner with a pair of tuned anodes. Complete selectivity can be obtained by means of the anode circuits, and the use of a secondary coil in the tuner greatly increases the tendency to oscillate. Nor will it be found possible in most cases to use reaction coupled to the A.T.I. If reaction is required it should be coupled to the second high frequency valve inductance. As a

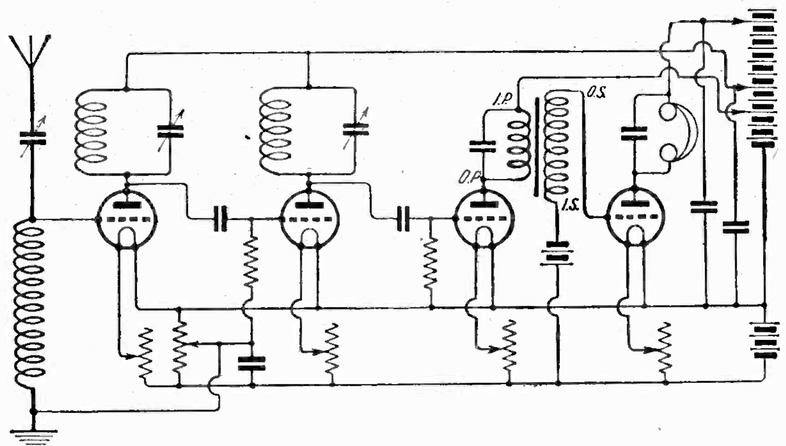


Fig. 3.—A set with multiple H.T. tappings.

the A.T.I., the C.C.I. or the reaction coil. Part of the business of these last coils is to provide a strong coupling when it is needed. The tuned anode inductance, however, we require to behave in exactly the opposite way; we want it to be a coil which will not cause interaction with others or be affected by them. The type of inductance which gives the strongest coupling is the pancake or flat basket design. If these are wound with heavy wire, and so made of large diameter, the distance at which interaction between two of them placed face to face can take place is really amazing. Some time ago I wound a pair with flex wire for broadcast reception, using them as primary and secondary of the tuner. I work them as a rule from 5 in. to 8 in. apart, obtaining very strong signals. With coils of this kind cross coupling may occur at very much greater distances, even up to several feet. Nor can zero coupling be obtained by placing them at right angles to one another unless they are a long way apart. The most suitable coils for the purpose

matter of fact, the signal strength with a pair of tuned anodes is so great that no direct reaction is usually required.

Tuning.

It might be thought that with two sharply tuned high frequency circuits searching would be rather a difficult business. As a matter of fact, it is not really, if the secondary circuit is eliminated, for then the only tuning controls are the three condensers, the A.T.C. and those of the anode circuits. These may be reduced to two if a double condenser such as the Fallon "Duanode" is used, but when this is done perfectly sharp tuning of both circuits is not obtainable unless the inductances have been very carefully matched. When searching for transmissions it is only necessary to set the second tuned anode condenser approximately and to work with the A.T.C. and the first. As soon as the sharpest tuning has been obtained with these two the second anode condenser may be finally adjusted. Alternatively, resistance capacity coupling may be used for the second valve whilst searching is in progress. This can be done very simply by setting its condenser at zero, removing its inductance from its holder and replacing it with a 50,000 ohm non-inductive resistance provided with plug and socket mounting.

Plate and Filament Potentials.

Perfect stability with two tuned anodes can be obtained only if the plate and filament potentials of the high-frequency valves are properly adjusted. It is a mistake, really, to attempt to use the same anode potential for all the valves of the set. It is very little more trouble to design the set in the way shown in Fig. 3, so that the potentials of high-frequency valves, rectifier and note-magnifiers may be adjusted independently. If the battery is equipped with sockets giving six volt steps, all that is necessary is to fit three high tension positive terminals to the set, marking them HF, R, and LF. Differently-coloured wander plugs should be used for each. The plugs may be marked very easily by making a hollow with a suitable drill at the top of each and filling with paint. The battery should be one with a maximum voltage of about 120. Eminently suitable for the purpose is the No. 924, made by Messrs. Siemens, which consists of very large cells and is capable of a big output without becoming noisy. A set made up on the lines shown in Fig. 3 will give very much better results than one in which a single high tension plus busbar is used, since all valves can be worked on the proper portion of their characteristic curves. The correct adjustment of filament and plate potentials for tuned anode valves is found in the following way: The filaments are set at about normal brightness and the anode potential is adjusted to the maker's figure. A strong signal is then tuned in as sharply as possible. The set will probably oscillate or even howl loudly. Use the potentiometer to check this to some extent, but do not introduce heavy damping by throwing a large positive potential on the grid of the first valve. Try the effect of varying the anode potential. If this does not stabilise the set, turn to the rheostats. Move them first in one direction and then in the other until the silent point is found. The valves will oscillate if they are receiving either too much or too little filament current. Once the correct setting for a given anode potential has been found the set will as a rule become perfectly stable. Do these experiments, if possible, outside broadcasting hours, such as when the station is testing.

A Stabiliser.

Should there still be signs of oscillation it is due to cross coupling either between the anode inductances themselves or between one of them and the A.T.I.—that is, supposing that care has been exercised to eliminate unwanted capacity. If the set cannot be tamed in any other way we must introduce a form of stabiliser which was referred to some months ago in MODERN WIRELESS. This consists simply of a 400-ohm potentiometer wired as a rheostat which is placed between the anode inductances and the HT plus lead, as shown in Fig. 4. This method, which I have now had in use for more than a year, is extremely effective, but I cannot pretend to say definitely exactly how or why it works. Certainly, even if the full resistance were thrown into circuit, which is very seldom the case, its effect upon the anode voltage would be negligible. Probably the potentiometer which is inductively wound acts as an adjustable radio frequency choke, and it may be that the extra resistance thrown into the circuit just suffices to prevent the valves from being tuned sharply enough to oscillate. I can, however, state emphatically that it is most effective. I have used the stabiliser now in four different sets, so there can be no question of a freak result obtained, only in one special set of circumstances. In every case it acts equally well. The following experiment will give convincing proof of its powers of soothing even the wildest combination of tuned anodes. Place the slider of the potentiometer so that there is no resistance in the circuit, then tune the set sharply to a strong transmission and get it into violent oscillation. Now move the slider slowly so that the resistance is gradually added. Up to a point nothing will happen, then oscillation will show signs of decreasing, and as the movement is continued it will disappear altogether. As more resistance is added after this point is reached the set begins to oscillate again and finally howls as badly as before. The adjustment of the resistance is not particularly critical, for once the silent point has been found the slider can be moved for some distance before oscillation begins again. When the resistance has been properly set it can be left alone for all wavelengths for a wide band on either side of that upon which the original adjustment was made. Small movements may be necessary on wavelengths very much above or below it.

Quiet, Efficient Working.

I have at the present time two double tuned anode sets in use, one with a single stage of note magnification and the other with two stages. Both are as stable as sets fitted with aperiodic high frequency transformers. Neither of them can be made to oscillate upon broadcast wavelengths unless the rheostats, the high tension wander plugs, the grid potentiometer or the stabilising resistance are interfered with. All of these may be described as permanent settings which do not require to be touched. Should either set show signs of oscillation it is a pretty certain indication that the

Arrangement of Inductances.

The arrangement of the coil-holders on these sets is the result of a considerable amount of experimenting with them in different positions. Fig. 5 shows how they are placed. It will be seen that all three are at right angles to one another. The A.T.I. is mounted upon the side of the cabinet in a horizontal position. The first tuned anode inductance stands upon the panel and is parallel with its short edge, whilst the second is parallel with its long edge. The distance separating each coil from its next door neighbour is 4 in. With this arrangement no interaction of any kind seems to take place, and it is one that may be adopted by experimenters with every confidence for circuits of all kinds.

Frame Aerial Efficiency.

I have often wondered if any

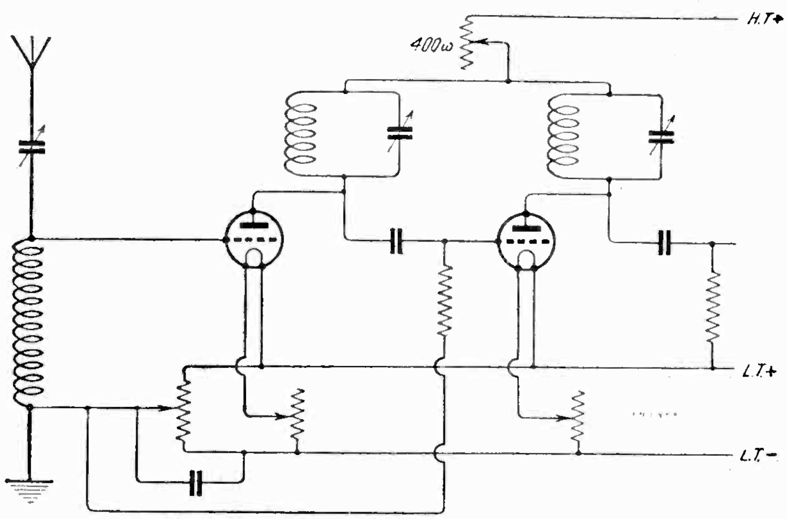


Fig. 4.—The use of a potentiometer in series with the H.T. lead is novel and interesting.

accumulator requires to visit the charging station. The selectivity obtainable is extraordinarily good. At twenty-five miles north-west of London either Cardiff or Manchester can be tuned in without interference from 2LO. 5IT again can be separated from 6 BM, and every British, French and Belgian broadcasting station comes in at good loud-speaker strength, even on the smaller set. I have not so far tried either of these sets on the very short waves, because I have not had the time to make up a suitable set of inductances. But I have very little doubt that they will do quite well, for both are perfectly stable on 300 metres, which is as low as I can tune them with the present set of coils.

definite figure could be given for the efficiency of a frame aerial as compared with an outdoor one in the same locality, but it seems to be a very complicated question. In my own case the outdoor aerial is infinitely superior to any two-foot frame—in fact, with the latter a five-valve set is no more efficient than a crystal and note-magnifier on an outdoor aerial. This I imagine is due to some curious local condition, for quite a short indoor aerial consisting of a suspended wire gives very satisfactory results and is infinitely better than the frame. Mr. Harris puts the frame down at two high-frequency stages worse than the outdoor aerial, whilst another friend who uses both finds that there is only one high-frequency stage between the two. There is little doubt that when it is used out of doors the frame works much better than it does within doors. If I take my frame down to the bottom of the garden, where it is away from all buildings, the results are quite passable. Another curious point is that the frame is in some cases strongly directional, whilst in others it is not so at all. At my station 2LO comes in best when the frame is pointing about 15 to 20 degrees off its true bearing. This must, I suppose, be due to the presence of gas or water pipes or some other metal objects in the walls. Those who rely upon their frame aerials for detection of howling fiends should be careful before making definite accusations, for bearings taken in this way are frequently most misleading. Not long ago two of us endeavoured

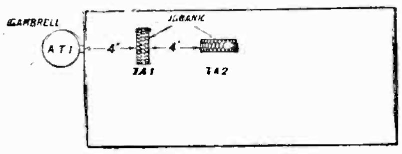


Fig. 5.—Showing how the coils in the author's set are arranged.

to locate a certain bad offender by taking cross bearings from our stations, which are a mile apart. Working very carefully each of us got a definite bearing, and these were plotted out upon a large scale map. You may imagine our surprise when we found that the point of intersection of the straight lines which we had drawn came in the middle of a ploughed field more than half a mile from any house and with no aerial at all anywhere in the neighbourhood. Thinking that we must have made a mistake we did all the work over again on another evening, taking even more trouble over it. The results were exactly the same!

LAMBDA.

A WARNING

Do not search for stations by making your reaction coupling very tight and then swinging the condenser backwards and forwards in the hope of picking up a carrier wave. If you do this you will be an intolerable nuisance to your neighbours and will completely ruin their enjoyment of signals. If you *must* oscillate use as little reaction as possible and *do not search near the wavelength of the station which is near to you.*

A Two-Valve Cabinet Receiver—(*Continued from page* 33).

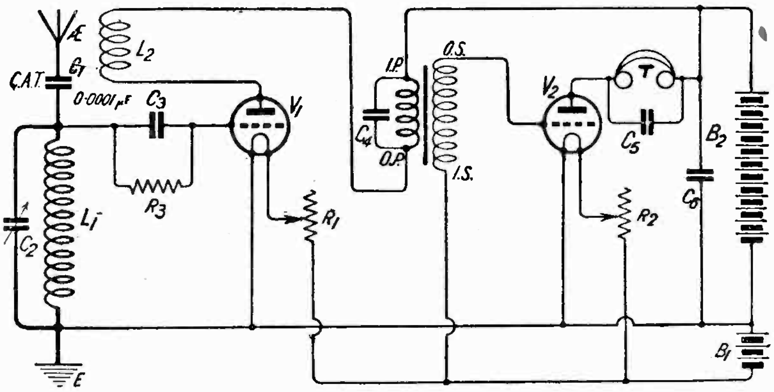


Fig. 6.—The theoretical circuit.

Should the set fail to show any tendency to oscillate, then the absence is indicative of the fact that the connections to the reaction coil should be reversed.

For the reception of the B.B.C. stations working on wavelengths between 400 and 500 metres, the same operations should be gone through, bearing in mind the same precautionary remarks relative to oscillating, using in the aerial socket coil No. 75 and No. 75 or 100 in the reaction coil socket.

These operations are precisely the same using either one or two valves.

Wavelengths other than B.B.C.

Those readers whose ambition takes them beyond the B.B.C. wavelengths, should, in the case of shipping and wavelengths above, connect the aerial to the terminal A_1, leaving the A terminal free and with the earth in its normal position, use a No. 50 or 75 in the aerial and a No. 100 for reaction; for aircraft telephony a No. 75 or 100 coil in the aerial with a No. 150 or 200 for reaction; for Radiola a No. 150 in the aerial and a No. 250 or 300 for reaction; for the Eiffel Tower a No. 250 in the aerial and a No. 400 or 500 for reaction, the operation of the receiver being the same for either one or two valves.

Valves.

It will be observed from the photographs that Myers' valves are used, though readers may, of course, use the ordinary four-pin valves

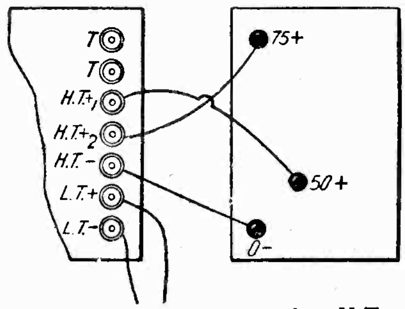


Fig. 8.—Illustrating the H.T. connections. The positions of H.T. + 1 and H.T. + 2 should be found by experiment according to the valves in use.

should their preference lie in that direction.

Whilst testing the set after its completion one of the valves shown was dropped on a tiled hearth without ill effect. This method of treating valves is, however, not to be recommended.

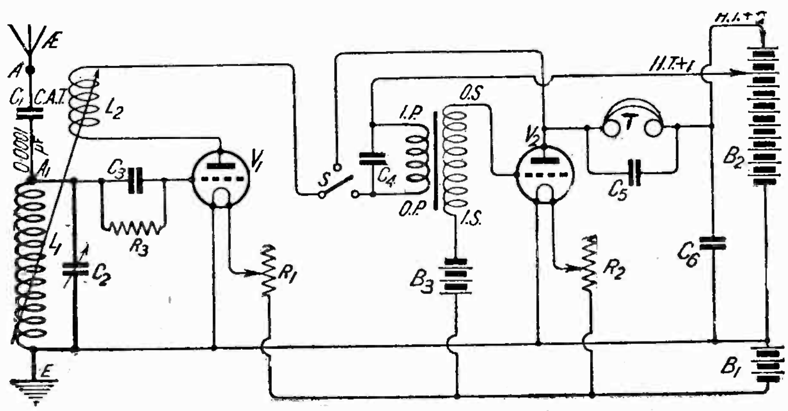


Fig. 7.—The circuit employed in the receiver.

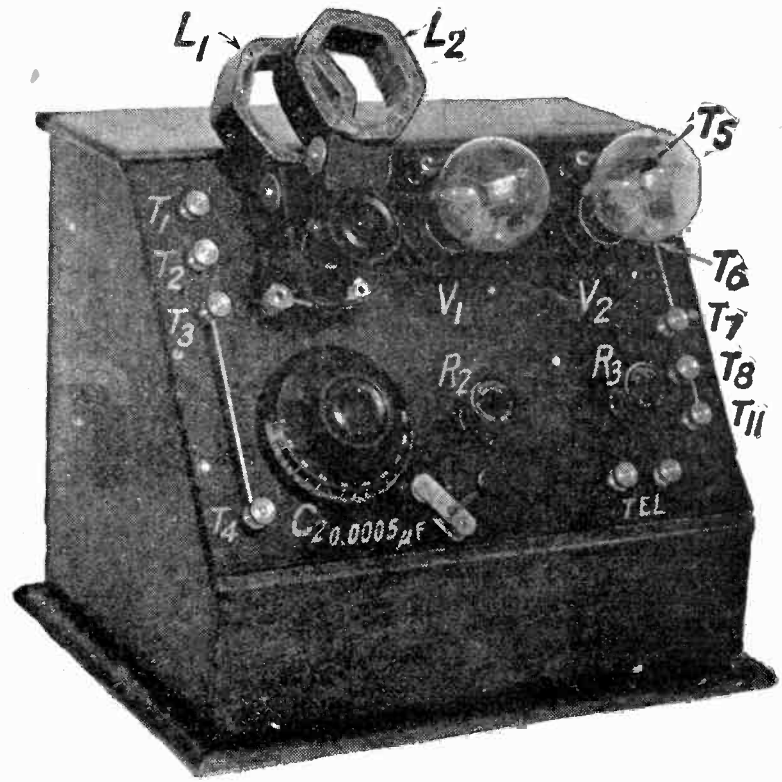


Fig. 1.—The appearance of the completed receiver.

The "Modern Wireless" High-Tensionless Receiver

By Herbert K. Simpson

A description of a two-valve set which will give good loud speaker signals without the use of a high-tension battery. The set has the additional advantage that it may also be used with ordinary valves and high-tension battery.

MUCH attention has been focussed of late upon the problem of eliminating the high-tension battery, and several designs have been put forward with this aim in view. A measure of success has been achieved in some cases, but when one considers the question of working a loud-speaker without the use of an anode battery, the problem assumes greater proportions.

By the use of valves of the four-electrode type, however, quite good loud-speaker signals are obtainable up to about 15 miles on two valves, the first acting as a rectifier, with reaction, and the second being a note magnifier. Apart from the valves, all the components used are of quite standard design, no special parts being required. The valves are obtainable from Messrs. Leslie Dixon, of 9, Colonial Avenue, Minories, London, E.1, and, to ensure the correct type being obtained, reference may conveniently be made to this article.

The appearance of the finished set is seen in the photograph, Fig. 1. L_1 is the aerial coil, being that plugged into the lower socket of the two-coil holder. The upper socket is that holding the reaction coil L_2, from which two rubber-covered flexible leads terminating in Clix plugs are led to two Clix sockets upon the panel. By this means the reaction coil may be easily reversed when required. C_2 is the aerial tuning condenser of 0.0005μF. capacity.

On the left of the set are seen four terminals, by means of which the three chief forms of aerial tuning, namely, constant aerial, series, or parallel tuning may be employed. On the right of the set are seen five terminals, which enable high-tension to be applied when desired.

Circuit Diagram

A circuit diagram is given in Fig. 2, and it will be seen that two valves are employed, the first, V_1, acting as a rectifier, reaction being provided by means of the coil L_2 being coupled to the aerial coil L_1, while the second valve, V_2, is purely a note magnifier. A terminal T_{11}, for grid bias, is provided in order that the experimenter may be sure that the valve, V_2, is acting properly as an amplifier. When no grid bias is used, this terminal must be shorted to the terminal T_8 immediately above it.

Constant Aerial Tuning

The constant aerial tuning system may be applied to this receiver by joining the aerial lead to T_1, leaving T_2 free, and connecting T_3 to T_4

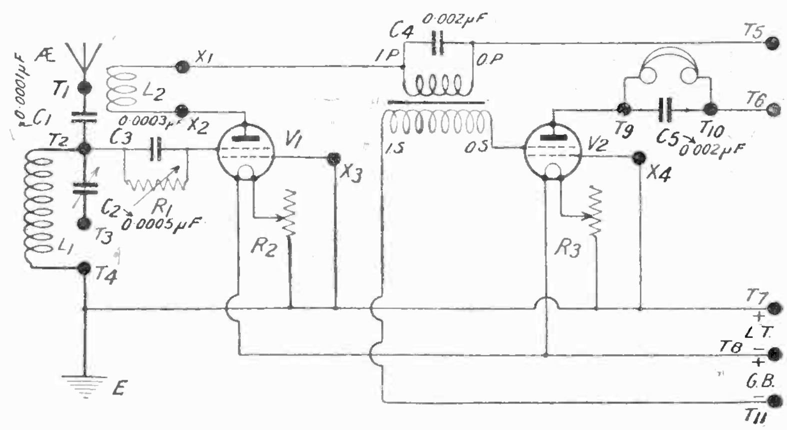


Fig. 2.—The arrangement of the circuit.

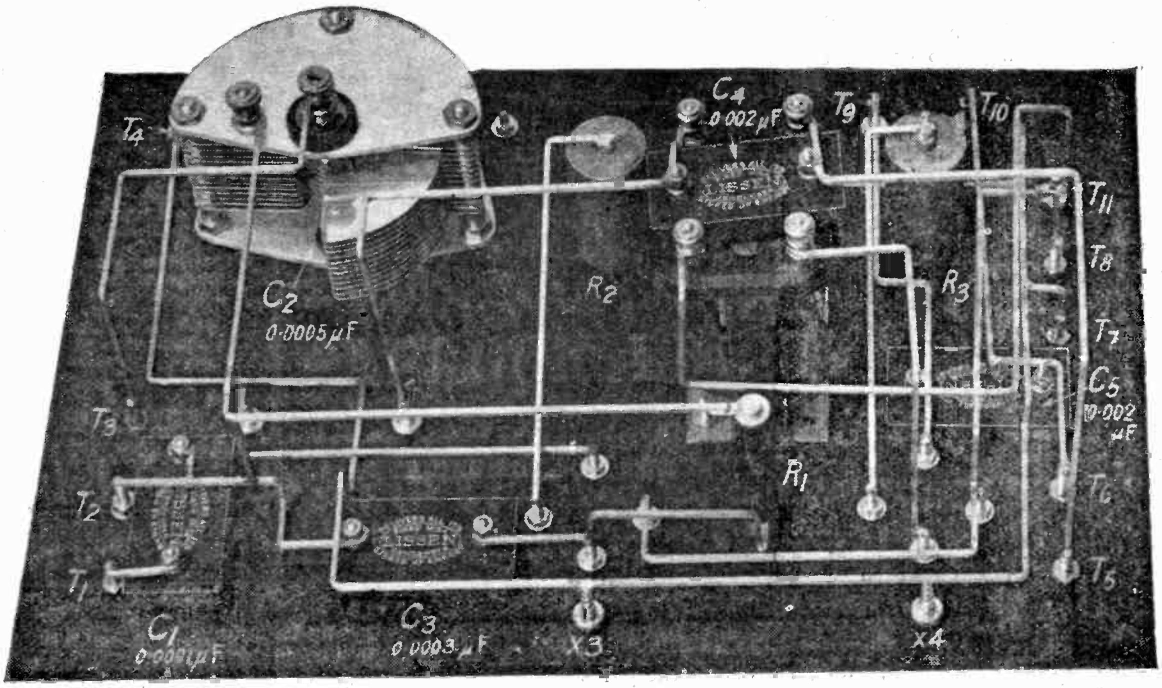


Fig. 3.—A view of the back of the panel, showing the lay-out of parts and wiring.

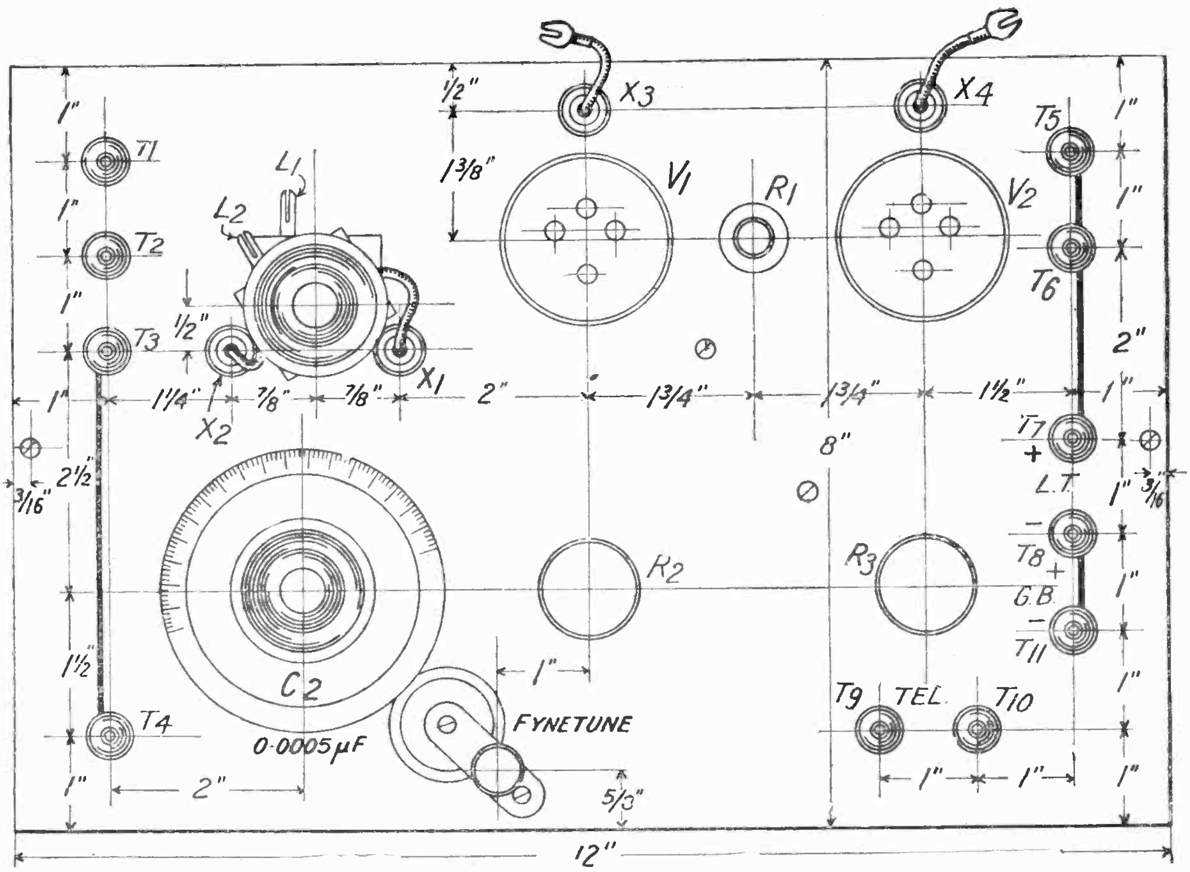


Fig. 4.—A half-size diagram, showing the lay-out of parts on the panel. All the necessary dimensions for drilling the holes are given.

and to earth. Tuning is carried out on the variable condenser C_2, which is in parallel with the coil L_1. Parallel tuning, with no constant aerial tuning, may be used by joining the aerial lead to T_2, leaving T_1 free, and joining T_3 to T_4, and to earth. Tuning is carried out, as before, on C_2.

Series Tuning

The aerial tuning condenser C_2 may be placed in series with the aerial tuning coil by joining the aerial lead to T_3, leaving T_1 and T_2 free, and the earth to T_4.

The inner grids of the valves, which are connected to a terminal on the cap of the valve, in the case of the valves mentioned, are joined to L.T. positive, by means of flexible leads from the terminals mentioned to Clix plugs, which plug in to Clix sockets X_3 and X_4 on the panel. The valves plug in to the usual four-pin socket.

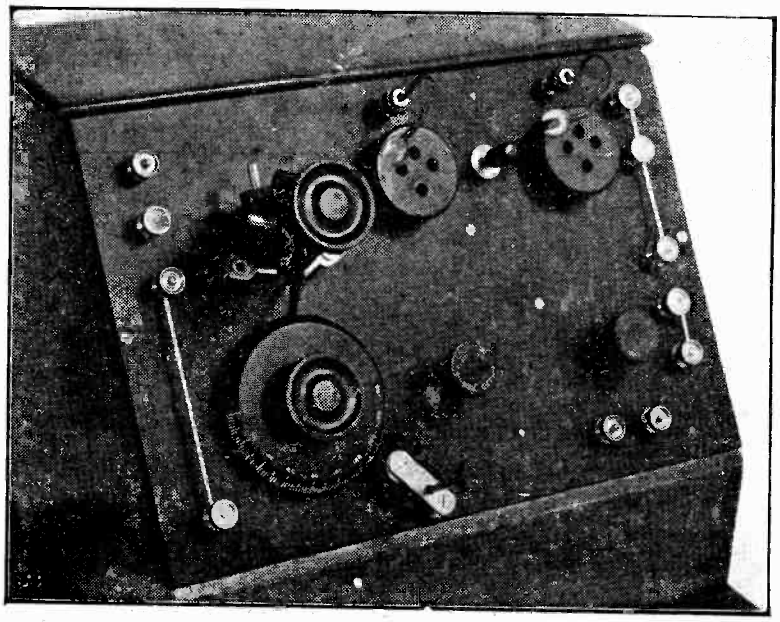


Fig. 5.—The lay-out of parts on the panel. Note the fine adjustment for the tuning condenser.

Components and Cost

As has been mentioned, no specially made components, apart from the valves, are employed, and those used are easily obtainable. The constructor may use such parts as he may already possess, but it is always desirable to adhere as closely as possible to the specification given :—

Components.

	£	s.	d.
Cabinet (Wright and Palmer, Type W.1)		16	0
Panel, 12 in. by 8 in. by ¼ in. (Paragon Rubber Co.)		6	0
2-coil holder (Goswell Engineering Co., Type V)		7	6
11 Terminals, 4 B.A., at 2d.		1	10
1 0.0005μF. variable condenser (K. Raymond, new type, with dial)		5	7
2 Lissenstat filament resistances (Lissen, Ltd.)		15	0
1 Lissen variable grid leak (Lissen, Ltd.)		2	6
1 0.0001μF. fixed condenser (Lissen, Ltd.)		2	0
1 0.0003μF. fixed condenser (Lissen, Ltd.)		2	0
2 0.002μF. fixed condensers (Lissen, Ltd.)		5	0
1 Fynetune Vernier Adjuster (Sparks Radio Supplies) ..		2	6
2 H.T.C. valve holders, Type A (H.T.C. Electrical Co.) ..		3	6
4 Clix, with insulator and locknut, at 4d. (Autoveyors) ..		1	4
4 Clix, with locknut only, at 3½d. (Autoveyors)		1	2
1 Powquip L.F. transformer (Power Equipment Co.) ..		14	6
10 ft. tinned bus-bar wire (Sparks Radio Supplies)			10
Screws, etc.			4
Total ..	£4	7	7

The valve holders are of a good type, combining safety with low capacity; no metal parts are exposed, thus it is practically impossible to short the filament of the valve across the high-tension supply, when one is used. The metal parts are as far as possible apart, thus ensuring minimum capacity in the socket.

The Panel

A half-size drawing showing the lay-out of the parts on the panel is given in Fig. 4, and all the necessary dimensions for drilling the holes will be found thereon. The positions for the holes for fixing the transformers are not dimensioned, although the screw heads are visible on this diagram, as the distances between such holes are not constant for any given make of transformer. The positions of all holes should be marked out with a sharp-pointed instrument, and all holes of one size drilled first. A template is supplied with each valve holder, ensuring correct drilling. A close-up photograph of the panel is seen in Fig. 5, which makes the layout quite clear.

Mounting the Parts

All holes being drilled, the smallest parts should be mounted up first, leaving such heavy parts as the variable condenser and transformer until the last. When all parts are mounted up, give an extra turn to all the nuts holding parts in position, to ensure that they are all tight. The fixed condensers are not secured to the panel, being held in position by the wiring. The "Fynetune" vernier adjuster on the variable condenser should be laid on the panel and a hole drilled in such a position that the rubber ring bears fairly hard against the dial of the condenser.

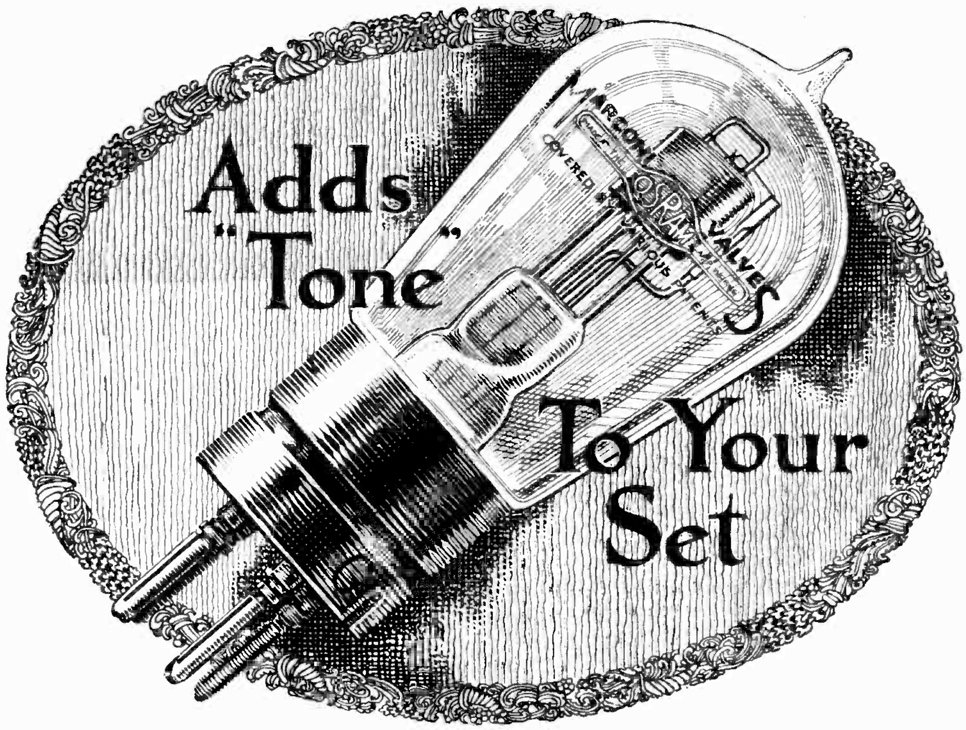
Wiring

Wiring is carried out with square bus-bar wire, obtained from Sparks Radio Supplies, and presents a very neat and workmanlike appearance. It is also possible to space the wiring out to a better degree than is possible when using systoflex covered wire. All points, such as terminal shanks, to which a wire has to be joined, should be well tinned before wiring is commenced, as this makes the process much simpler. Bend the wire to the exact shape before commencing to solder, as the stiffness of the wire will make it difficult to bend without fracturing the joint once it is soldered to any point. A wiring diagram is seen in Fig. 7, and will make the wiring perfectly clear. Figs. 3 and 6 are photographs of the back of the panel.

The Cabinet

The cabinet is of the sloping front type, and was obtained from

(*Continued on p.* 43).



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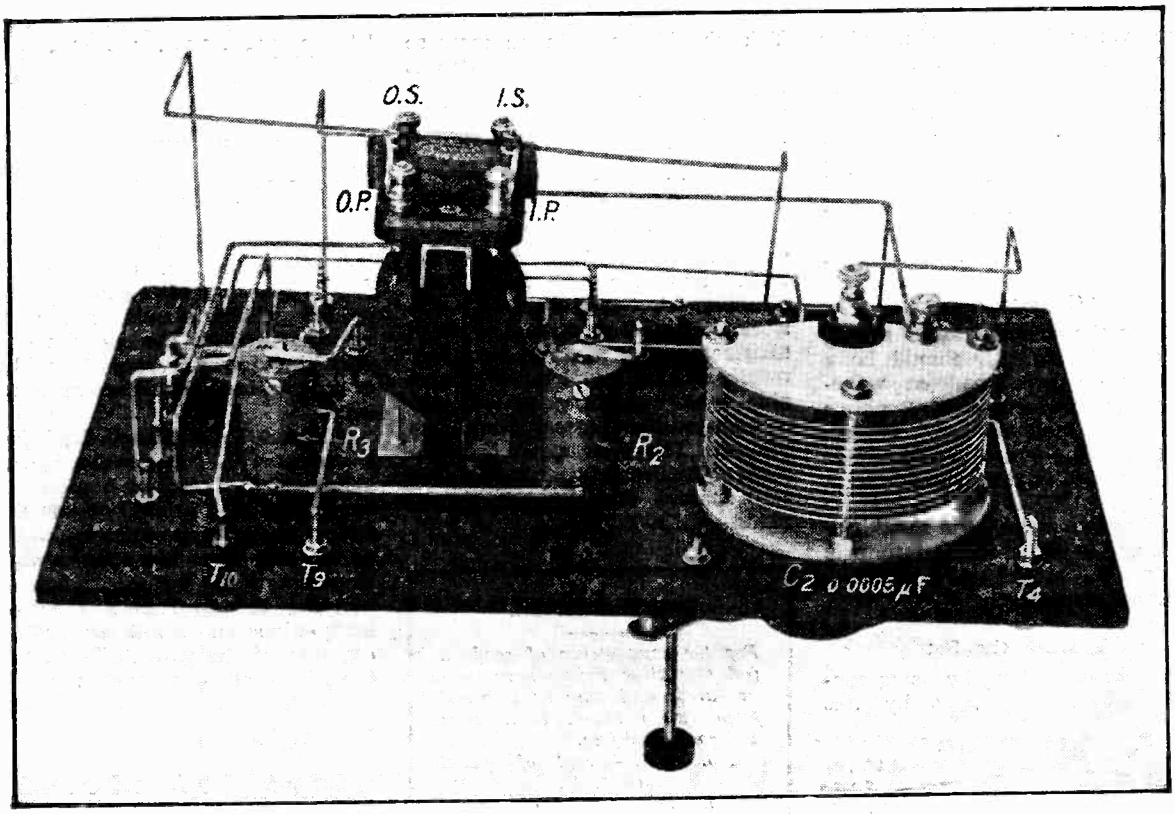

Fig. 6.—A view of the underside of the panel, showing the filament resistances,

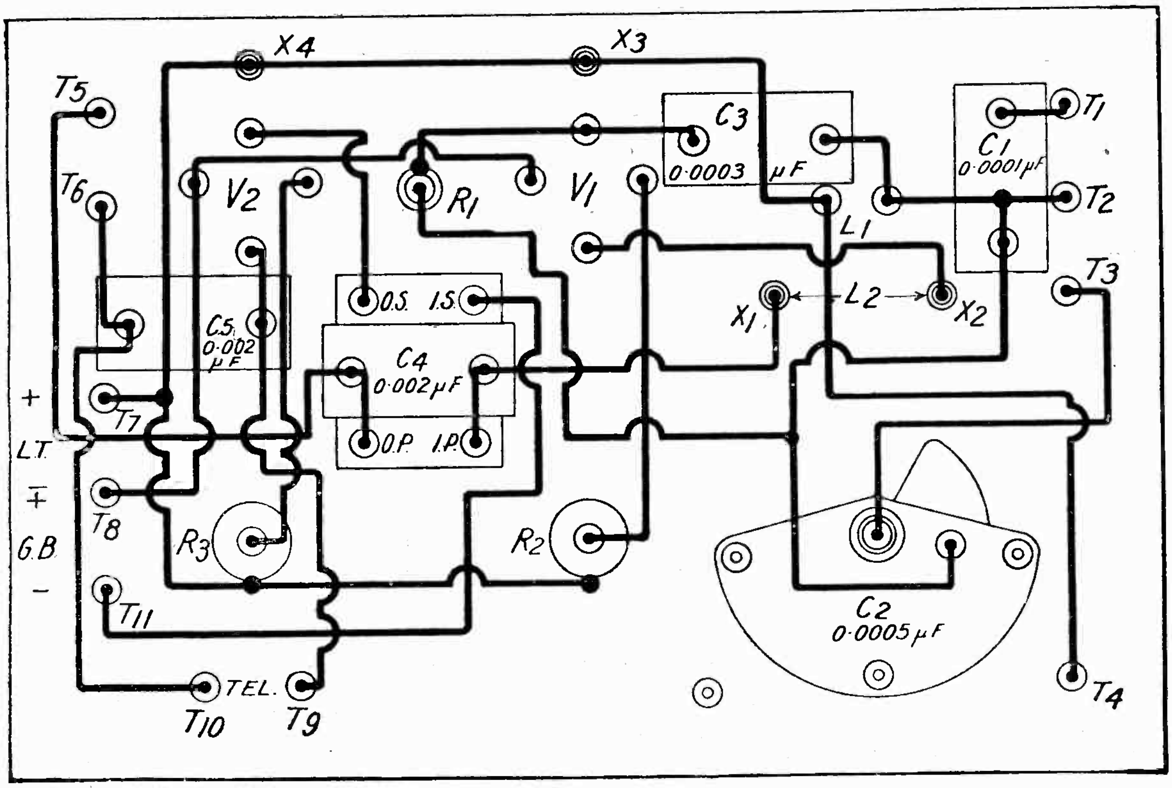

Fig. 7.—The wiring of the receiver. The lettering conforms with that of Fig. 2.

Messrs. Wright and Palmer, of Forest Gate. It is known as the type W1 cabinet, and may be obtained, at short notice, from this firm. For those who propose to make their own cabinet, a dimensioned drawing is given in Fig. 8, and no difficulty should be experienced in the construction. The panel is secured to the cabinet by means of two wood screws, one in the middle of each of the shorter sides.

Coils to Use

Using the constant aerial tuning system, the coil L_1 should be a number 50 for broadcast wavelengths up to 420 metres, above which a 75 may be used. The reaction coil L_2, the movable one in the two-coil holder, should be a No. 75.

A 6-volt accumulator should be used, and is joined to the terminals T_7 and T_8, in the order positive-negative respectively.

Testing the Set

Commence testing by using constant aerial tuning, as by this

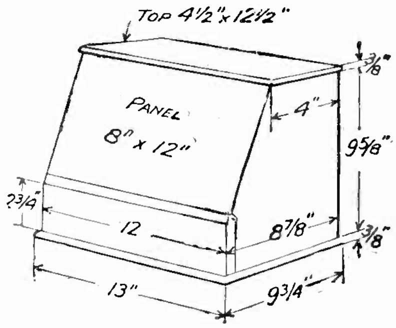

Fig. 8.—A dimensioned view of the cabinet.

means the local station will be easily picked up. Connect the aerial to T_1, earth to T_4, and join T_3 to T_4 by means of a piece of wire. Join T_5, T_6 and T_7 together, and also join T_8 to T_{11}, thus using no extra grid bias.

Insert a 50 coil in the lower socket of the coil holder, and a 75 coil in the upper, provided that the wave-length of the station to be received is under 420 metres. If the wave-length is over 420 metres, the aerial coil L_1 may be a 75, and the reaction a 100. Insert the valves and join the fourth electrodes to the Clix sockets upon the panel behind each valve-holder.

Connect the telephones to the terminals marked in Fig. 1, and turn on the filaments of the valves, keeping the moving coil L_2 well away from the fixed coil L_1. Tune on the condenser C_2, and when the local station is heard, bring L_2 closer to L_1, re-tuning on C_2. This should result in an increase of signal strength, and if this is not the case, the leads from the reaction coil L_2 to the Clix sockets X_1 and X_2 should be reversed.

Test Report

This set was tested out on a standard aerial at 10 miles from 2LO, and results were quite pleasing. A loud-speaker was worked at medium strength—quite satisfactory for many people, but results did not equal those obtainable when ordinary valves and a high-tension battery were employed. The alternative arrangements which may be tried on the set enable comparisons to be made.—J. S.-T.

BLUE PRINTS.

For the convenience of readers, full size Blue Prints have been prepared, and may be obtained from Radio Press, Ltd., price 1/6 each, post free.

No. 47A.—Front of panel (Fig. 4).

No. 47B.—Back of panel (Fig. 7).

"A Simple Reflex Set"

To the Editor of MODERN WIRELESS

SIR,—I feel I must write and thank you for giving the details of Simple Reflex Circuit in January MODERN WIRELESS. I built up the set last Saturday and have since got the following results (all telephony) with two pairs of 'phones: Saturday night, Birmingham too loud for phones; Sunday morning, amateurs as far away as Banbury and also 2 HS. After Birmingham had closed down, I got Aberdeen (over 400 miles), Bournemouth, London and another station, but did not wait for his call sign. Then to my surprise a Continental station quite readable, but as I did not understand the language I could not say if it was Brussels or P and T, Paris. Last night I found, to my surprise, I could get Bournemouth, London or Cardiff whilst Birmingham was carrying on as usual, although I am only three miles distant.

I am, etc.,

F. J. NOON.

Birmingham.

A New Idea for the Constructor

"The next best thing to having the set in front of you."

RADIO PRESS are about to publish No. 1 of a new series of constructor's guides which should prove of immense help to the experimenter who likes to get a very clear idea of his proposed set before he starts work.

"Radio Press Panel Card No. 1 consists of an envelope containing a flat cardboard model of the panel itself, printed on one side with a photograph of the top of the panel, and upon the other with a drawing of the wiring. Accompanying the card is a sheet of instructions and a full size drilling diagram of the panel. The Panel Card will sell at 1s., and the date of publication is announced elsewhere.

New Radio Press Envelopes

AS announced in detail in the advertisement pages of this issue, two additions are about to be made to the series of Radio Press Envelopes. These two sets will be of great interest to the constructor, representing as they do the product of two designers working upon widely divergent lines. Envelope No. 3 concerns a three-valve set which has been christened the "Simplicity" receiver, which was designed on the assumption that the average user will obtain actually *better* results with a very simple set than with one of more elaborate design and difficult operation, while Envelope No. 4 gives instructions for making a "de Luxe" model of the well-known "All-Concert" three-valve receiver, with totally enclosed valves, switching devices, square-law condensers, and other refinements.

The author of Envelope No. 3 is G. P. Kendall, B.Sc., Staff Editor, MODERN WIRELESS, and No. 4 is the work of Percy W. HARRIS, Assistant Editor, MODERN WIRELESS. The price of each is 2s. 6d., post free 2s. 9d., and the date of publication is given in the detailed announcements.

A GOOD INDUCTANCE

—what it means to your receiver.

YOU may have noticed how a small fragment of cork floating on water is sensitive to every movement of the surface. A large piece of cork would not be so sensitive. This is due, among other things, to the phenomenon of inertia, which is common to all physical bodies.

Inertia and friction losses, for instance, which, in a physical body, make that body more or less difficult to move, can be likened to losses in coils which uselessly absorb the vital energy which ought to be fully transferred and applied.

LISSENAGON coils are to other coils what a fine mirror spot-light galvanometer, for instance, is to a linesman's galvanometer. Both are galvanometers, both are the same in so far as they are used to detect electrical currents, but the former will detect currents in circuits where no deflection of the needle at all could be obtained with the linesman's instrument.

Users of coils should submit them to the test of distant telephony. LISSENAGON coils are splendidly responsive to faint signals in the same way as the fine mirror galvanometer is to minute electrical currents.

The analogy between LISSENAGON coils and the mirror galvanometer can be strikingly proved by alternatively plugging in LISSENAGON coils on distant signals and then plugging in other coils. Distant stations that will be distinct on LISSENAGON coils often cannot be heard at all as soon as the other coils have been substituted.

In the design and making of LISSENAGON coils provision has been made for the fact that low wavelength coils have to deal with enormously higher frequencies than high wavelength coils. Each LISSENAGON coil has been designed to be strongly resonant to a certain pre-determined band of frequencies. The appropriate LISSENAGON coil for a given wavelength is more resonant to the frequency corresponding to that wavelength than any other make of coil, and will also more effectively bar out all frequencies except that to which it is definitely tuned—in other words, LISSENAGON coils are highly selective, and the circuits in which they are used can be much more sharply tuned than the same circuits when other coils are used. This gives LISSENAGON coils an immense advantage on distant telephony. LISSENAGON coils are interchangeable with any other coils.

LISSENAGON COILS TUNE SO SHARPLY & STRONGLY BECAUSE THEY TUNE WITHOUT ENERGY LOSS.

HOLD A LISSENAGON COIL UP TO THE LIGHT.

WHY USE MIXED PARTS? There is a LISSEN part for every vital place of your receiver. We guarantee every LISSEN part to satisfy you perfectly—we EXPECT TO HEAR FROM YOU IF YOU ARE NOT SATISFIED.

If you use mixed parts your finished instrument will never give you the same results as a receiver BUILT WITH ALL LISSEN PARTS.

LISSENAGON TUNING CHART. Note the Intermediate Coils, 30, 40 and 60.

TABLE 1. Wavelength range when used as Primary Coils with Standard P.M.G. Aerial and .001 mfd. condenser in parallel.			TABLE 2. Wavelength range when used as Secondary Coils with .001 mfd. condenser in parallel.		
No. of coil	Minimum Wavelength	Maximum Wavelength	Minimum Wavelength	Maximum Wavelength	PRICE
25	185	350	100	325	4/10
30	**235**	**440**	**130**	**425**	**4/10**
35	285	530	160	490	4/10
40	**360**	**675**	**200**	**635**	**4/10**
50	480	850	250	800	5/-
60	**500**	**950**	**295**	**900**	**5/4**
75	600	1,300	360	1,100	5/4
100	820	1,700	500	1,550	6/9
150	965	2,300	700	2,150	7/7
200	1,885	3,200	925	3,000	8/5
250	2,300	3,800	1,100	3,600	8/9
300	2,500	4,600	1,400	4,300	9/2

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The Cowper High-Tensionless Circuit

A Remarkable New Receiver for any Valve

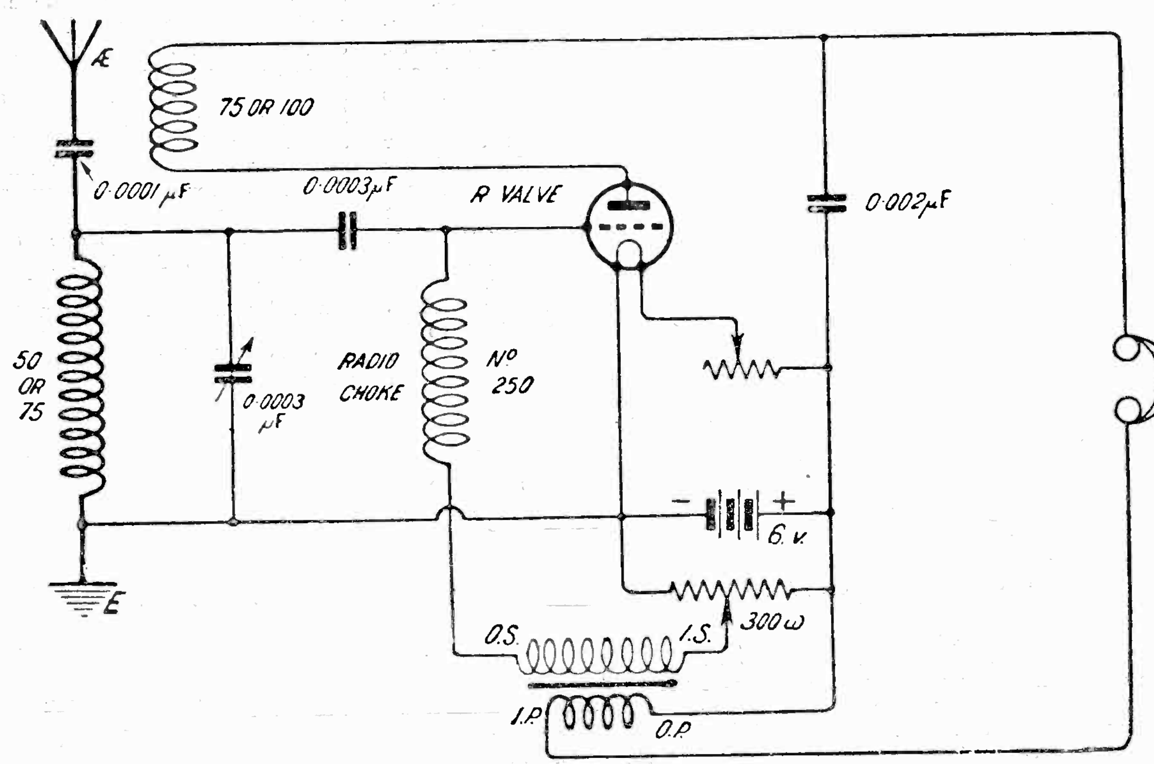
MR. A. D. COWPER, whose remarkable work in evolving new circuits is a feature in both *Wireless Weekly* and MODERN WIRELESS, has now produced a most interesting form of single-valve circuit which will operate without any separate high-tension battery and has the particular advantage of being usable with any types of bright or dull emitter. For example, it has been used quite successfully with the .06 ampere type of dull emitter, the sole battery supply for the whole set being a 4½ volts flash-lamp battery.

The new Cowper circuit, which was first described in *Wireless Weekly* for May 28th, has aroused so much interest that we are reproducing it below. The following technical particulars will enable those of our readers who so desire to build up the set in practical form.

Constant aerial tuning is used in this set and is necessary in order to obtain oscillation when required. A .0001 mfd. fixed condenser of good make should be used here, and for tuning a No. 50 or 75 coil shunted by a suitable variable condenser of, say, .0003 or .0005 mfd. A grid condenser of .0003 μF is used without a gridleak, connection being made to the grid as shown. The plate circuit is taken from the plate of the valve to a reaction coil (a No. 75, 100 or 150 will do here), through the telephones, the primary of a good intervalve transformer to the positive end of the filament battery. The secondary of this transformer is connected at one end to the slider of a standard potentiometer, the other end being connected to a radio-frequency choke coil (a 250 plug-in coil suits here) and thence to the grid.

The operation of the set is quite simple. Tuning is carried out in the ordinary way, and the reaction coil is brought up against the aerial tuning coil until the maximum amplitude is obtained. It will be found that at one position of the potentiometer the set will give a violent audio-frequency howl, and by bringing the slider of the potentiometer towards the other end the howl will be lessened until a point is reached where it ceases. This is the best point of adjustment. Actually, the circuit operates in a peculiar manner, and audio-frequency reaction, controlled by the potentiometer, is used.

Full practical details of how to build a receiver on these lines will be given by Mr. Percy W. Harris in the issue for *Wireless Weekly* dated June 4th. Readers should place their orders in advance. On this date a special series of articles on the whole question of high-tensionless receivers will begin.



The new Cowper circuit.

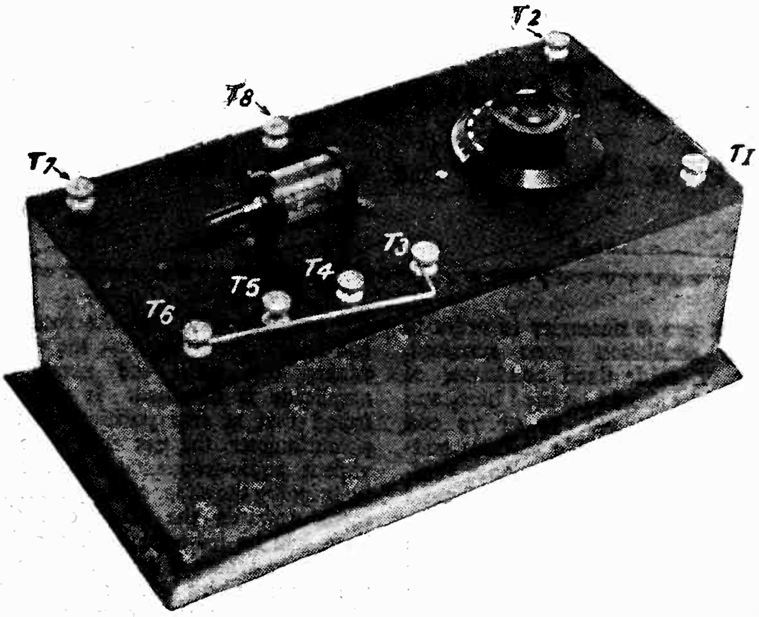


Fig. 1.—Many original ideas are incorporated in this instrument.

A Crystal Receiver

With Special Coupling.

Special "Modern Wireless" Design

In this set special arrangements are made for giving high selectivity. The instrument may also be used as a separate tuner.

MANY users of crystal receivers, who dwell in regions near the coast, are troubled with interference from ships, and often spark signals from land stations; in most cases it is found impossible to tune out these signals with the tuning arrangements provided in the receiver. Some form of coupled circuit is essential in these cases, and possibly the simplest is that in which the aerial coil consists of a few turns of wire wound immediately on top of the tuning coil, the aerial coil itself being untuned. A set on these lines was described by Mr. Percy W. Harris in *Wireless Weekly* for September 19, 1923. The present set follows the same general form, but provision is made whereby the crystal detector and telephones may be tapped across a part of the closed circuit inductance, thereby reducing the damping in that circuit and so increasing its selectivity. There is the additional advantage of the coupling arrangement that the receiver may be used on any aerial without affecting the tuning of the closed circuit. Great selectivity is obtained by this coupling, but a greater effect is obtained by tapping the crystal across only a part of the coil, thereby allowing the closed circuit to oscillate more freely, owing to the reduced damping. Apart from selectivity, the circuit design is a highly efficient one from the point of view of signal strength.

The "aperiodic" method of aerial coupling has been incorporated in the present set, and this, together with the tapped detector and the use of thick (No. 18) wire, accounts for the good results obtainable. A photograph of the finished set will be seen in Fig. 1, and the terminals on the right of the receiver are those to which the aerial and earth connections are made, the former to T_1 and the latter to T_2.

The telephone receivers are connected to terminals T_7 and T_8, while the crystal detector and telephones may be tapped across part of the coil by joining the terminal T_8 to one of the other three terminals T_3, T_4 or T_5 by means of the link, which latter is a piece of square-section wire bent so as to have two arms, one $4\frac{1}{2}$ in. long and the other 1 in. long, at right angles to each other. At the end of the shorter arm a hook is formed to enable the link to be easily and quickly secured to the two terminals required to be joined.

Circuit Diagram.

The circuit arrangement of the receiver is shown in Fig. 2. T_1 is the aerial terminal, the earth lead being joined to T_2. L_2 is the main inductance, and consists of 80 turns of No. 18 s.w.g. double cotton-covered wire, wound on a cardboard tube 3 in. in diameter, $6\frac{1}{4}$ in. long, tapped at the 26th, 52nd and 80th turns. The aerial coil, L_1, consists of 10 turns of the same size wire, wound on top of the first coil, between the 52nd and 80th tappings. In this diagram a wandering lead is shown with an arrow-head pointing to terminal T_4. This represents the external link previously mentioned, by means of which T_8 is joined to one of the three terminals T_3, T_4, T_5. The closed circuit inductance L_2 is tuned by the variable condenser C_1, which has a maximum capacity of 0.0003 μF, this condenser being permanently connected across the

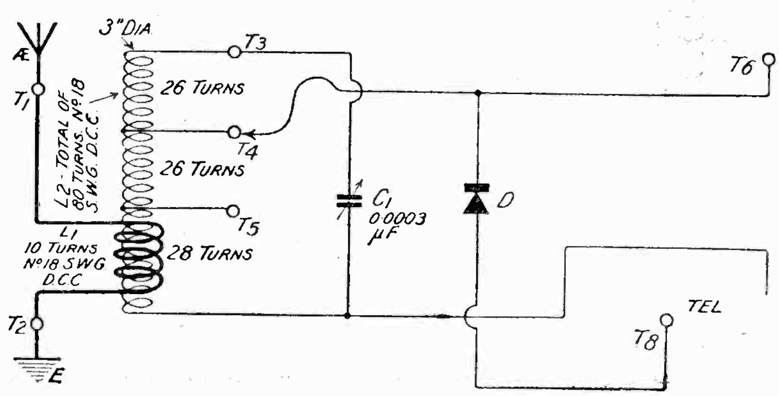


Fig. 2.—The circuit arrangement.

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The long life battery.

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Type "R" Dull Emitter ..	1 HZ 2 100 **17/6**	1 HZ 2 40 **17/6**	1 HZ 3 40 **21/-**	1 HZ 4 40 **24/6**	1 HZ 4 30 **24/6**	Battery Type. Burning Hours. Price.
Pea-nut Dull Emitter ..	1 DTG 36 **5/-**	1 HZ 2 75 **17/6**	1 HZ 2 43 **17/6**	1 HZ 3 50 **21/-**	1 HZ 3 37 **21/-**	Battery Type. Burning Hours. Price.
·06 Amp. Dull Emitter ..	2 DTG 200 **10/-**	2 DTG 106 **10/-**	2 DTG 60 **10/-**	2 DTG 38 **10/-**	2 DTG 27 **10/-**	Battery Type. Burning Hours. Price.

Prices are uncharged, without acid, except the DTG type, which is supplied fully charged and needs only acid adding to be ready for service.

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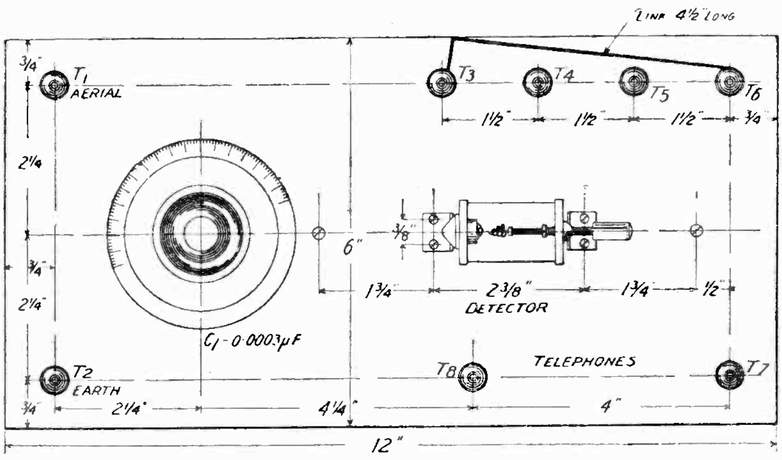


Fig. 3.—The top of the panel, with all dimensions for drilling.

whole of the coil L_2. D is the crystal detector, and the telephones are joined to T_7 and T_8. If more than one pair of telephones are used, the receivers may be connected in series by joining one tag of the first pair of telephones to T_7, the other tag to one of the second pair, and the remaining free tag to T_8; to join the 'phones in parallel, one tag of each pair is joined to T_7, the other of each pair being joined to T_8.

As a Separate Tuner.

The receiver may be used, without alteration, as a selective tuner, for a valve, by joining T_6 and T_7 to the grid and filament respectively of the valve, when the latter is functioning as a high-frequency amplifier. If the valve is acting as a detector, the terminal T_6 of the tuner is joined to one side of the usual grid condenser and leak, the other side of the condenser and leak being connected to the grid of the valve. T_7 is, in this case, connected to the filament positive. The telephones are not joined to T_7 and T_8 when the set is used in this manner, but are normally connected in the anode circuit of the last valve, if more than one valve is used. The crystal detector D in this case is not included in the circuit.

Components and Cost.

Very few parts are required for constructing this set, and a list will be found below. The constructor may already possess such component parts as crystal detector, cardboard tube, and so on, and these may be used, and will no doubt be found satisfactory.

The Tuning Coil.

The coils are wound upon a cardboard tube 3 in. in diameter, and 6¼ in. long. The coil L_2 is wound first with No. 18 s.w.g. double-cotton-covered wire; 80 turns are put on, and the ends are secured by passing through holes in the cardboard tube. At about ten turns from one end, ten turns are wound on over the first layer, to form the aerial coil. The ends of this coil may be secured by means of string, looped round the wire, passed round the tube, and tied tightly. Tappings to the coil L_2 are made by scraping the insulation off the wire at the point where the tapping is to be taken, and soldering a wire on here. Further particulars as to tappings will be discussed later, when wiring up the set, as it is not necessary to make the tappings until that stage is reached. The coil is mounted upon the panel by means of two pieces of wood, 2½ in. long, ⅜ in. thick and ¾ in. high, cut out so that the cardboard tube fits in, the latter being fixed to the wood by small screws.

The Panel.

The panel, which is of ebonite, measures 12 in. long by 6 in. wide by ¼ in. thick, and needs very few holes to be drilled in it, the positions of those necessary being found in Fig. 3. Having located all the holes, make a mark at the centre of the place where a hole is to be made, and make a small indentation with a hammer and a nail. A woodworker's countersinking tool may be used, if at hand. The drill point is thus prevented from "wandering," and it is ensured that the hole will be drilled in the correct place.

COMPONENTS.

	£	s.	d.
Cabinet, 12 in. by 6 in. by 4 in. deep (Wright & Palmer) ..	0	10	0
Panel, 12 in. by 6 in. by ¼ in. (Paragon Rubber Co.)	0	5	0
0.0003 Variable condenser (K. Raymond, New Type)	0	5	3
Burndept Crystal Detector	0	5	0
8 4 B.A. W.O. Type Terminals	0	1	4
Cardboard Tube, 3 in. diameter, 6¼ in. long	0	0	6
½ lb. 18 s.w.g. D.C.C. Wire	0	2	0
4 ft. Square Bus-Bar Wire (Sparks Radio Supplies)	0	0	4
Total	£1	9	5

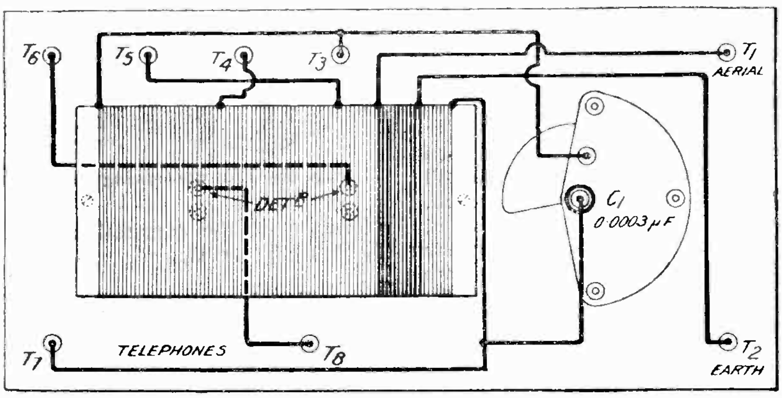


Fig. 4.—The wiring of the set.

Mounting the Parts.

When all the holes have been drilled, the terminals and clips for the crystal detector should be mounted up, one of the latter being then connected to T_6 and the other to T_8. These wires must be put on before the coil is mounted, as otherwise the latter would render it impossible to solder the wires to the detector clips.

The coil is then mounted up, so that the end upon which the ten-turn coil is wound is in the middle of the panel, toward the variable

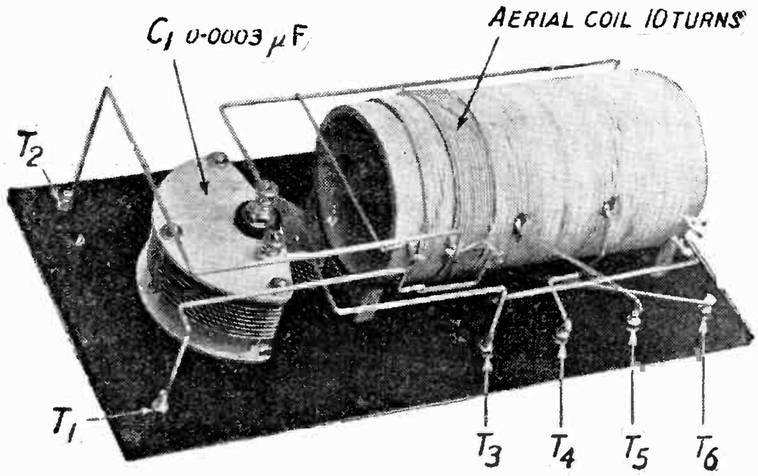


Fig. 5.—A photograph showing how the tappings are made.

condenser, which latter should then be secured in position.

Wiring.

Wiring is carried out with square-section "bus-bar" wire, obtainable from Sparks Radio Supplies, and gives a very neat and workmanlike appearance to the set. The ends of the ten-turn coil are connected to aerial and earth respectively, and the end of the larger coil nearest this coil is joined to the moving plates of the condenser and to T_7. Turn now to the end of the large coil remote from the smaller one, and count 26 turns from this end. Scrape the insulation off here, and join this point to terminal T_4. Count another 26 turns along, in a direction toward the variable condenser, and, having scraped the wire clear, solder a wire on to this point, carrying the wire on to T_5. The end of the large coil from which the turns were counted, as above, is now joined to T_3 and to the fixed plates of the variable condenser, thus completing the wiring of the receiver. No difficulty should be experienced in this operation, if the wiring diagram, Fig. 4, is carefully studied, while a glance at the photograph of the back of the panel, Fig. 5, will clear up the whole question.

Testing the Set.

When complete, the set may be connected up to an aerial and tested. Connect the aerial to T_1, earth to T_2, and telephones to T_7 and T_8. By means of the link already described connect T_6 to T_3, and adjust the condenser, with the cat-whisker touching the crystal, until signals from the local station are heard. The crystal may then be adjusted to its most sensitive point, readjusting the condenser C_1 for the loudest signals. The link between T_6 and T_3 may be taken out, and instead, T_6 may be joined to T_4 or T_5, whichever gives the best results with least interference. At each alteration the condenser should be readjusted to the best point.

When the set is used as a tuner for a valve, T_6 is connected to the grid (or grid condenser if the valve is working as a detector), and T_7 to the filament. Tuning is carried out on the variable condenser C_1, which must be adjusted after each

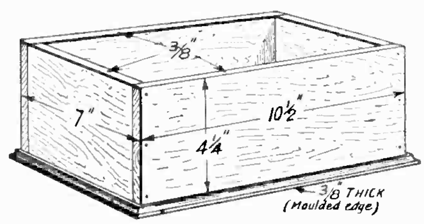


Fig. 6.—The containing box.

alteration of the connection from T_6 to T_3, T_4 or T_5.

Results Obtainable.

The set will easily cover the band of wavelengths used by the British broadcasting stations, with the coil provided, and good signals should be obtained, on a reasonably efficient aerial up to 15-20 miles from a station. On a 90 ft. aerial some 12 miles from 2LO, very good signals were received, and, owing to sharpness of tuning, the receiver was found to be very selective.

TEST REPORT

This receiver is remarkably efficient and has been tried on various sizes of aerials, the tuning remaining substantially constant for all aerials. The efficiency is high and the selectivity is remarkable, the best results being obtained when the crystal detector is connected across the smallest portion of the inductance. For a one control set it should prove ideal for general use, and particularly for those troubled by interference. The set covered the whole broadcast waveband on any aerial.

J. S.-T.

Good Things You May Have Missed.

A PERUSAL of the recent issues of *Wireless Weekly* will show to those readers of MODERN WIRELESS who do not read the sister journal, that it is possible to miss a number of good things appearing exclusively in *Wireless Weekly*.

There have been, for instance, during the last month a brilliant series of articles by Professor J. H. Morecroft, dealing with the "Wireless Valve and How It Works." Again there has appeared a series of simple back of panel wiring diagrams whereby the veriest amateur may construct his own crystal or valve receiver. This feature is continued week by week.

With so much interest being shown in circuits designed for use without H.T., *Wireless Weekly* again leads the way in that no less than a dozen circuits have been published, including full theoretical and practical details of the new three-electrode valve high-tensionless circuit discovered by Mr. A. D. Cowper, M.Sc.

Some two months ago readers of MODERN WIRELESS were made acquainted with the merits of the Reinartz circuit. In *Wireless Weekly* recently, Mr. John L. Reinartz, the inventor, contributed a most instructive article, describing a new design of All-Wave Tuner, with many novel points.

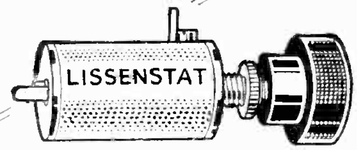
Aperiodic Aerial Coils is another interesting topic recently dealt with in *Wireless Weekly*, results of actual tests upon given coils being published. The experiments in question have been carried out by Dr. E. H. Chapman, M.A., D.Sc.

The increasing circulation and the demand for back numbers of *Wireless Weekly* (a demand which we can rarely satisfy) is a plain indication of its value. Any reader of MODERN WIRELESS who do not read *Wireless Weekly* should leave an order with his newsagent to supply the paper for a week or two for a trial run. Start on Wednesday next and begin the remarkable new series of articles on high-tensionless circuits.

Wireless Weekly was the *first* periodical to publish high-tensionless circuits and was the first to give a constructional article dealing with a two-valve high-tensionless loud-speaker receiver.

LISSENIUM

Lighting the Valve Filament



The days are gone when mere lighting of the valve filament was called filament control. The successful tuning of the detector and H.F. valves is a critical thing which largely depends upon the proper regulation of electron emission. Filament temperature must be exactly right for each station tuned in—especially is this important on long distance work. The introduction of LISSENSTAT control has shown what unique filament control can do to improve the detection of long distance telephony. The difference it makes to tuning is a revelation. There are three types to choose from. Each is suitable for dull emitter and all valves :—

LISSENSTAT (prov. pat.).—This is the super filament control—brings in stations which have previously eluded every other control of the receiver.. **7/6**

LISSENSTAT MINOR (prov. pat.).—There must be hundreds of thousands of inefficient rheostats in use. The LISSENSTAT MINOR has been introduced to provide something of the beautiful LISSENSTAT control at a popular price. It is well worth while discarding any existing rheostat and replacing it with this perfect little control **3/6**

LISSENSTAT UNIVERSAL (prov. pat.).—Gives full LISSENSTAT control, and by means of an ingenious arrangement a minimum resistance can be left in circuit to protect expensive valves, while zero resistance can also be obtained when full battery pressure is required.. .. .. **10/6**

The Loud Speaker's Voice

You have no doubt heard that blurred, woolly reproduction which is more jarring than beautiful. More often than not such reproduction comes from a badly designed transformer. Not all high priced transformers are well designed. If you would have beautiful tone quality, crystal-clear music, perfect in every detail of light and shade, song and speech that come through with absolute fidelity of tone, you will fit LISSEN Audio Frequency Transformers, at the price you choose.

MAKES A WHISPER LOUD.—The LISSEN T1 has a coil with over 8 ozs. of copper in the coil—the coil would amplify by itself without any iron core at all—for immediately after the detector valve always, throughout when superlative amplification is desired, and especially for POWER WORK also.. .. .. **30/-**

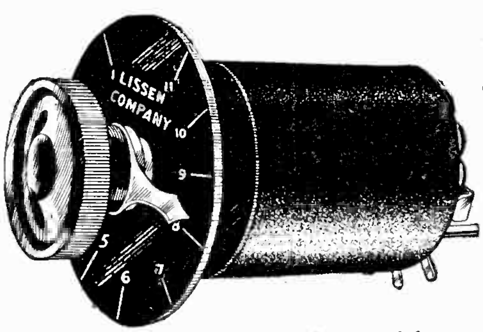
AUDIO FREQUENCY IN REFLEX CIRCUITS.—An all purpose transformer is the LISSEN T2, and it has been found an excellent transformer in dual and reflex circuits, where it will yield pure and powerful amplification. May be used for all stages, and recommended to follow the LISSEN T1 where multiple stages of audio frequency are used.. .. .. **25/-**

SKILFULLY BALANCED DESIGN.—Many expensive transformers are not so good as the LISSEN T3—it is one of the best light transformers made. **16/6**

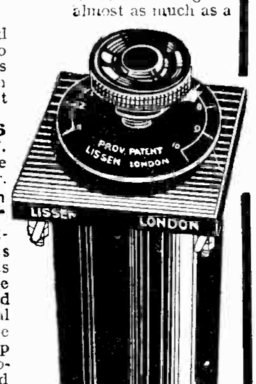
Stronger Light—and Fading Signals. The Need for Radio Frequency Amplification.

Have you yet noticed how signals which used to come in strongly are now more difficult to tune in while daylight lasts? No sooner has darkness set in, however, than signals seem to come in strongly again. *Summer shows up any weakness in your set if it is without proved radio frequency amplification.* Build up wave energy with the aid of LISSEN radio frequency amplification. Then see how strongly your signals are received, and with what certainty they come in. There are three well-known types of LISSEN radio frequency parts:—**When to use the LISSEN Selective H.F. Transformer.** In some dual and reflex circuits transformer coupling of H.F. valves is essential, and even where it is not indispensable many still like to use transformer coupling. The advantage the LISSEN H.F. Transformer has over all others is that it makes a receiver exceedingly sensitive—it is also very stable and as many stages of H.F. as desired can be introduced into a receiver. 150-4,000 metres **19/6**
Blue print with each shows easy connections.

When to use Lissen Reactance (prov. pat.).



If you desire great purity of reception, a high degree of amplification, and extreme sensitivity, the LISSEN REACTANCE should be introduced into the anode circuit of the H.F. valve. Diagram with each shows how. It gives greater amplification than any other H.F. coupling, and it will amplify even the loudest of signals almost as much as a good audio frequency transformer. Recommended for one or two stages H.F., for which it is easy to control. Beyond two stages some little skill is required. It is widely used, and has done much to popularise radio frequency work. Gives its best results with aerial reaction.
150-10,000 metres **19/6** 150-600 metres **17/6**
The LISSEN REACTANCE AND LISSEN H.F. TRANSFORMER have the same outward appearance—latter has four connections instead of two, however.



Successfully Used in the Reception of American Telephony.
No aerial reaction need be used for the LISSEN REGENERATIVE-REACTANCE (prov. pat.) will take its place. It is non-radiating—replaces plug-in coils—it is lower in cost than a set of coils to cover the same wide range; it is easier to handle, one knob controls tuning and reaction; reception is often possible with both aerial and earth connections dispensed with; cuts out the local station and tunes in the others with full built up strength. Continental stations come in easily. Introduced into the anode circuit it forms an unequalled first stage of radio frequency. Blue print with each shows easy connections—unbroken regeneration possible over the whole range—
150-4,000 metres **£2/12/6**
Tune always with a vernier—preferably the LISSEN Vernier, which is specially designed for fine tuning in H.F. circuits, **12/6.**
NOTE.—LISSEN H.F. Transformer and LISSEN REACTANCE are self tuned and no separate condenser is essential, but the aid of a vernier will oftentimes be an advantage, and the LISSEN VERNIER is recommended. All these parts have LISSEN ONE HOLE FIXING, OF COURSE. And the radio frequency parts are complete with internally connected switch, so that drilling and soldering are avoided.

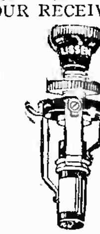
Cutting Out Station after Station

Start with any station you please, and you can go right round them all if you use the LISSENCEPTOR and a separate tuning condenser. In turn you can cut out any of the stations you do not want—Morse interference also. Users on the coast say they can now enjoy broadcasting in a way impossible before. Some type of Morse interference calls for somewhat more skill, but 95 per cent. of Morse is cut out easily. Even the more difficult Morse, however, can be sufficiently subdued so that it ceases to be troublesome.

LISSENCEPTOR Mark 1 type, for broadcasting .. **7/6**
LISSENCEPTOR Mark 1 type, for 600 metres .. **7/6**
LISSENCEPTOR Mark 2 type for broadcasting and 600 metres combined (with switch for more selective tuning).. .. .. **15/6**

THE LISSENCEPTOR ACTS AS A SENTINEL BESIDE YOUR RECEIVER.

Switching that is Helpful to Regeneration



When working on the lower wavelengths perhaps the set will just oscillate with the condenser in parallel. If the LISSEN Series Parallel switch were fitted you could immediately try the effect of putting the condenser in series, and so seeing whether the increased regeneration obtained would more than compensate for the slight damping of signals consequent upon the changing over of the condenser. The LISSEN Series-Parallel switch is easy to fit—takes up little room—LISSEN ONE HOLE FIXING, OF COURSE.. .. **3/9**

Make Your Batteries Last Longer

In the case of dull emitters, the current taken per valve is small, but there is a drain on the batteries all the same. If the dry cells used are given the opportunity to recuperate the voltage which has dropped when the cells are in use will rise again. Two cells, for instance, which are worked alternatively throughout will last a great deal longer than twice as long as one cell which is worked continuously. Apart from the economy of introducing a switch to change over to alternate batteries, the voltage will be steadier and the efficiency of the set improved. The best switch to use is the LISSEN two-way switch—easy to fit—hardly any room is taken up—LISSEN ONE HOLE FIXING, OF COURSE .. **2/9**

What would Happen to the Negative Charge?

If you had an unreliable grid leak in your receiver, the negative charge left on the grid of the valve by each radio frequency oscillation of a radio wave would leak away too quickly, with the result that it would be impossible to regulate the charge that should accumulate on the grid. When the LISSEN Variable Grid Leak (prov. pat.) is used it is possible to select the exact value of leak resistance, and to obtain correct grid potential under all conditions of valve and circuit. An interesting alternative use is across the secondary of a transformer or across the loud speaker itself, when it will suppress any tendency for the high notes of the musical scale to be amplified disproportionately to the lower notes.

LISSEN Variable Grid Leak has positive stops both ways—continuously variable ½ to 6 megohms—LISSEN ONE HOLE FIXING, OF COURSE **2/6**

LISSEN Variable Anode Resistance, 20,000 to 250,000 ohms continuously variable, same outward appearance as the LISSEN Variable Grid Leak **2/6**

WHY USE MIXED PARTS? You can be sure that your receiver built with all LISSEN Parts will give results which would never be possible with a receiver built with mixed parts.

LISSEN LIMITED

20-24, WOODGER Rd., GOLDHAWK Rd., SHEPHERD'S BUSH, LONDON, W.12.

Telephones—Hammersmith 3380, 3381, 3382, and 1072.
Telegrams (Inland) "Lissenium, Shepherds, London."
,, (Foreign) "Lissenium, London."

BUILD—WITH LISSEN MASTER PARTS.

Released!

the biggest thing of the year.

THE Genie of the Arabian Nights made a considerable stir on emerging from his brass bottle;—he was a big thing in his way.

The release of the new GENERAL RADIOPHONES is another event destined to create great interest, because—GENERAL RADIOPHONES are different. Their ready response to signal intensity of ·00000000011 of an ampere is an achievement which places them far above all competitors for efficiency.

A new method of matching the earpieces by means of specially invented visual gauges, and the incorporation of a carefully designed sound box, ensures singular clarity and natural reproduction.

GENERAL RADIOPHONES are unrivalled for strength and finish, and they weigh only 7 ozs.

Ask your dealer for a demonstration.

If you have any difficulty in obtaining GENERAL RADIOPHONES send direct to us. Please give name and address of your wireless dealer.

Our Technical Service Dept. answers queries free of charge. Address letters to Dept. M.

20/-
per pair.

Every pair carries a full guarantee.

GENERAL RADIOPHONES

FAMOUS FOR EFFICIENCY

GENERAL RADIO COMPANY LIMITED,
Radio House, 235, Regent St., London, W.1.

Telephone: Mayfair 7152. Telegrams: "Algenrad, London."

Regular Programmes from British and Continental Broadcasting Stations

Times in British Summer Time.

GREAT BRITAIN.

Station.	*Call Sign.*	*Wave-length.*	*Times.*
Cardiff ...	5 WA	353	3.30 to 4.30 p.m
London ...	2 LO	365	and
Manchester	2 ZY	375	5.0 to 10.30 p.m.
Bournemouth	6 BM	385	
Newcastle ...	5 NO	400	SUNDAYS.
Glasgow ...	5 SC	420	3.0 to 5.0 p.m.
Birmingham	5 IT	475	and
Aberdeen ...	2 BD	495	8.30 to 10.30 p.m.

FRANCE.

EIFFEL TOWER. FL 2,600 metres.
(*Daily.*)

7.40 a.m. Forecast.
10.50 a.m. Fish prices in the Paris markets.
11.15 a.m. Regional forecast.
12.0 noon Livestock prices.
12.15 p.m. Announcement of the time. (*Tuesdays and Thursdays.*)
3.40 p.m. Financial news.
5.30 p.m. Closing prices. (*Saturdays excepted.*)
6.15 p.m. Radio concerts.
8.0 p.m. General forecast.
11.0 p.m. General forecast. On Sundays the radio concerts and forecasts are given at 7 o'clock.

ECOLE SUPÉRIEURE DES POSTES ET TÉLÉGRAPHES (450 metres).
Concerts generally at 9 p.m. on Tuesday and Thursday.

RADIOLA (1,780 metres).
12.30 p.m. }
4.30 p.m. } Concerts.
8.30 p.m. }
These concerts are preceded by news items.

BELGIUM.

BRUSSELS (405 metres).
5.30 p.m. }
6.0 p.m. } Concerts and News.
8.30 p.m. }

HOLLAND.

THE HAGUE, PCGG (1,050 metres).
Concerts. Sundays, 3.0 to 6.0 p.m.

THE HAGUE, HEUSSEN PCUU (1,050 metres).
Thursdays, from 7.45 to 10.0 p.m., Irregular.
Sundays, from 9.40 to 10.40 a.m., Irregular.

THE HAGUE, VELTHYSEN, PCKK.
Fridays, from 8.40 to 9.40 p.m., Irregular.

THE HAGUE, IJMUIDEN, PCMM.
Saturdays, from 8.40 to 9.40 p.m., Irregular.

SPAIN.

MADRID (2,100 metres).
Trials from 11.0 to 1.0 p.m., Irregular.

SWITZERLAND.

LAUSANNE (1,100 metres).
9.5 a.m. Meteorological forecast for Lausanne.
11.50 a.m. Meteorological forecast for Geneva and Dubendal.
2.0 p.m. Meteorological report for Switzerland.
7.55 p.m. Meteorological report for Switzerland.
5.0 p.m. Tuesdays, Thursdays and Saturdays, Concerts.
8.0 p.m. Mondays, Wednesdays, Fridays and Saturdays, Concerts.

ITALY.

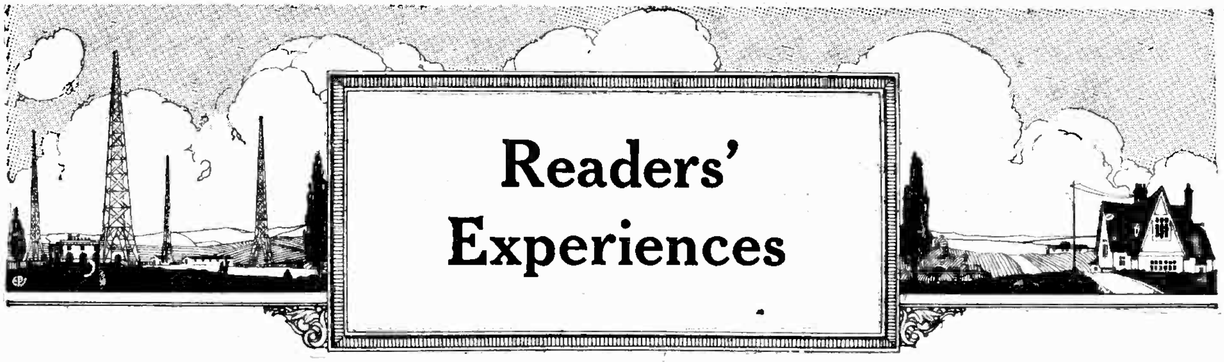
ROME (540 metres).
Weekdays from 6 p.m. to 7 p.m.

GERMANY.

BERLIN, VOX HAUS (Radio Stunde A.G., Potsdamer Str. 4).
Wavelength.—About 420 metres, varying between 415-435.
9 a.m.—Market prices.
9.15 a.m.—News report.
11.15 a.m.—Exchange quotations.
11.55 a.m.—Time signal.
1.15 p.m.—Exchange quotations.
3.5 p.m.—Concert.
6.30 p.m.—Lectures (not daily).
7.30 p.m.—Concert. (Sundays and holidays 6 p.m. / 7 p.m.).
8.45 p.m.—Last news report. Weather forecast.
9.50 p.m.—Dance music (not daily—usually Thursdays).

LEIPZIG—MITTELDEUTSCHE RUNDFUNK A.G.
Wavelength, about 400 metres.
9 a.m.—Market prices.
11.45 a.m.—Exchange quotations, etc.
11.55 a.m.—Time signal (from Nauen).
3.30 p.m. / 5 p.m.—Concert.
8.15—Concert and news (Sundays and holidays, 4 p.m. to 5 p.m.)
9 p.m—Dance music (not daily).

KONIGSWUSTERHAUSEN L.P., 4,000 metres.
6 a.m./7 a.m.—News.
11 a.m. to 12.30 p.m.—Exchange (on 2,700 metres).
3 p.m. to 4.30 p.m.—Exchange and news (on 4,000 metres).



Readers' Experiences

To the Editor of MODERN WIRELESS.

SIR,—Having read in your columns various articles on crystals, home made and otherwise, I would like to draw your attention to the specimens enclosed, together with a brief description of how they came into my possession.

A few friends and myself are in the habit of taking small portable crystal sets with us on cycles for experiments of varying distances from the near stations.

On Saturday, December 8, we were at a place near Chesterfield (Derbyshire).

We, as usual, rigged up our aerial (using Electron wire, page 369 MODERN WIRELESS, No. 5, Vol. II.) earth and set, then imagine my discomfiture to find the tube in which I carry my crystal was in none of my pockets.

At this, of course, all thoughts of reception had to be put aside. So feeling rather disconsolate I set off to inspect a nearby quarry, and it was in this quarry that the enclosed specimens attracted my eye; it was lying about in tons. Curiosity prompted me, and I chipped a piece off and carried it to my set, not without some misgivings as to the stability of my reason. Needless to say, after a few fine adjustments I was able to receive Sheffield relay quite well.

My friends and I were quite jubilant and we left that spot with a goodly collection of these crystals to be had merely by bending one's back.

Of course I am not thinking I have made a great discovery, but one wonders at the price of a good specimen of treated crystal in comparison.

Wishing MODERN WIRELESS every success, I remain, sir,

Yours truly,

T. PAYNE.

Editor's Note.—The crystals submitted by our correspondent worked quite well in comparison with the commercial types.

To the Editor of MODERN WIRELESS.

SIR,—I wanted to make a receiving set for my parents who live at Maidstone. As they are both getting on for 80 years old I wanted something as simple as possible and yet which would give fairly loud reception as they are both rather deaf. I therefore, made up the "Old Folks" set from the October, 1923, MODERN WIRELESS, and I am pleased to say that it is a great success. They heard the Bishop of London on Easter Sunday and the King at Wembley very clearly, and they are enjoying the programme every evening. I used 3 Ediswan A.R.D.E. valves and 2 R.I. transformers.—Yours truly,

A. T. GRANT.

To the Editor of MODERN WIRELESS.

SIR,—I have wired up the Reinartz circuit with your improvements according to your very lucid directions in the March MODERN WIRELESS and I am taking the liberty of writing to you. I have used loose parts on a walnut board with English apparatus, *e.g.*, R. I. Ltd. transformers and 3-valve panels fitted with Burndept coil-holders and rheostats and M.O. "R" valves.

It all works splendidly and the surprising thing is that I get well such distant stations as Minneapolis, Chicago and Davenport, about 900 to 1,000 miles distant with L.F. amplifiers. The building up of the reaction is very satisfying.

My aerial is 50 feet high, T type from exact centre, and I use Brown's low-resistance telephones with a Burndept tel. transformer in a box.

I have used No. 21 wire B. and S. This is nearly the equivalent of No. 22 S.W.G. In Canada we use the American wire standards. Almost everyone in Canada uses American wireless apparatus, or if made in Canada, instruments of American type.—Yours faithfully,

F. A. MAGEE.

Sparks Street,
Ottawa, Canada.

To the Editor of MODERN WIRELESS.

SIR,—As regards your latest 3-valve dual, I have converted your ST. 100 Star to that circuit, and find it very good for long distance stations. On Saturday the 12th, after listening on your one-valve reflex, by Kendall B.Sc., to the S.O.S. calls going on, etc.; at about 3 a.m. I turned on the three-valve dual, and tuned in W.G.Y. which was quite strong and clear, and very steady.

The orchestra was playing the Savoy type of music. At about 3.15 I left it at that, and went to bed. The next night, Sunday 13th, at about 12.25, I tuned in the Spanish Station, Radio Elevar, Madrid, and heard that station quite London crystal strength, with practically no fading.

The orchestra was composed of mandolines, etc. G.B.L. had a lot to say, and practically drowned it out, so went to bed again.

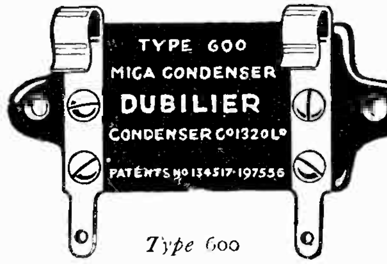
The three-valve dual is much too powerful to use here (Earl's Court), even on loud speaker, and I find it is not very pure for the local station. Admittedly my second transformer is not a first-class make, but it worked your All-Concert type satisfactorily. Your ST. 100 was very pure, but not selective. The first night I used it I got Aberdeen on L.S. I must add, that my aerial has walls on three sides of it, as I am in a lower maisonette, and also there are tall houses fifty yards off on the fourth side, so it is not quite ideal! I think MODERN WIRELESS the finest radio magazine, as all your circuits are laid out so clearly. The only fault I find is, that as soon as we get settled down to our circuit, out comes another, and we must try it!

I remain,

Yours truly,

V. KEBBELL.

Earl's Court, W.



Type 600

Confidence.

When you buy a fixed condenser of any unknown make for your set, you buy on trust.

You hope that it really will be of the capacity stated; you hope that it will remain constant and not produce mysterious faults by leaking or altering its capacity.

Not having an electrical laboratory at your disposal, you cannot prove the matter either way. So you hope for the best.

How much wiser to buy a condenser in which you *can* have confidence.

There may be an extra outlay of a few pence, but the soundest possible insurance against condenser faults in your receiver is to

Specify Dubilier.

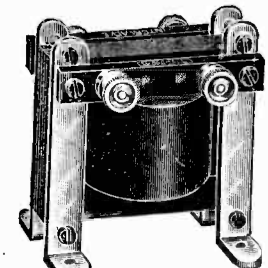
Advt. of the Dubilier Condenser Co. (1921), Ltd., Ducon Works, Goldhawk Road, London, W.12

DUBILIER CONDENSER CO. (1921) LTD

E.P.S.59.

The inimitable "L.F." —*Woodhall Number One.*

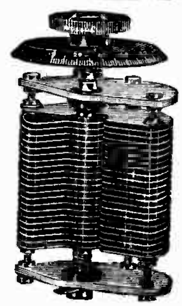
You cannot get a better Transformer at any price. You cannot obtain "S.T.100" results with an inferior transformer.



The formula used in this famous transformer is a unique one: it combines the best enamelled wire with simultaneous turns of fine silk, giving a spacing to turns and a cushioning effect that eliminate "parasitic noise," and yield pure, full-toned amplification, equally mellow on the top notes of a soprano vocalist, the bass notes of the bassoon, and the octaves between. Behind all formulæ and purely mechanical detail, however, is the "human element"—experience, skill, and thoroughness—that individualises Woodhall-Wireless Components and makes them *inimitable.* PRICE **23/6**

The WOODHALL Variable Condenser

Type 3 — Light-weight — Metal Ends.



A lighter-weight condenser of similar construction to type 1—with ALUMINIUM END-PLATES and BEST EBONITE BUSHES. The vanes are 24-gauge aluminium and the spacers are 3/32nd in.

Accurate bearings giving smooth movement and adjustable tension. The adjustment of vanes is a point to which very careful attention is paid. Terminals are provided—no soldering required. Mounted on panel by drilling *one hole only.*

.001	8/-	.0002	5/-
.0015	6/-	.0001	4/9
.0003	5/6	.00005	4/6

Above prices include Knob and Anticapacity Dial.

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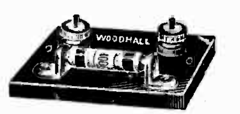
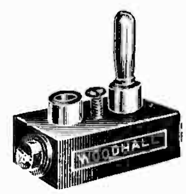


Constructed by a new method, sealed against the effect of damp or heat, and guaranteed exact and constant. Mounted on best ebonite base with terminals. Standard resistance 100,000 ohms or can be supplied in any value from 20,000 ohms to 5 megohms **2/9**

The WOODHALL Panel-Mounting Coil Plug

For addition of loading coil to existing sets, or for many other purposes. Attached through panel from back, giving neat surface appearance; supplied with drilling template **1/6**



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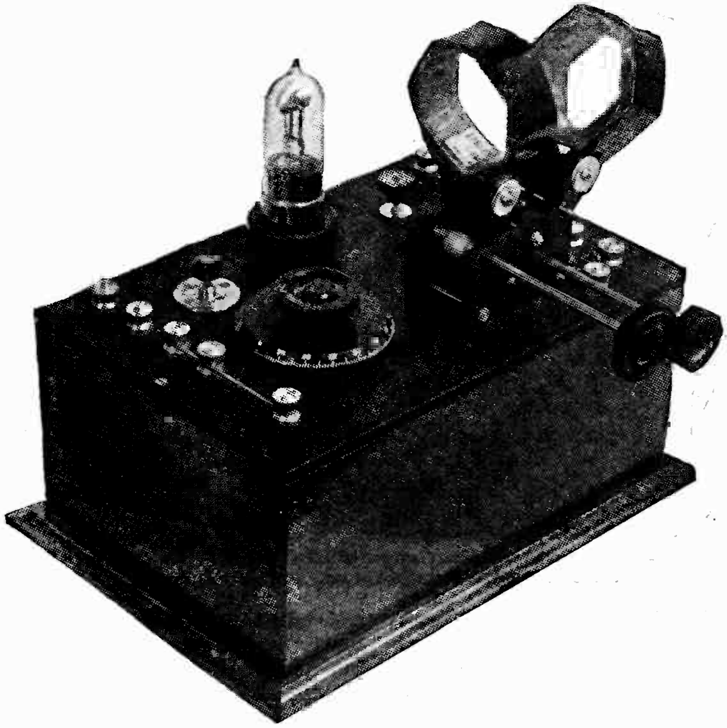


Fig. 1.—The appearance of the finished set.

An Efficient Single-Valve Receiver

By
HERBERT K. SIMPSON

VALVE sets of many types are continually making their appearance in the technical journals, but the modest single-valve set, in which the valve acts as a rectifier, receives very little attention. This is hardly as it should be, considering the good results which are obtainable from such a set with a minimum of trouble and experience.

The set seen in Fig. 1 is of the single-valve type, reaction being provided on to the aerial coil by means of the two-coil holder, on the left of which is seen the aerial tuning condenser. The valve-holder is seen at the back of the set, with the variable grid leak on the left and the filament control on the right. The terminals on the left-hand side of the set are those in the aerial circuit, by means of which we may use the three chief forms of tuning—namely, constant aerial tuning, series tuning, or parallel tuning. On the right are six terminals. Reading from the top, these are high-tension positive and negative, low-tension positive and negative, and telephones. Two terminals are provided close to the reaction coil socket of the two-coil holder (the right-hand socket), by means of which the reaction coil may be reversed. The two-coil holder used is of a good type, as shown in the illustrations, and can be obtained with a special device, incorporated on one of the sockets, for reversing the connections to that socket. If this type of coil-holder is used, the necessity for the reaction terminals on the panel will be obviated, the leads going direct to the coil-holder. If in doubt, construct the set exactly as shown.

Circuit Diagram

A diagram of the circuit arrangement is given in Fig. 3, and from this the various aerial circuit connections may be followed. Constant aerial tuning may be applied by joining the aerial lead to terminal T_1, leaving T_2 free, and joining T_3, T_4 and T_5 together. The earth is connected to T_5 in all cases. If it is not desired to use constant aerial tuning, but to have the aerial tuning condenser in parallel with the aerial tuning coil, the aerial lead is joined to T_2, leaving T_1 free, and T_3, T_4 and T_5 are connected together and to earth. Tuning is carried out on the variable condenser C_1, the coil L_2 being coupled to L_1 to obtain reaction.

Series Tuning

The aerial tuning condenser may be used in series with the coil by joining the aerial lead to T_1, earth to T_5, leaving T_1 and T_2 free, and connecting T_3 to T_5 with a piece of wire.

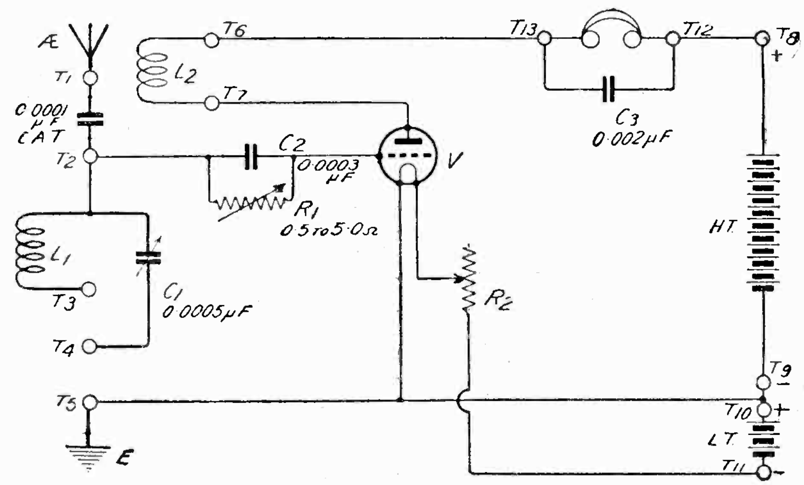


Fig. 3.—The circuit arrangement of the receiver.

Although there is a considerable interest in two, three and multi-valve sets, the single-valve receiver still appeals to a very wide circle. This article gives full constructional details for a thoroughly efficient set.

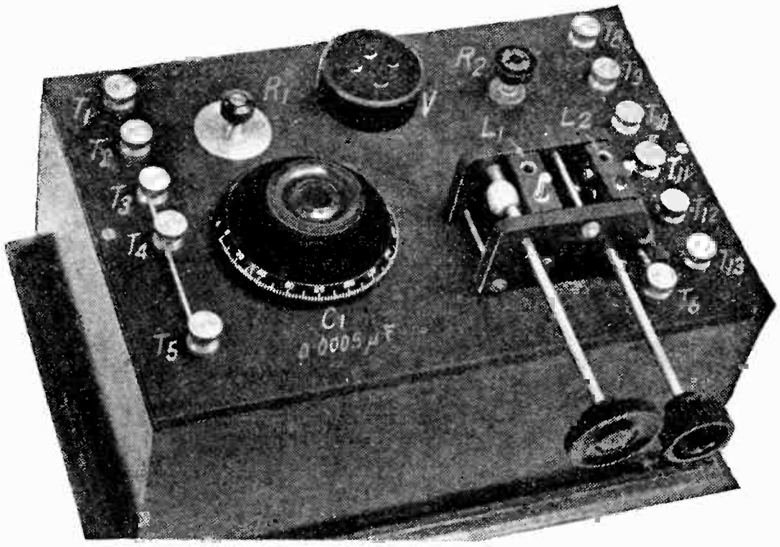


Fig. 2.—A close up view of the top of the panel. Note the vernier adjustment on the coil holder.

Components and Cost

The parts required for this set are listed below, and will be found simple and inexpensive. If the constructor has any parts already in his possession, such as a variable condenser, valve-holder, and so on, he may use his own components, but at the same time he is advised to adhere as closely as possible to the specification, as good parts are necessary to ensure efficient working of the receiver.

COMPONENTS.

	£	s.	d.
Cabinet (Wright & Palmer), 10½ in. by 7 in. by 4¼ in. deep ..		9	3
Panel, 10½ in. by 7 in. by ¼ in. (Paragon Rubber Co.)		5	0
0.0005 Variable Condenser (K. Raymond; new type)		5	11
Two-Coil Holder (without reaction reversing switch) (Goswell Eng. Co., Ltd.)		9	0
Valve-Holder (H.T.C. Electrical Co., Ltd.) Type A		1	9
Grid Leak (0.5 to 5 megohm) (Watmel)		2	6
Lissenstat Minor Filament Resistance		3	6
13 4 B.A. W.O. type Terminals (K. Raymond)		2	2
Fixed Condensers (Dubilier)—			
One 0.0001		2	6
One 0.0003		2	6
One 0.002		3	0
6 (2 ft.) Lengths Square-section Wire (Sparks Radio Supplies) ..		1	0
Screws, Rubber Leads, etc.			6
Total	£2	8	7

Notes on Components

The two-coil holder is of a very neat design, incorporating fine adjustment of the coupling between the coils, by means of a cam operated by the usual knob; it is made by the Goswell Eng. Co., Ltd.

The valve-holder, made by the H.T.C. Electrical Co., is made with no metal parts visible, thus rendering it almost impossible to short the filament legs of the valve across high tension when inserting the valve. There is the added advantage of extremely low capacity in the socket; but when using Ediswan valves care must be taken that proper contact is made, as the pins on this type of valve are shortened for the sake of protecting the filament.

Dubilier fixed condensers have been used in this set, and a Raymond new type variable condenser. Wiring is carried out with square bus-bar wire, obtained from Messrs. Sparks Radio Supplies.

The Panel

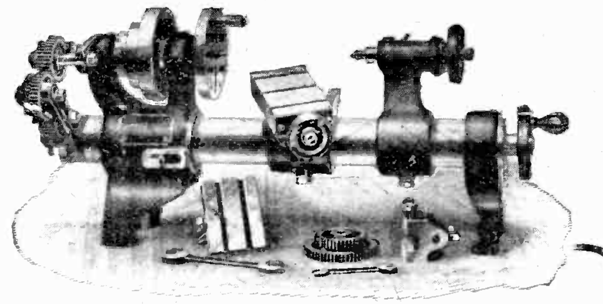
The Panel, which is of ebonite, measures 10½-in. by 7 in., and may be either ⅜-in. or ¼-in. thick. The ebonite used was obtained from the Paragon Rubber Company, and is of very good quality, there being no need for "matting" (i.e. rubbing with emery paper). A drilling diagram is seen in Fig. 4, with the dimensions necessary for locating the holes. Have all the components to hand before drilling, and ensure that the size of hole is correct before drilling same, otherwise too large a hole may inadvertently be drilled. Make a small indentation with a hammer and a nail at the point where the hole is to be, taking care not to hit too hard, or the panel may be cracked. This prevents the point of the drill from "wandering" when drilling is commenced. A ⅜-in. hole is drilled in the panel, in a position in between the two sockets of the coil-holder, in order to allow the leads to the aerial coil to pass through the panel.

Mounting the Components

When all holes are drilled, the various parts may be mounted up, commencing with the terminals, valve-holder, and such small parts, leaving the variable condenser and coil-holder until last. In this way the panel does not become so awkward to handle at first. The fixed condensers are held in position on the panel by the wiring, there being no need for securing bolts.

Wiring

Wiring is carried out with square-section bus-bar wire, and should present no difficulty to the careful worker. It is advisable to tin all the points to which a wire has to be soldered, for example, terminal shanks, condenser lugs, and so on, before wiring up is actually commenced. A wire is then bent to the exact shape to fit between two, or three, points, as the case may be, and carefully soldered to each point in turn. Rubber-covered flexible leads join the ends of the aerial coil to terminal T_3 and the fixed plates of the variable condenser respectively. Flexible leads also join the reaction coil socket to the two terminals on the



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Winding coi's, turning up formers, plugs, knobs—a hundred and one jobs, drilling, slotting, boring, screw-cutting—all may be done well and cheaply on the Drummond. A contact stud —or a bush for your car—make it yourself, and pay for the lathe with the money you save.

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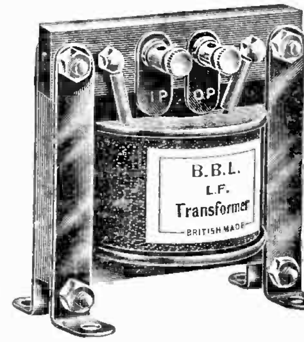

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An excellent type of light transformer giving maximum amplification in all stages of Audio Frequency. The laminations are built up of Swedish soft iron (stalloy), the receiving bolts being kept clear and so conforming to the best present-day practice. Tested 500 volts between windings. Ratio 4 to 1. No. 17185. Price **13/6.**

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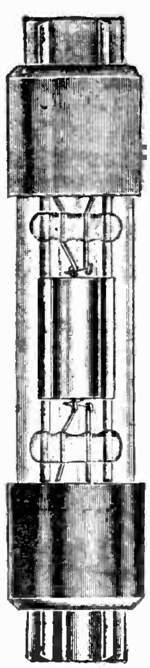
Exactly how vital the bearing of correct valve design upon perfect reception the MYERS demonstrates to a remarkable degree.

Valve efficiency is, primarily, the result of a large internal capacity due to bunched leads. This capacity produces valve distortion.

But in the MYERS valve the grid and anode leads are brought out at opposite ends. Thus the electrodes of the MYERS are free of this sterile capacity and perform perfectly.

The deficiency of any valve as an amplifier may be directed to an imperfect vacuum. The presence of gas inside the valve functions as an impermeable wall from which electrons rebound *back* to the filament.

The maximum amplification (10) given by the MYERS is the product of a perfectly vacuumed valve. It is pumped free of all gas. The entire electron stream—essential for good amplification—therefore reaches the anode.



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Experimenters with multi-valve sets employing *MYERS* valves will recall their joy at the discovery that the substitution of MYERS enabled them to dispense with one valve. This distinction, among many others, is the reward of scientific design to place a valve of pre-eminent performance within the experience of every user.

Myers Valves

PRACTICALLY UNBREAKABLE

In addition to its other remarkable features the MYERS is ruggedly constructed. It may be roughly handled—even dropped upon a cement floor; but no alarm need be felt for the safety of the glass or filament.

Candidly, there is every reason why you should decide to use MYERS from to-day; and, moreover, to insist upon MYERS at your dealer's. If he cannot supply, send to the nearest selling agent or direct to the Sole Distributors and be supplied post free.

MADE IN TWO TYPES.

UNIVERSAL
4 volts ·6 amps **12/6**

DRY BATTERY
2½ volts ·25 amps **21/-**

PLATE VOLTAGE
2 volts—300 volts

Remember that mounting clips are supplied free. Drilling template with each valve.

AGENTS:

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MANCHESTER.—*R. Davies & Sons, Victoria Bolt and Nut Works, Bilberry Street, Manchester.*
NEWCASTLE. — *Gordon Bailey & Co., Consett Chambers, Pilgrim Street, Newcastle.*
LIVERPOOL.—*Apex Electrical Supply Co., 59, Oldhall Street, Liverpool.*
GLASGOW. — *Milligan's Wireless Co., 23-25, Renfrew Street, Glasgow.*
YORKSHIRE.—*H. Wadsworth Sellers, Standard Buildings, Leeds.*
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Clarke's "ATLAS" SPECIALITIES

Dealer : "Oh, yes ; besides **CLARKE'S "ATLAS" PATENT PLUG-IN COILS,** we stock all other **"ATLAS" SPECIALITIES,** such as, for instance, the **"ATLAS" VARIOMETER,** which comprises an ebonite ball-type rotor, swivelling inside an ebonite tube stator. This Variometer, which is of the one-hole fixing type, covers all the British Broadcasting, and is an extremely efficient apparatus.

Further, the **"ATLAS" FIXED CONDENSER** possesses special features, one of which is that the casings and inserts are made of Bakelite—well known as one of the finest of Insulating Materials, and the copper-foils and sheets of mica forming the dielectric are held under pressure. The value, therefore, of the Condenser is kept constant all the time.

Again, **CLARKE'S "ATLAS" VARIABLE CONDENSERS** are built not simply for **sale** but for **use** in the positions for which the Condensers, of their respective capacities, are destined. They are supplied with full-round or semi ebonite end plaques, the fixed and moving Aluminium Vanes being correctly spaced and beautifully balanced."

Customer : "And do Clarke's make Coil Stands, Rheostats, etc. ?"

Dealer : "Yes ; their latest type of **"ATLAS" 2-WAY AND 3-WAY HORIZONTAL AND VERTICAL COIL STANDS** is second to none. They are fitted with plugs and sockets set at standard centres, and the Stands are provided with a neat Tension Adjustment, all fittings being nickel-plated.

Respecting Rheostats, **CLARKE'S "ATLAS" 'VELVET TOUCH' RHEOSTAT** is the acme of perfection, and, as its name implies, the action of the contact arm passing over the coils of the resistance spring produces just that 'Velvet Touch' which, in the cheaper types of Rheostat, is so conspicuous by its absence.

The large ohmic value of this 'Velvet Touch' Rheostat—viz., 6 ohms—makes it impossible for the full voltage to be put on to the Filaments straight away ; consequently the life of your Valves is increased."

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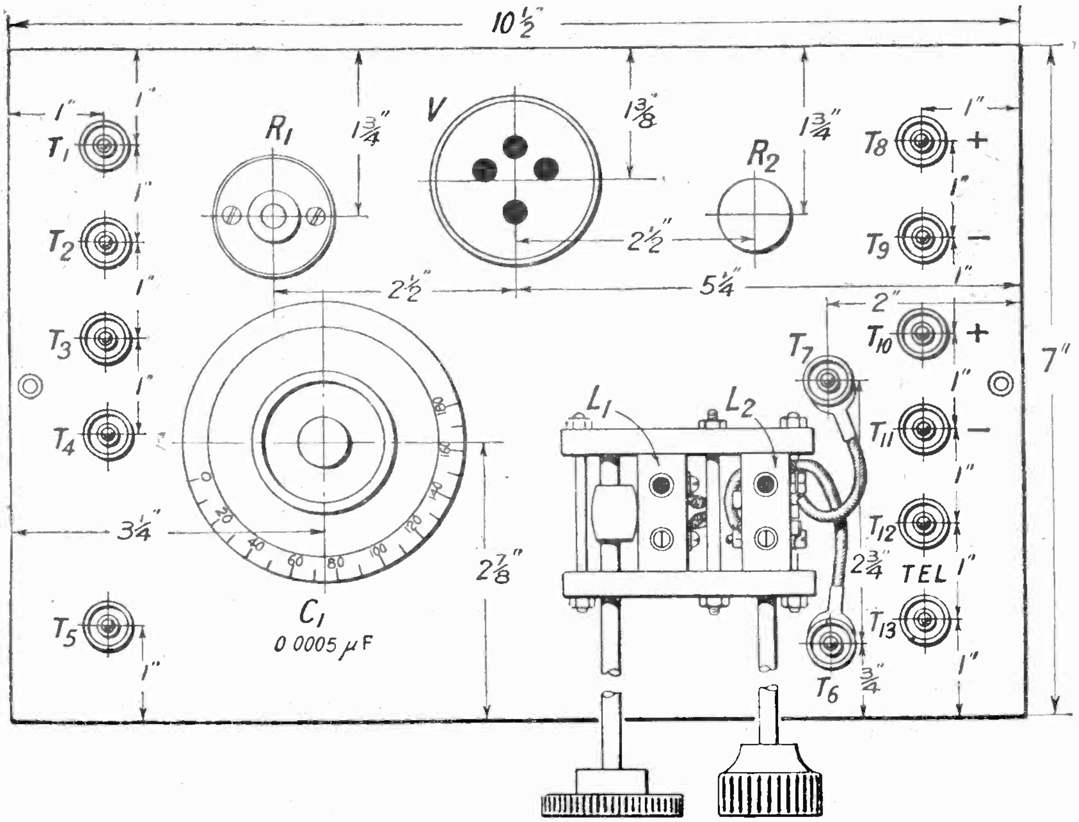

Fig. 4.—A scale drawing of the top of the panel, showing the layout of the parts, and all necessary dimensions for drilling the holes.

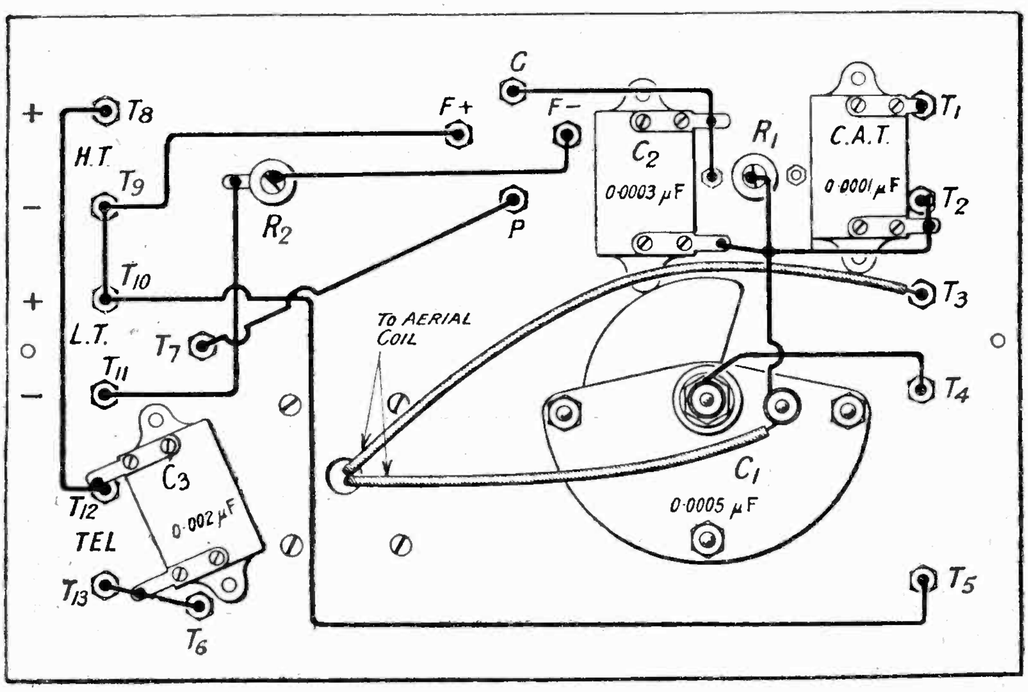

Fig. 5.—The back-of-panel wiring diagram of the receiver. Flexible leads go from T_3 and C_1 to the aerial tuning-coil.

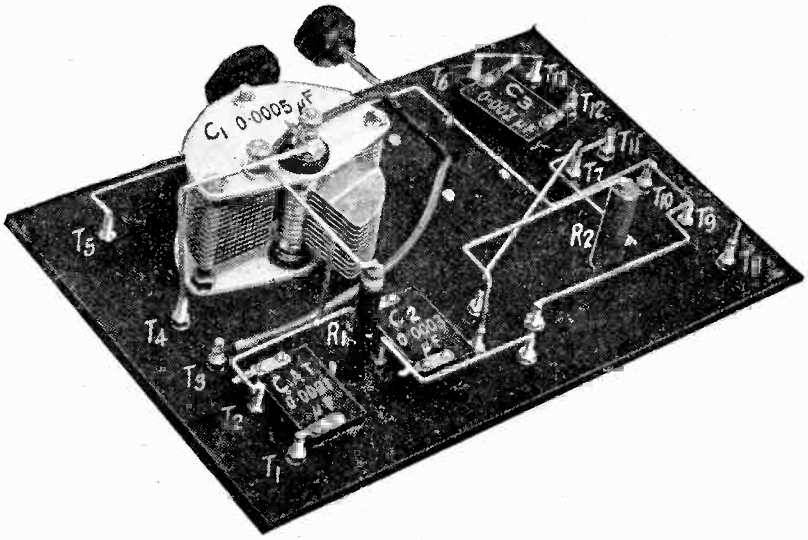

Fig. 6.—A photograph of the back of the panel.

panel. If the special type of coil-holder which incorporates the reversing device, previously referred to, is used these terminals may be dispensed with, and the flexible leads from the coil-socket will then be taken respectively to T_{13} and the anode of the valve. A wiring diagram is given in Fig. 5, and a photograph of the back of the panel is seen in Fig. 6.

Coils and Valves

When using constant aerial tuning a No. 50 coil should be used in the aerial socket, when the wave length of the broadcasting station listened to is below 420 metres, above which a 75 coil may be used. When using parallel tuning a 35 or 50 coil may be required in the aerial socket, according to the size of the aerial, while, when series tuning is employed, a number 75 coil will be necessary. The reaction coil may be a 50 or a 75. Any good make of valve may be used, and no alteration to the set will be necessary if a dull emitter valve is used, as the Lissenstat Minor filament control is equally suitable for either type of valve.

Testing the Set

The constructor should now commence testing by using the constant aerial tuning system, in which case the aerial lead is joined to terminal T_1, T_2 is left free, T_3, T_4, and T_5 are connected together by a piece of wire, and the earth is joined to T_5. The batteries are connected to the terminals on the right hand side of the set, indicated in Fig. 4, and the telephones are joined to the bottom two terminals in this row.

Having inserted the valve and coils as mentioned above, turn on the filament supply by rotating the knob of the filament resistance in a clockwise direction until the filament of the valve is sufficiently bright. Keeping the reaction coil well away from the aerial coil, tune on the variable condenser C_1, when the local station should be heard at once. Bring the reaction coil up closer to the aerial coil, retuning on the condenser, and note whether the signal strength increases. If this does not happen, the leads from the reaction coil to the two terminals T_6 and T_7 should be reversed. Bringing the coils closer together and retuning on the condenser will now result in an increase of signal strength, up to a point, at which the set will commence to oscillate, and distortion of the speech will take place. Care must be taken not to couple the two coils up sufficiently closely to cause the set to oscillate, as when this takes place, interference will be caused to nearby listeners, thereby upsetting their reception.

The Blue Print of the wiring is No. 46.

TEST REPORT.

The One-Valve Set.

THIS set was tested on a 75 ft. single wire aerial about 15 ft. high, and also on a 5 ft. indoor aerial.

At 10 miles from 2LO signals came in on a loud-speaker sufficiently clearly for the News Bulletin, etc., to be plainly heard at any part of the room. Constant aerial tuning was used and a No. 50 Lissen coil was in the aerial circuit, while a No. 75 coil was used as reaction. The London station came in on 56 degrees of the condenser.

The 5 ft. aerial was next tried and London came in plainly on the phones, using a 50 coil in the aerial, a 75 in the reaction and using constant aerial tuning. Owing to the very small size of this aerial more condenser was required, and 2LO came in at 74 degrees.

The earth connection was now taken off the earth terminal and the lead was connected to the aerial terminal, no aerial being attached to it. The earth terminal was left free. 2 LO came in just as well, if not rather better, on the phones at 65 degrees on the condenser.

Birmingham was next tried for and was received on the 75 ft. aerial with a No. 50 coil in the aerial circuit and a No. 75 as reaction.

The wavelength range on the 75 ft. aerial, using a No. 50 in the aerial circuit and a No. 75 as reaction and using constant aerial tuning, was 250 to 530 metres.

Brussels came in very clearly using the above coils on the 75 ft. aerial using C.A.T. The adjustment of the variable condenser was 12 degrees and the wavelength appeared to be about 265 metres.

For wavelengths over 430 metres, a No. 75 coil in the aerial circuit is recommended, the same size coil for reaction being used. J. S.-T.

Radio Press Information Department

Owing to the tremendous increase in the number of queries, and the policy of the Radio Press to give expert advice and not merely "paper circuits," it has been found necessary to enlarge our staff dealing with such matters. In view of the expense incurred, we are reluctantly compelled to make a charge for replies of 2s. 6d., according to the rules below.

All queries are replied to by post, and therefore the following regulations must be complied with :—

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(2) Not more than three questions will be answered at once.

(3) Complete designs for sets and complicated wiring diagrams are outside the scope of the department and cannot be supplied.

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With a wide spread interest in high-tensionless receivers, it will be known that the H.T. battery conceals numerous inefficiencies.
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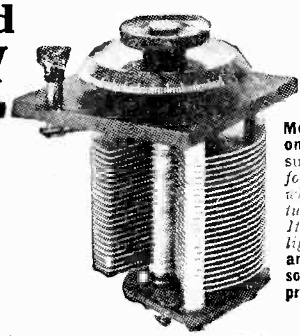
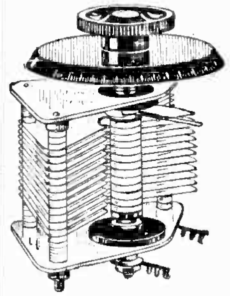
When "J.B." Condensers offer a resistance as negligible as 0.05 ohms, the effect upon signal strength is truly amazing. Tuning becomes bright. In fact, if you are building high-tensionless receivers, the only condensers which will bring success to every builder are "J.B."



SUPER ALL-METAL CONDENSER.



This model has set the standard of modern condenser efficiency. **Brass End Plates** give it the finish of the scientific instrument which it is. Incorporating all the proven **"J.B."** mechanical features and **generously guaranteed against manufacturing fault for six months.** One hole fixing, large top and bottom bush of Grade A, Post Office Ebonite. Spade terminal connections.

A distinctive "J.B." condenser costing no more than the many unnamed. The maximum capacity of the "J.B." is up to specification while the minimum is extremely low—essential for capacity reaction circuits and maximum wavelength range.

.001	..	9/6
.00075	..	9/-
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.0003	..	6/9
.00025	..	6/9
.0002	..	5/6
.0001	..	5/3
Vernier	..	4/6

Complete with Knob and Dial.

Twin Model (Brass End Plates) for Dual H.F. tuning.
Each half .00025 mfd. ... ... **19/6** each.

When buying condensers remember that good condensers are the key to perfect reception. Incoming signal energy is lost even in the most efficient tuners. If your condensers are poor further energy is **wasted.** *Therefore use the "J.B." Precision Condenser. They are pre-eminent.*

"J.B." Condensers are obtainable from your dealer. If he cannot supply you we strongly advise you to write direct.

Post: One, **6d.**; Two, **9d.**; Three **1/-**.

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Movement to 1/20° possible with readings on one dial. Crude attachments are superseded. *Recommended for long-distance work where extremely accurate tuning is indispensable. Its H.F. resistance is negligible.* **This vernier is not an attachment; but is sound engineering practice.**

Complete with Knob and Dial		
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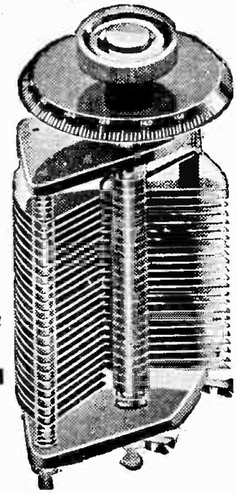
Twin Model Microdenser for the simultaneous tuning of dual H.F. Stages. Vernier tuning is applied to *both halves* at the same time. Each half .00025 mfd. **£1 2 6**



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End plates made by special process, ensuring low dielectric losses. Owing to close accurate spacing (dielectric .026), **"J.B."** take up much less room under panel; silent, metal plain bearings, which do not work slack, are a few of the distinctions **obtainable only in the "J.B."** One hole fixing. Spade Terminal Connections provided.

This model is a real precision instrument at a minimum cost.

Complete with Knob and Dial		
.001	....	8/6
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WIRELESS TELEPHONY AND BROADCASTING

By H. M. DOWSETT.

For nearly 30 years the author of this wonderful work has been intimately associated with every aspect and development of Wireless Telegraphy and Telephony. He has "demonstrated" in all parts of the world and, apart from his services to various Governments and to the Marconi Company, since 1915 he has been editor of the *Handbook of Technical Instruction for Wireless Telegraphists*, the standard handbook for training ships' operators. Mr. Dowsett is thus thoroughly equipped, not only because of his scientific training as an electrical engineer, but also by reason of his extraordinary *practical* experience, to produce a work of the highest authority. A glance at the contents of these volumes will show their wide scope, but even a cursory examination of the books themselves would prove they contain a mass of information, of photographs and of diagrams, unequalled in any other work yet produced.

Every page is clearly and fascinatingly written. Every part of each subject is carefully and convincingly explained so that the merest amateur can follow the most intricate description with the ease of an expert. As for the expert himself, he will find hundreds of practical suggestions for improving his own apparatus. Photographs and working drawings abound to elucidate difficult combinations and the most complicated wiring systems are easily unravelled by means of superb coloured diagrams. Mr. Dowsett has produced *the* Wireless *Vade Mecum*.

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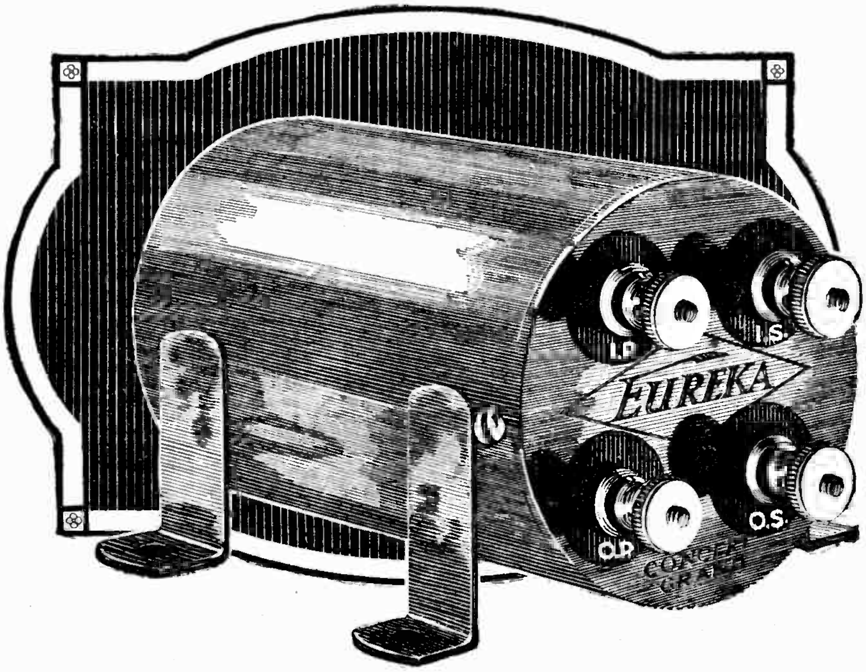

2¼ miles of wire on a Eureka Concert Grand

INSTEAD of being built to a price, the Eureka Transformer is built to an ideal. As manufacturers of Broadcast Receiving Sets from the commencement, we have had the opportunity of comparing practically every worthwhile Transformer on the market. In our expert opinion, they all failed in one point—purity of tone. Volume they had—for volume is merely the result of mathematical calculation of ratio between windings. A step-up ratio of five to one will produce any amount of noise—it will give volume, but at the expense of purity of tone.

The Eureka has been designed regardless of mere cost entirely for those who appreciate the folly of spending £8 or so on the parts for a three-valve Set and economising on the most vital item—the L.F. Transformer.

While other makers, for instance, are so parsimonious as to cut down the amount of wire necessary and use a higher step up ratio to make up for the deficiency, our policy is to use the largest number of turns possible.

Frankly, we would use even more than 2¼ miles if the results justified it. That our efforts to produce a Transformer which would set a definite standard of its own—both in appearance, workmanship and performance—are appreciated, is proved by the immense demand for the Eureka.

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Concert Grand	**30/-**
No. 2 (for second stage)	**22/6**

EUREKA
Low frequency Transformer

Gilbert Ad. 823.

Date of Publication: 7th June.

An Innovation

By
RADIO PRESS LTD

EVER on the watch for new methods of helping readers of MODERN WIRELESS to build up good Receiving Sets that will really work, Radio Press, Ltd., believe that they have hit upon a method that will be extremely popular. The idea is to supply a large cardboard model of the panel of the Receiving Set showing both the back and the front.

Panel Card No. 1.

How to make the W 1 3-Valve Set.

Enclosed in the Envelope with the cardboard model of the Panel is a full size drilling plan which can be used as a drilling template for the Ebonite panel. The holes to be drilled are plainly marked and no mistake is possible.

The Cardboard model on one side makes the disposition of each component perfectly plain while the other side clearly shows how every part is wired up.

Full instructions for every step are included together with the theoretical circuit diagram. The total components for this Receiver — even generously priced — do not amount to more than £5 12s. 6d., surely a low figure for a really high-grade 3-Valve Set.

As to operation, this Receiver will easily pick up all B.B.C. stations—the nearest on the Loud Speaker—while 12 miles away it has successfully received 2 L.O. with no aerial at all.

This panel card system is certainly appealing very strongly to those home constructors who want to get a very clear idea of the lay-out and arrangement of the Set before they start work. It undoubtedly permits a very good conception of the ultimate result being obtained before the expenditure of a penny piece on components.

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G.A. 889

Why Constructors Sometimes Fail

A Short Chat on an Ever-Topical Subject

By the EDITOR

No matter how efficient a set is described, no matter how simple the construction, no matter how detailed and lucid the instructions, there are always a certain number who do not get the full results, and some who do not get any results at all.

We have, as an organisation which depends almost entirely on the confidence which the public places in our designs and circuits, made a special study of the constructor's troubles and tried in every possible way to produce constructional articles which would ensure success.

The Constructive Ability

The constructor, before he makes his set, must not over-estimate his own ability. He must, moreover, have regard to the simplicity of design of the set. The simpler the design, the greater will be the proportion of constructors who achieve success with the set. For example, a set in which the first valve acts as a detector and the second as a low-frequency amplifier, if built up by one hundred readers would probably result in 90 per cent. getting the correct results. Add reaction to the set and probably 80 per cent. would get the desired results; the others would probably use the wrong sizes of coils, would not tune correctly, would have the reaction coil connected the wrong way round, or something of the sort.

H.F. Troubles

If, now, a set containing a stage of high-frequency amplification is made, the chances are that the number of successful sets will be lower; while if a dual receiver using two or more valves is described, perhaps only 60 per cent. would get good results.

The fault is either in the article or in the constructor, or just as likely in the apparatus he uses.

As regards the effectiveness of the sets described in Modern Wireless and *Wireless Weekly*, there can be no question. Every single set which is now published in Modern Wireless and *Wireless Weekly* has been personally tested by a member of the Radio Press staff fully qualified to carry out the work, and I myself, as a matter of personal interest, have tried out many of the sets.

Readers will also be interested to know that sets constructed for Modern Wireless and *Wireless Weekly* are frequently exchanged between different members of the staff to try out. From this it will be seen that every precaution is taken to see that the actual set gives really good results.

We could easily arrange for any one having any doubts as to the capabilities of a set to have a demonstration, provided the application was made early enough and before the set was dismantled.

As regards the description of sets, the numerous letters which we receive make it clear that even absolute beginners frequently get excellent results the first time. Very rarely some slight error in the description occurs, and a correction, in such cases, invariably appears in the next issue of the paper concerned.

"Improvements"

The reason for lack of success, in some cases, must therefore be looked for elsewhere. It is astounding the extent to which designs published in these papers are improved upon by constructors. A straightforward panel set is converted into a most elaborate cabinet set looking like a piece of furniture, with great long leads between different parts of the set, and innumerable switches introduced to enable different combinations to be obtained. When the set does not work the constructor writes plaintively to us and expects to receive our sympathy and advice.

Some other constructor, even if he adheres to the described arrangement, alters the components and perhaps connects in the set some shabby, nameless transformer. While we do not expect every constructor to buy a complete set of new components for every set he makes, yet if he departs from the description he does so entirely at his own risk. In some kind of circuits the substitution of different transformers, for example, causes entirely different results to be obtained.

Transformer Troubles

Where only one note magnifier is employed, the chances are that different transformers may be tried without very much difference, but when two transformers are employed, a low-frequency howl may be set up, or bad distortion may arise. These disadvantages may be corrected to some extent by the man who has a good grounding in the general technics of valve circuits, and problems of this nature are dealt with very frequently in my weekly "Valve Notes" published in *Wireless Weekly*. The constructor, however, without much technical knowledge of the subject meets with difficulties. This is particularly the case when dual circuits are being arranged. I do not for a moment suggest that any particular type of transformer is best for dual circuits; I do, however, suggest that if a constructor departs from the instructions given in the article dealing with a dual circuit, he may find that the results he gets are very different from those which the author of the article originally got.

For example, with a certain pair of transformers, a certain condenser connected in a certain position might be found desirable by the author of the article. The arrangement may be perfectly stable, but if some other kind of transformer is used, the reaction may be increased, or some other effect may be varied, and the circuit may be unstable and give inferior results.

Dual Circuits

In dual circuits, particularly, is it desirable to adhere strictly to the specification if at all possible. Often the specification may be varied by the substitution of different components, but, as stated before, the risk is the constructor's. In order to ensure that the set may be exactly reproduced, we are making a practice of specifying the actual names of all the components. This has been done as a result of the answers on question papers which we recently issued. Not only are these lists of components valuable to those who desire to reproduce the set exactly as described, but they also give the constructor some idea of reliable component parts. An unsatisfactory component would naturally not find its way into one of our sets.

While writing about components, it might be as well to suggest to readers that the practice of going into a shop and buying a variometer, or condenser, or even small components such as valve holders, of nameless brand, is a very dangerous practice. The great interest in radio has resulted in a large number of nonentities producing inferior stuff which is sold at large discount to shop-keepers. Many of these, even with the best intentions, may sell these components without knowing their inherent faults. For example, in the case of a valve holder, the effect of a perfectly constructed set may be completely spoiled by leakage in the valve holder due to the use of inferior composition or ebonite.

An Ebonite Warning

The same warning may be issued in connection with ebonite, which is sold in many grades, including very poor quality material quite unsuitable for wireless reception. Unfortunately, the selling of branded ebonite is all but unknown in this country, and the lack of enterprise amongst ebonite manufacturers is such that I cannot recall one particular brand which is sold for wireless purposes under a branded name. The result is that the constructor may have very inferior ebonite sold to him, and the only real way to make sure of the quality of the ebonite is to buy a guaranteed branded manufacture, and I would urge readers to support those who are prepared to give a name for their ebonite and guarantee that it is made to a standard.

Nameless Goods

We cannot emphasize sufficiently the dangers of buying nameless goods. Frequently such goods are a trifle cheaper; their origin is always doubtful; and if the apparatus is faulty you have nobody to blame. In the case of named goods, you know the manufacturer, and if there is anything faulty he will replace it.

Readers of our papers who order apparatus from advertisers are particularly secure. If they have any complaint regarding either the quality of the goods supplied or delay in delivery, and they fail to get satisfaction, they have the whole weight of Radio Press, Limited, behind them to have their wrongs set right. In no single case have we been appealed to and failed to obtain full satisfaction for our reader. As a matter of fact, such cases are exceedingly rare because we exercise particular care when accepting advertisements.

The manufacturer of a product which he knows is not of high standing never attempts to advertise it in a reputable journal. Nevertheless, his products very frequently get into the shops, and the foolish purchaser can get no redress.

Minor Faults

The experience of individual members of our staff, and of our Information Department, indicates that frequently the source of trouble is in some minor component which is, perhaps, of faulty insulation. A valve holder, for example, is a frequent source of trouble, in spite of the fact that special valve holders are now marketed with widely spaced connections, so that not only is the capacity effect greatly reduced, but also the chance of leakage. The ordinary valve holder with nuts is a very frequent source of trouble; the nuts come very close to each other, and not only is there a greater capacity between the pins, but a very serious chance of leakage. A little dirt, and a few filings, and the set will either not work at all or work in a very inferior manner. A few more pence on a special valve holder will insure you against this trouble.

Tuning

Tuning is also a very common source of trouble to beginners, although to the experienced man it will seem very simple. There are still an extraordinary number of constructors who do not realise that when tuning a set it should be possible to tune out both above and below the incoming wavelength. The question of different aerials is an extremely important one and a set which may be stable on one aerial may oscillate furiously on another. For this reason I am encouraging the fitting of sets with a constant aerial tuning condenser, consisting of a series condenser of 0.0001 μF capacity in series with the aerial, parallel tuning being used. The use of this fixed condenser virtually places practically all aerials on the same plane, by reducing their capacity to a minimum, enabling similar coils to be used in all cases.

Valves

As regards valves, I do not attach very much importance to specifying valves in constructional articles. The valves at present on the market are all very much of a muchness, although some manufacturers seem to ensure a uniform standard for their valves, an extremely important matter for the enterprising valve manufacturer.

As regards distortionless reception, this is a matter in which technical knowledge plays more part than anything else; it is a question of the proper operation of the set, the avoidance of excessive reaction, the introduction of grid bias on the low-frequency amplifying valves, the use of good quality transformers, and the ability to introduce various correctives, such as resistances and condensers, to ensure perfect reproduction. Only by reading notes of the character outlined above will the home constructor be able to get the best results. There is far more in radio than merely joining together a number of different components and mounting them on a panel. The best results will always be obtained by those who have some theoretical knowledge of the subject.

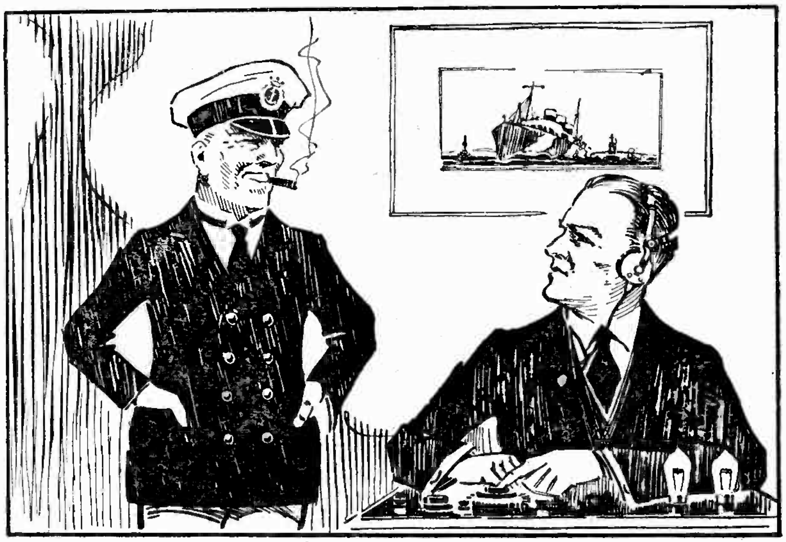
Envelope No. 2

To the Editor of MODERN WIRELESS.

SIR,—I have just built "The Family Four-Valve Receiver, No. 2 Envelope," the components being exactly as description, except that I have used "Silvertown" transformers and ebonite panel. I get all B.B.C. stations on G.E.C. loud-speaker with wonderful clearness and volume. Our local station and Manchester I have to tone down when using four valves; the latter station comes in practically as loud as Sheffield and with exceptional clearness. I thought it well to make known my result as this is my first attempt at building a set.

Yours faithfully,
J. W. MORTON.

Sheffield.



"If it's good enough for the biggest ships afloat . .

where Wireless is, of necessity, a matter demanding the R.C.C. Standard of accuracy and efficiency, then the Polar Condenser has certain advantages which you wireless landsmen would do well to note:

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This is an ideal arrangement from all points of view, as the scale is marked in wavelengths (metres) and the capacity is graded so as to give uniform change of WAVE-FREQUENCY for a given movement at any part of the scale.
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You can buy the POLAR CONDENSER in the following capacities:—
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"Polar" Condensers are eminently suitable for the following purposes:—
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A Super model of the perfect lightweight headset. Like the Wembley Phone, this is entirely British owned and fully guaranteed to give perfect reception. It fits comfortably and lightly yet firmly to the ears, and every pair is most carefully tuned before your dealer gets them. You may pay more, but the extra money will not give you any advantage over the wonderfully clear reproduction you get from the Stella Phone at **17/6** a pair.

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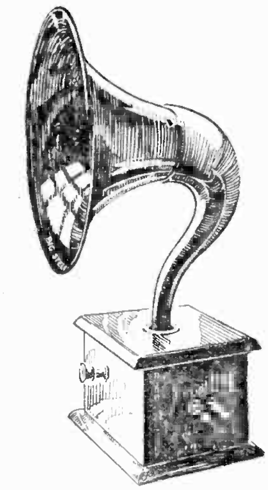

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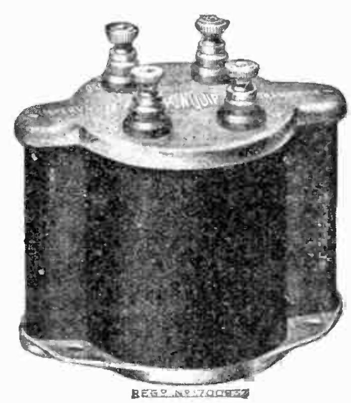
In order to deal satisfactorily with the enormous demand for "Powquip" intervalve transformers we have found it necessary to take over much larger premises and install extra plant.

We are now in a position to supply "Powquip" transformers in any quantity, large or small, and our up-to-date methods of manufacture and careful inspection ensure that the standard of our products shall be fully maintained.



"THE TONE IS BRILLIANT."

NEW ADDRESS:

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Std. type. Ratio 4 : 1 for 1st stage.
Ratio 2 : 1 subsequent stages.
PRICE 14/6
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SPECIAL TRANSFORMER RATIO 14 : 1 FOR HIGH TENSIONLESS CIRCUITS, PRICE 16/-

Tested by Ourselves

Accumulator Terminal Clips

Messrs. The Runbaken Magneto Co., Ltd., have sent for report a sample of their Radio Accumulator Terminal Clips, for making connections to the accumulator. These are easily removed and non-corrosive. They take the form of a strong spring jaw, with teeth, opening about ⅜ in., which can grip the nut or screw of an accumulator terminal, and cut through a superficial layer of corrosion so as to make good electrical contact. The hold was found to be extremely firm, and on trial, even on a badly corroded terminal, where the terminal nut could not be moved without endangering the lead plates, a low-resistance connection was possible.

The connecting wire is made fast to a small screw in the other end of the clip, small tags being bent down on the insulated covering to hold it the more securely.

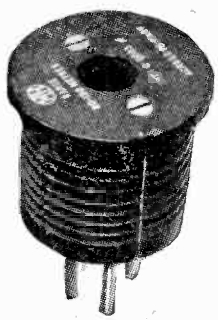
It might be suggested that the clips would be somewhat easier to connect up if the screw to hold the lead-wire were a little longer. Except for this small point, the clips can certainly be recommended as a substitute on accumulators for ordinary terminals, where sooner or later the latter always corrode and give trouble.

Harmotone Crystal

Messrs. The Sclerine Crystal Co. have sent for test a sample of their "Harmotone" crystal, in boxed form, and with a special cat's-whisker. This is a coarsely granular galena type of crystal. The number of sensitive points was found on trial to be very great, and a freshly broken surface showed similar results. Tested quantitatively and qualitatively in aural tests, in comparison with the customary standard of galena crystals, it showed up well as a good all-round crystal for general use and in reflex circuits.

A Short-Wave Plug-in H.F. Transformer

Messrs. Leslie McMichael & Co., Ltd., have handed us for trial a plug-in H.F. transformer to cover the range from 80 to 150 metres, with a .0003 μF parallel tuning condenser. This is a highly finished unit, with the windings in slots on a 1½ in. diameter ebonite cylinder, and having the usual four-pin fitting at the lower end.



A McMichael H.F. short-wave transformer.

On test it proved to cover exactly the stated range with a condenser of the specified size, and operated successfully in a two-valve short-wave receiver, short-wave amateur Morse and telephony being received with fair selectivity. The amplification was, as is usually observed on these extremely short waves, not of a very high order.

Inductance Formers

Messrs. London Hydroloid Products, Ltd., have submitted for test samples of their waterproof tubes for inductance formers, which they make in various sizes in demand. The samples were of the 4 in., 4½ in., and 5 in. diameter types.

These tubes were of a stout cardboard, treated in a manner to render them less susceptible to moisture. This was confirmed by actual trial by immersing it in water. Tested practically as a former for a receiving tuning-inductance, the signal-strength, sharpness of tuning, and small reaction-demands for steady oscillation gave evidence of small dielectric losses. The insulation-resistance between brass screws inserted an inch apart was the satisfactory figure of nearly 30 megohms.

The tubes were mechanically strong, standing up to a cutting-tool and not tearing readily where wires were brought through for tappings and ends of coils.

A Steel Accumulator

Many of the troubles associated with the ordinary lead accumulator appear to be eliminated in the Ni-Fe cell supplied by Messrs. Batteries, Ltd., of Redditch. These are of the type usually known as the Edison cell; they are made under the Swedish Jungner patents. Both of the plates, and the container as well in some models, are made of steel, whilst the electrolyte is an alkaline solution. The voltage per cell falls from about 1.5 to 1.1 during discharge, the greater part of the effective discharge being around 1.2 volts. A very large range of sizes is listed by the manufacturers, up to the largest for power purposes; those recommended for radio are rated at 5 volts (for 4-volt valves), and from 22 to 90 ampere-hours (actual) capacity. These have four cells. Some three-cell types are also listed which would be suitable for the .06 type of valve. The makers claim that these cells are immune from self-discharge; *e.g.*, a small cell they make for bell-ringing and similar domestic uses can be charged once a year, and will last almost indefinitely.

A small two-cell unit, type dA1, of 10 ampere-hours capacity, and rated voltage of 2.5, was submitted for test by the makers, and was put through an ordeal that very few batteries of any type would have any chance of surviving, without apparently suffering the least damage, giving the full capacity and unimpaired voltage after the ill-treatment.

The battery was in a strong steel container, 3 by 2½ by 4 in., and weighed just under 3 lb. Substantial nut terminals, insulated by rubber sleeves, were provided in the top, and screw vent-plugs. The cell was wrapped up in a paper parcel, with no attempt to keep it right side up: only a very slight seepage had taken place, and this of relatively harmless alkali.

The accumulator gave about 2.5 volts on open circuit; with 10 amperes current the voltage was 2. On steady discharge at about 1 ampere, the voltage was, for the better part of the time, around 2.4 volts, and full capacity was shown. After running down completely overnight, and short-circuiting with a short copper wire for half an hour, the cell was rolled down a short flight of stairs, and then thrown out of a first-storey window on to a grass lawn. It was then inverted over a clean sheet of paper; after some time only a very slight seepage of alkali took place.

After standing discharged for a day the voltage had recovered to 2 volts. It was then charged at a rate of approximately 7 amperes, for four hours. Discharged at a 1-ampere rate, it gave approximately 11 ampere-hours, the voltage falling meanwhile from 3. (when freshly charged) to 2.4 and 2.2. It was then short-circuited for half an hour, and placed on charge *reversed* (a thing that has been known to happen at charging stations) at a 10-ampere rate for two hours. It showed a reversed voltage of 3 volts, rapidly falling to zero. On giving a charge in the right direction, now at a 5-ampere rate for some four hours, it was gassing freely, and showed full voltage; discharging through a valve which took .4 ampere, it gave practically full capacity, and in actual reception was silent and quite satisfactory in every way.

Several subsequent charges and discharges confirmed that the accumulator was in no way injured by this drastic treatment.

It is an accepted fact that the Edison type of accumulator has a rather smaller current efficiency than the lead type; this fact is of small moment in connection with the accumulators used in a radio set. But the matter of voltage-drop during discharge must be taken into account; for this reason the 5-volt (four-cell) type is recommended for 4-volt valves, and the three-cell for valves requiring 2.5–3 volts.

Whilst the initial cost of these Ni-Fe accumulators is heavy, being twice to three times that of the ordinary lead accumulator, the makers rightly point out that the immunity from sulphating, buckling of plates, etc., and the life, measured in years, which can be expected from a steel accumulator in a steel container, must be set off against first cost.

Plug-in Basket-Coils and H.F. Transformers

Messrs. Reynolds & Bradwell have sent for test types of their plug-mounted basket-coils on rigid formers, and basket-coil transformers of the plug-in variety.

The coils are wound on small wooden spokes fixed firmly into an ebonite centre-piece, and fastened securely into the standard type of plug-and-socket fitting for use in ordinary coil-holders. The lower members are wound of a reasonably stout gauge of wire. The construction is neat and substantial, the coils, unlike most basket-coils, appear to be capable of withstanding hard wear and rough treatment.

On actual test, on a double 40 ft. P.M.G. aerial, the range covered with a .0005 μF (actual—not "nominal") variable condenser in parallel was: No. 2, 375–510 metres; No. 3, 460–680 metres; No. 4, 700–1,000 metres; No. 5, 1,000 to 1,450 metres; No. A, 1,300–2,320 metres; No. B, 1,700–3,000 metres; No. C, 2,400 to over 4,000 metres (the last three with .001 condenser). The figures given by the maker differ somewhat from these, and were evidently determined on an aerial of lower capacity. It will be noticed that the No. 2 is not available for the lower wavelength stations, except on an aerial of small electrical capacity or by the use of a series condenser of unusually large size. The No. 3 is also of rather awkward size, as when used with a series condenser (the most efficient manner for valve-reception) one of ordinary size is not very convenient. It is possible that the makers, who are located in Birmingham, were chiefly concerned with a design most suitable for 475 metre reception.

The matter of overlap to cover the whole range might receive attention also. With a series condenser there was no difficulty in choosing a suitable reaction-coil.

In actual reception very satisfactory results were obtained with these coils, tuning being sharp and selectivity higher than is usually observed with plug-in coils. The No. 2 coil, with a .0001 μF parallel tuning-condenser at its minimum, when it just tuned to 365 metres on the large aerial, gave a signal-strength, measured by rectification of whole carrier wave of the local station, at least as high as any commercial tuning-device we have tested, being actually 90 per cent. of the standard.

In valve reception, with critical reaction, an unprecedentedly high figure for the signal-voltage was also recorded. The effect of the generous wire-size and small dielectric losses and distributed capacity were noticeable here. With the Nos. 3 and 4, and series condenser, Cardiff, Manchester, Newcastle, Glasgow, Birmingham, Postes et Télégraphes, and Brussels came in well with a detector-valve alone. Aberdeen happened to be badly jammed by Morse.

The plug-in H.F. transformers were of similar general design, but with the customary 4-pin fitting for plugging into a valve-socket holder. The two windings were apparently wound on together on the same former. On test with the "Meg" tester, the mutual insulation-resistance proved to be adequate.

The T2 covered from below 300 to 530 metres with a .0002 μF parallel tuning condenser, and with efficient tuning device and L.F. stage, on an I—V—I receiver all the broadcast stations came in well on the loud-speaker, with this as H.F. coupling. The T4 covered from 600 to 1,250 metres; T6 from 1,100 to 2,200; and T7 from 1,800 to 3,200 metres. With three valves Radiola came in extraordinarily well with the T6 on the loud-speaker; Eiffel and Königswusterhausen on the T7—Eiffel being readable on two valves on the loud-speaker.

With a reservation as to the precise numbers of turns on the lower members, these coils and H.F. transformers can be heartily recommended for experiment and regular use, showing an efficiency which compares favourably with that of any of the commercial types of plug-in inductances available.

Terminal Tags

Samples of terminal tags have been sent for inspection by S. H. Collett from a wide range of different types manufactured. These are made of the spade and eyelet variety, in brass and copper, and bright, tinned, or nickelled finish, of various sizes. The samples submitted proved to be of the right kind of material, being sufficiently malleable to endure opening up of the jaws to remove an old wire and to replace a fresh one—a severe test. The soldering-tags tinned easily and stood sharp bending.

A Reader's results with the Auto-Transformer Crystal Set

To the Editor of MODERN WIRELESS.

SIR,—It may interest you to know that I made up the auto-transformer crystal set described in your spring number. I used 22 and 26 S.W.G. wire instead of the thick wire reco mended, and obtained wonder ly good results for a crystal set. Aerial is a standard P.M.G. one with ordinary water-pipe earth.

Signals are quite loud, and when things are quiet in the vicinity every word from 2LO can be easily heard and distinguished.

The set is made up quite roughly and nothing whatever is soldered.

Perhaps you may describe in an early issue of MODERN WIRELESS how to make a set of this description to receive signals from the proposed 1,600 metre station.

Wishing your paper every success,
I am, yours truly,

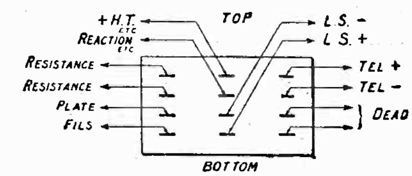
D. A. TROWBRIDGE.

Staines, Middlesex.

(*Continued from page 22.*)

the broadcasting station (say 10 or 15 miles) you will hear signals in excellent strength and will not need to use reaction. If, however, you are some distance away turn your potentiometer knob slowly clockwise until you find the best reaction effect produced. For every small movement of the potentiometer readjust your condensers so that you do not suddenly hit oscillation point and cause howling. When you have practised this and obtained the best signals from your local station (I am assuming that you connected the telephones to their right terminals and also a loud-speaker to the specified position) turn the change-over switch to the 5-valve position and light your last two valves by turning on the filament resistances. You should now get excellent signals in the loud-speaker and a little practice with the switch will show you that it is a simple matter to tune in on three valves and then, when everything is right, to turn on to 5-valves for the loud-speaker. You will be astonished at the purity and quality of signals obtained. Note that the change-over switches turn the last filaments on and off.

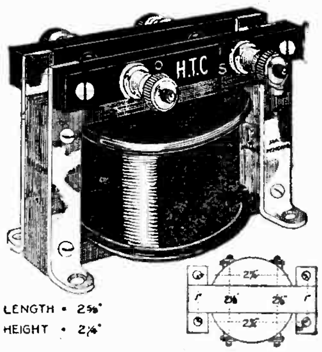
If you are very close to a broadcasting station you will find that you can turn off the high-frequency filaments leaving the detecting valve alone alight and still hear excellently either on telephones or using the change-over switch on the loud-speaker. For distant stations you will find that the reaction is controlled by the potentiometer without the use of any reaction coil, and on my own aerial I find it is easy to obtain all the reaction necessary to bring the set up to oscillation point with this potentiometer, even on the longer wave such as that used for the Eiffel Tower telephony. However, on some aerials which do not oscillate easily, it may be necessary on the longer wavelengths to use a small reaction coil. If this is so then withdraw the short-circuiting plug and plug-in, say, a 35 or similar coil, and use it carefully to obtain the reaction effects.



Switch details.

Valves to Use

The reader has a very wide choice in the valves he can use, and it would be invidious to make comparisons. I would recommend, however, if it is possible to do so and if you have large enough accumulators, to use bright emitters throughout. For the two high-frequency sockets choose valves which are good for this work. Most of the general-purpose valves will do here, and there are one or two valves sold specially for high-frequency amplification. For detecting any good general-purpose valve will do, or a special detecting valve such as the R.4.B. made by the Marconi Osram Company. "R" type valves serve excellently for the note magnifying stages, and I would recommend you to use on them not less than 100 volts. For the very best results, of course, you should use a power valve in the last socket with the correct grid bias. Readers who construct this set are invited to write to us stating the results they obtain, and in particular the valves they use. Comparisons of readers' results are very helpful.



By reason of imperfect design many transformers perform satisfactorily only under certain conditions. *This inefficiency has been overcome by the H.T.C. Its design is such that all conditions are favourable.* **The H.T.C. operates over the extremely wide range of frequencies contained in Broadcast without accentuating any one note or its harmonics. The design also allows for the varying strength of signals so that there is no possibility of any distortion due to overloading. In fact, the H.T.C. is an excellent all-round transformer. You may purchase with more than trust; you may buy them with confidence, although the price is low.** The H.T.C. Telephone Transformer is equally perfect, and similar in appearance and finish.

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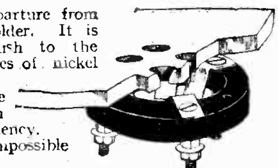

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Any persons or firms manufacturing or offering for sale valve apparatus embodying patents controlled by Marconi's Wireless Telegraph Company, Ltd., without its permission render themselves liable to legal proceedings for infringement.

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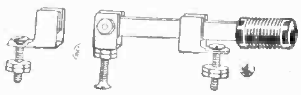

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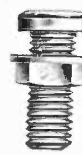

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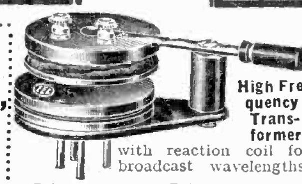

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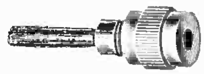

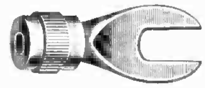

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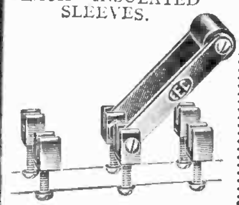

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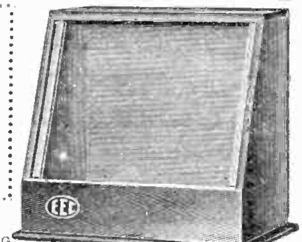

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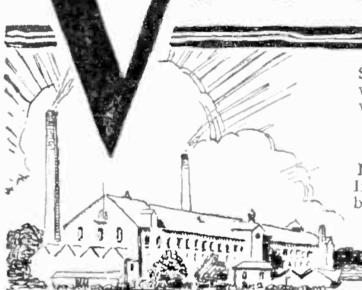

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The Use of Taps in Wireless Work

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

Tapping ebonite and brass is often thought to be a difficult job. This article shows how simple the task can be made

THE average constructor of home-made wireless apparatus soon attains a certain amount of dexterity in the use of quite a number of tools. He has not been long at the game before he learns to drill straight, to measure carefully, to mark out accurately and to file cleanly; but there is one tool at which for some reason or another he is apt to shy, regarding it apparently as something too advanced for him to tackle. This tool is the tap which is used for threading holes. It is the rarest thing to find any tapped holes at all made in the home-made set. Clearance holes are used everywhere for terminals, valve legs and so on. Now for these things the tapped hole is better, since it makes for a much firmer job. Further, if they are screwed into the panel it is not usually necessary to place nuts upon their shanks, which is a very great advantage in the case of valve legs in particular. If nuts are used upon the shanks of valve legs, they must necessarily come very close together on the underside of the panel with a consequent increase in capacity. A further point about tapping is that it very much simplifies the process of soldering on leads, for terminals and valve legs so treated have not nearly the same tendency

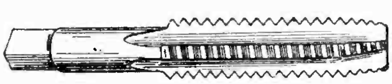

Fig. 2.—Second cut tap.

to loosen under the heat of the soldering iron.

Again there are many jobs of quite a simple kind which cannot be done unless tapping can be undertaken. You wish, for example, to make up a plug and socket coil holder. You drive the plug and socket into $\frac{1}{4}$ in. holes in the ebonite, and to fix them in place it is necessary to insert screws from the edges as shown in Fig. 1. The holes for them must, of course, be tapped. If you cannot use the tap you must needs purchase the coil holder, though it can be made at home for about a quarter of what you pay for them.

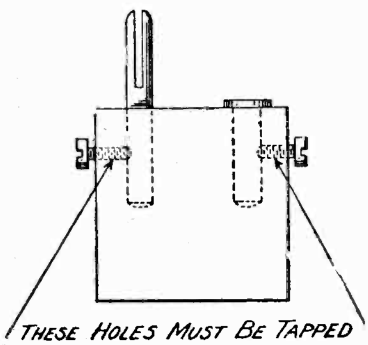

Fig. 1.—A simple job which cannot be done without tapping.

And there are very many other useful jobs which are outside the scope of the home workshop, unless screwed holes can be made.

Why constructors should be unwilling to tackle tapping I do not know, for in the case of ebonite especially, it is one of the easiest of workshop jobs. If you provide yourself with the right tools for the purpose, you will have absolutely no difficulty whatever in turning out thoroughly good work. Beginners at tapping do not know as a rule what kind of tap to buy. They go to the tool shop and ask simply for a 4 B.A. tap. "First, second or third cut?" asks the salesman promptly, and the beginner, not wanting to show a lack of knowledge, frequently makes a shot, selecting either a first or a third without in the least knowing what is the difference between them. In the case of very hard metals, screwed holes have to be made with two or three taps. The first, which is very finely tapered, and has hardly any thread at all upon it, is put through to clear the way for the second, which is tapered only at its point. The job is finished off with the third cut, or plug tap, which has no taper at all. First cut taps are not required for ebonite, which is a soft material, and plug taps are needed only when we have to thread a hole which does not go right through the panel. As this can be done successfully only with material at least $\frac{5}{16}$ in. thick, we shall not find much use for the plug or bottoming tap in wireless work. What we need is a second cut tap such as that shown in Fig. 2. Always buy taps of good make—the "saving" on those of inferior quality is only about a penny apiece for B.A. sizes, and with them good work is problematical. Do not be put off with long-shanked taps, for these are always liable to break if any strain is put upon them. The best type are those made by Card's, which in the B.A. sizes measure $2\frac{1}{8}$ in. over all. The wireless constructor can confine himself entirely to the 4 B.A. tap, though it will be useful if he provides himself also with second cut taps for No. 2 and No. 6 B.A. To use these he will require a tap wrench, such as that shown in Fig. 3. He will also need drills for making holes of appropriate sizes. The tapping sizes laid down in the tables are No. 26 for 2 B.A., No. 34 for 4 B.A., and No. 43 for 6 B.A. These are, as a matter of fact, rather a tight fit and it is a distinct advantage to use drills of slightly larger gauge. One gets quite a full thread by doing so, and

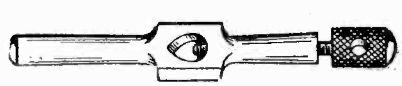

Fig. 3.—A good and inexpensive type of tap wrench.

the tap is very much easier to start and to keep straight in the larger hole. I would recommend those who contemplate taking up tapping to use No. 23 drill for 2 B.A. and No. 32 for 4 B.A., and No. 42 for 6 B.A.

Do not start your activities by tapping upon the panel of the set under construction. Take a few odd pieces of ebonite from the scrap box and use them for practice until you have acquired the art of keeping straight and putting on a good clean thread. In one of these pieces drill half-a-dozen holes with a No. 32 drill. Then place your 4 B.A. tap in the wrench, fixing it tightly, so that it will not be able to move. Put the point of the tap into one of the holes, see that it is upright and then give half a turn to the right, at the same time applying a certain amount of pressure—just how much pressure should be applied is a thing that one learns by practice. As soon as the tap has started to cut, lift the work up and look at the shank of the tap to see whether you are going straight. If you can start the tap straight it will keep

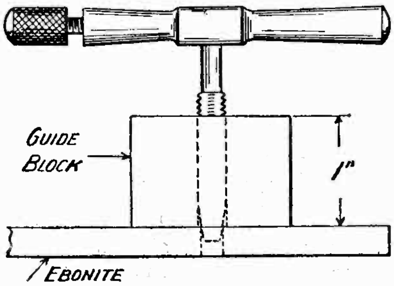

Fig. 4.—Method of using a guide block.

itself straight for the rest of its passage through the ebonite. If, as will probably be the case, you find it slopes a little in one direction, remove it and try again. After one or two attempts you will most likely find that you are getting the knack, and that you are now able to start the tap straight. There are, however, people who can never acquire the art of keeping taps straight. Should it happen that you are one of these, you had better use a guide block to help you. Fig. 4 shows how this is done. The guide block is simply a piece of oak or any hard wood about 1 in. in thickness, through which is drilled a hole just large enough to allow the tap to pass freely. The tap is inserted into it with its point protruding, and the point is pressed into the hole in the ebonite. You may now turn down the tap with a certain amount of confidence for the block will help it to start straight.

Once your tap is started, whether you are using a guide block or not, the rest of the process is easy. Put it through quite quickly by a series of full turns forward and quarter turns backward. Should it feel to be binding a little in the hole remove it and wipe off the ebonite dust with which it will be covered. Then continue as before. Taps will last longer if they are lubricated with a drop of turpentine at each hole; ebonite, though soft material, has an extraordinary blunting effect upon steel tools unless a little lubrication of this kind is used. When you have succeeded in making half-a-dozen well-threaded holes in your odd piece of ebonite, you can then tackle a real constructional job, feeling pretty sure that you will not make a mess of it. If the instructions given are carried out anyone can learn to tap ebonite in half-an-hour.

As your skill in the use of taps grows, you will find that you can save a good deal of time over the work when numbers of tapped holes have to be made by discarding the wrench and placing the tap in the chuck of the breast drill. Do not begin by doing this, for you will not be successful until you have got the feel of things and know the right amount of pressure to apply. Once, however, you have reached this stage you will find that you can run your taps through as easily and as quickly as drills.

If the constructor's outfit is limited to the 4 B.A. tap alone, he will still be able to tackle the job of making screwed holes of other sizes, for quite satisfactory taps for ebonite work can be made at home with the greatest ease. They are a little more difficult to use perhaps than the correctly made bought tools, and one should not attempt to do so until one has had a little experience. Let us suppose that an occasion arises which calls for a 2 B.A. screwed hole and that you have no tap of this size. Cut off a piece of 2 B.A. studding about 2 in. long. Then with a file make a flat upon it, tapering off a little towards the end. Turn the studding over and make a second flat opposite the first. Then make two more at right angles to the first pair. The end of the studding will now be square and the thread will

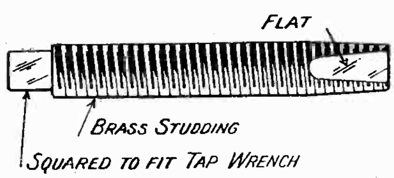

Fig. 5.—A makeshift tap made out of brass studding.

remain only at the corners. These are the cutting edges of the home-made tap. Square off the other end so that it will fit into the wrench, and your 2 B.A. tap is ready for use. Though they are intended for emergencies, brass taps of this kind give very good service, and they will last for quite a long time if a little turpentine is used to lubricate them. They are extremely useful sometimes, as for example when you find that you have purchased a batch of B.A. screws which are not true to size—this does, unfortunately, happen sometimes as many of us know to our cost. With such screws the standard tap is either too large or too small, and the only thing to do is to convert one of them into a tap in the way described.

We may sum up the golden rules of tapping as follows:

(1) Make all holes large enough to allow the tapered portion of a second cut tap to enter.

(2) Start straight. Examine your work as soon as the tap has "bitten" to see that it is going straight.

(3) Do not use too much force.

(4) Do not turn it too quickly.

(5) Lubricate with a little turpentine.

(6) Do not tackle a big job until you have had some practice on some old scraps of ebonite.

Results with the Trans-atlantic Receiver Abroad.

To the Editor of MODERN WIRELESS.

SIR,—I promised to let you know what results I got with your trans-atlantic set. I am using the set here and getting excellent results. I only use a single valve amplifier after it and am able to pick up twenty-three broadcasting stations; this I have done in two weeks.

KDKA comes in stronger than 2LO when I was in Edmonton. I will mention a few of the stations I receive, showing distances and location, and bar a little statics, every note of a piano and every word of speech is *perfect*:—WGAM, WGY, WQAM, WLW, WSAI, 6KW (Cuba), WKY, WCAD (New York). My reception on your set is far better than many of the big sets here costing as much as £150. My only trouble is static, and if you could give me any suggestion *re* this trouble, I shall be much obliged. I am only using a 100 ft. single aerial, about 25 ft. from earth and badly sheltered by trees.

Yours truly,
ARTHUR VERLEY.
Kingston, Jamaica, B.W.I.

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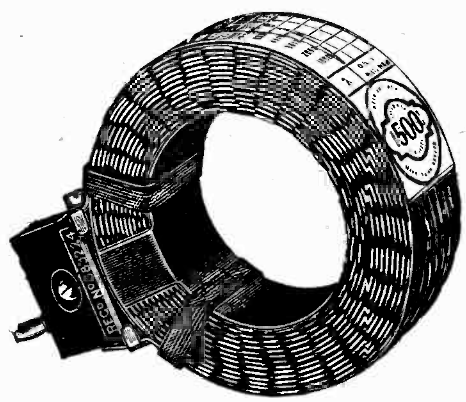
So symmetrically wound !
So superbly finished !

Yes ? but neither of these is the chief merit of

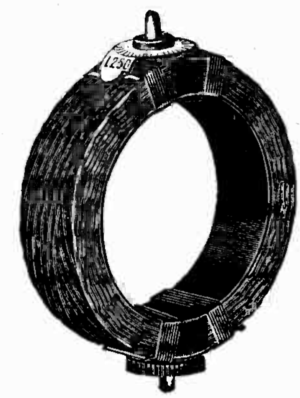
IGRANIC

Honeycomb Duolateral Coils

(De Forest Patent No. 141344)



Plug Mounted Coil.



Gimbal Mounted Coil

The real cause of their overwhelming popularity is that they always perform their intended function perfectly. There is nothing haphazard about them no "rule of thumb."

SCIENTIFICALLY DESIGNED, PRECISELY AND ACCURATELY WOUND, CRITICALLY TESTED.

Every coil is a certainty

. . . . and the buyer always gets what he pays for. To enquirers for low priced coils some dealers will offer substitutes, but, even then, they generally say—"of course,

If you want the best, buy "IGRANIC"

and every dealer stocks them
Write for Lists Z. 188.

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Use only ·25 amp. at 3·5 to 4 volts. Anode Volts 30 to 90.

On all normal plate voltages no grid bias is needed.

Two Types: A2 for amplifying. D4 for detecting.

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Ordinary Bright Emitter Types

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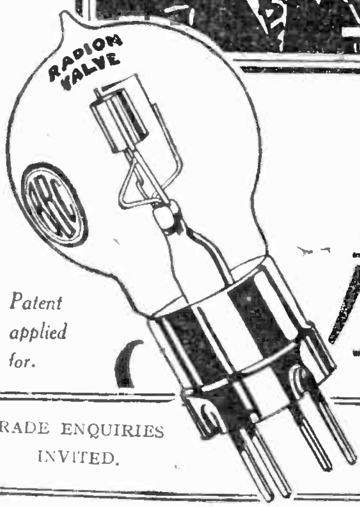
10/- EACH



Patent applied for.

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TRADE ENQUIRIES INVITED.

—— and amplify enjoyment!

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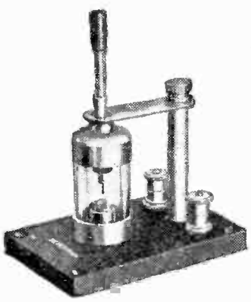

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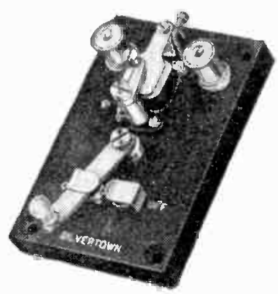

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WIRELESS ACCESSORIES

Quality guaranteed by over 50 years' electrical manufacturing experience.

Further Notes on the 10-Valve Armstrong Supersonic Heterodyne

By KENNETH ALFORD.

This article has been written to answer a large number of letters addressed to Mr. Alford concerning his previous contribution.

A VERY considerable interest has been aroused in this instrument, judging from the voluminous correspondence I have received on the subject, and it appears that certain points of the design cause difficulty. It is, therefore, attempted in this addendum to clear up the more general queries raised.

It must be realised by all that an instrument such as the superheterodyne is not like the common or garden 2-, 3- or 4-valve set, which can be put together with heavy odds on its working well on its first test. The manipulation of the superheterodyne is so essentially different that even although the instrument is perfectly in order, in the hands of some it is considered quite useless. It must, therefore, be clearly understood that in an instrument which represents the higher order of radio technique the operator must be prepared to use patience and endeavour to reason out his apparent difficulties.

In certain quarters the multiplicity of controls has raised comment, but in the design of the instrument practically every " variable " was provided with a variable control. To the uninitiated the advantage of this is obvious, and it must not be supposed that each and every control is brought into operation each time the instrument is used.

Simplicity of operation is all very well in many cases, but to give a constructional description of this instrument " wire for wire " and " hole for hole " would fill at least one whole copy of MODERN WIRELESS. To proceed with the more general points raised: The first appears to be an abject horror of the enormous size of the instrument and the large number of valves used.

Now the superheterodyne can be investigated by anyone possessing a good short wave and long wave receiver in separate cases by simply coupling these two instruments together by means of the " transfer coils," and arranging for a separate oscillator or heterodyne covering the required wavelengths to be coupled to the tuned anode circuit of the first H.F. valve on the short wave set. This may be illustrated by a simple diagram, Fig. 1.

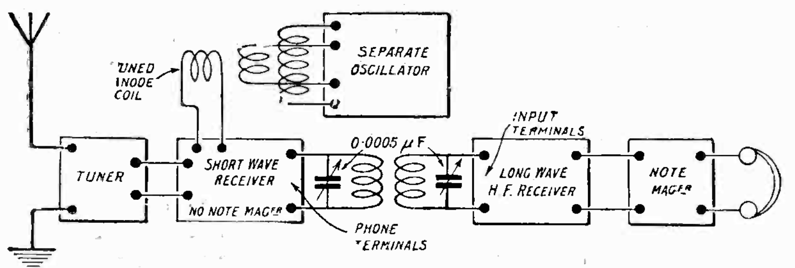


Fig. 1.—How existing sets can be arranged to make a supersonic receiver.

Any telephone condenser on the short wave receiver must be removed and also any note magnifier which may be incorporated. The long wave receiver may consist of 3-5 H.F. stages coupled in any conventional way. Resistance cap. or transformer having an optimum preferably between 4,000-8,000 mètres.

The Heterodyne Coils

It was stated in the article that the higher range heterodyne coils were wound " hankwise," a term which has caused some embarrassment. The method was to wind the necessary turns on a circular former to form a " bundle," which is removed from the former and taped or bound into a firm coil. There is no particular virtue in this method, and doubtless readers of MODERN WIRELESS may prefer to try some other method, but in any case the heterodyne coils should be connected to the oscillator valve and their range checked by wavemeter.

Switching

The instrument is capable of conversion into a 2-, 3- or 4-valve instrument of conventional type, embodying 1 H.F. amplifier, and 1 or 2 note magnifiers. The connections are as shown in Fig. 2.

The operation is fairly obvious and shows the long wave side bridged and allowing the note magnifiers to be added to the short wave side.

The same arrangement may be adopted for cutting out the short wave receiver and using the long wave side only.

The small coil in series with the rectifier valve of the short wave side in the sketch of the technical

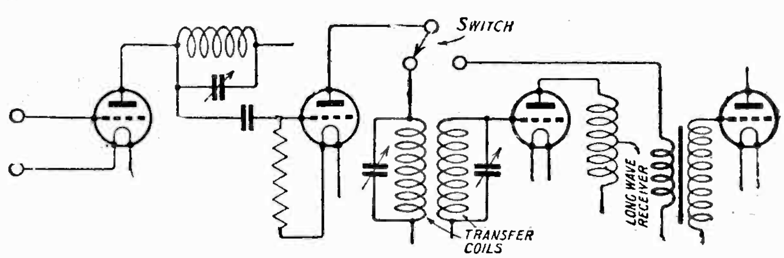


Fig. 2.—Details of switching.

arrangement was a "reaction" coil, which ought to have been labelled, although it is not necessary to use it when the instrument is operating as a superheterodyne. When the instrument is being used as a short wave receiver this reaction coil may be coupled to the tuned anode coil or closed circuit coil in the ordinary way to obtain regeneration.

With regard to the plugs and sockets used in connection with the small electrostatic - reaction condenser, it is necessary to change the position of the plug when the number of H.F. valves in the long wave side is changed. This is due to the fact that the sign of reaction changes, and if the wrong number of valves is bridged by the condenser there can be no regeneration, and the condition of oscillation cannot be reached.

Finally, to those whose ambition is to possess the most wonderful of radio receivers, I would suggest that the construction be undertaken in a painstaking and careful manner, and that the immediate successful operation of the receiver should not be altogether looked for, and that this should only serve as showing those factors which play the most important part in its efficiency.

The wiring should, if possible, be carried out with stiff wire, especially grid and anode wiring, which should be well spaced to avoid capacity effects. The universal adoption of "Spaghetti" or other forms of "hay wiring" is deprecated in the extreme.

It is of considerable assistance, if the short and long wave sides of the receiver are tested independently on signals before the supersonic arrangements are brought into play. This will eliminate a great deal of uncertainty.

When the instrument is completed and tested on an aerial and found apparently satisfactory it should be connected to a "loop" aerial of dimensions to cover, say, the range of B B C stations, and, as stated in the former article, all these stations should come in at good strength.

The fact which will strike one extremely forcibly when the above achievement has been reached is the extraordinarily small difference in strength of signals received on the frame to the same signals on the outside aerial.

Through the courtesy of Messrs. Cunningham and Morrison, who represent the "Myers" valve in this country, I am replacing the present valves in the instrument with high μ Myers valves, which have a voltage or amplification factor of 20 against 6 or 8 of the ordinary R valve. The results should prove very interesting.

The Four-valve Family Receiver

To the Editor of MODERN WIRELESS.

SIR,—In accordance with the desire expressed in your instructions, I have great pleasure in informing you that I have successfully constructed your four-valve family receiving set.

I have followed your instructions in every detail, and the results have been magnificent, having had the majority of British broadcasting stations on a loud-speaker.

I am using three "Cossor" valves and a "Marconi" as a detector.

Thanking you, I remain, yours faithfully,

RAYMOND TODD.

West Hartlepool.

Reflex Wireless Receivers in Theory and Practice

By JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

CHAPTER IV.

Previous instalments of this interesting series appeared in the issues for March, April & May

It is proposed in this chapter to discuss the more common forms of dual amplification circuits.

In the last issue of MODERN WIRELESS, a circuit was given in which a dual amplification effect was obtained and in which loose-coupling was used between the aerial and the grid circuit of the valve, and a transformer to feed the amplified high-frequency currents into a detector circuit. This transformer was shown aperiodic in Fig. 10, but more usually such a transformer is tuned. Sometimes the primary is tuned and sometimes the secondary, and sometimes both windings are tuned.

As regards which arrangement gives best results, the following remarks may prove of interest.

The transformer itself may consist of two inductances variably coupled, but more usually ready made transformers are supplied which will cover a given range with, say, a 0.0003 μF variable condenser. If of the variable type, greater selectivity will be obtained by tuning both the primary and secondary. When using a fixed transformer, however, there is no special point in tuning both windings; only one winding may be tuned, and as regards sensitiveness and selectivity, there is, generally speaking, no difference which of the two windings is the one to be shunted by a variable condenser. The question of stability, however, is one which arises, although the matter is not one which has received proper consideration in the past. If the anode coil, *i.e.*, the primary of the transformer, is tuned by means of a variable condenser, the tendency of the valve to oscillate at high-frequency is much more pronounced. The coupling between the tuned anode circuit and the tuned grid circuit is accomplished through the inter-electrode capacity, the grid and anode forming what is substantially a small condenser. If the secondary winding is tuned and the primary is left aperiodic, the tendency to oscillate will not be so great.

In the case of Fig. 11, this is partly due to the fact that the distance between the coils L_3 and L_4 makes L_3 act more like an aperiodic coil, and partly because the oscillatory circuit has now got the heavy damping effect of the crystal detector and the primary T_1 of the step-up transformer T_1 T_2. It is known, for example, that a valve without any intentional reaction tends to oscillate quite readily when both the grid and anode circuits are tuned, but when the anode circuit contains an inductance which is not tuned, or of the properties of the tuned circuit L_4 C_5, and capacity reaction takes place through the inter-electrode capacities. If, now, we reverse the connections to the coil L_3, the tendency for reaction to take place will be greatly lessened and the circuit will be much more stable. It is, therefore, advantageous, when using a circuit of the Fig. 11 type, to be able to reverse the connections to the coil L_3. Sometimes it will be found that louder results are obtained with the coil connected a certain way

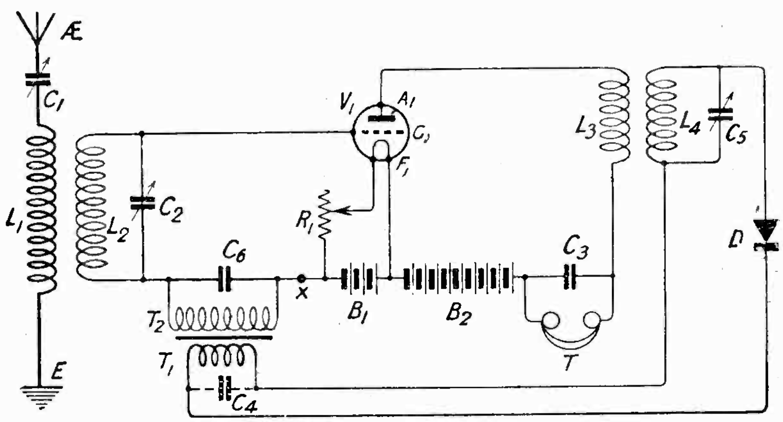


Fig. 11.—A loose-coupled dual circuit with H.F. transformer.

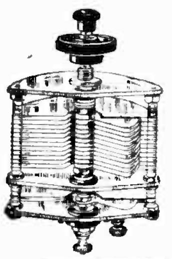
approximately tuned to the same wavelength as the grid circuit, the tendency to oscillate is no longer present. If you add to this fact the presence of a crystal detector which may have a resistance as low as 2,000 ohms, or in many cases, very much less, the tendency to oscillate is still further reduced.

The connections to the primary L_3 in Fig. 11 are rather important from the point of view of a tendency of the valve to oscillate. When the coil L_3 is fairly closely coupled to L_4, as it is when transformers of fixed coupling are used, it will be found that making the connections to L_3 in a certain direction will result in the valve V_1 having a much greater tendency to oscillate if the connections to L_3 are reversed. When a fixed or tight coupling of this kind is employed, the coil L_3 does not act as an aperiodic coil, but partakes round because of the unintentional capacity reaction strengthening the signals; but on the other hand, this unintentional reaction effect may be sufficiently strong to produce self-oscillation, in which case the coil L_3 should have its connections reversed. As a matter of fact, the chances of self-oscillation are remote when using a crystal detector shunted across L_4 C_5.

It is important to note here that adjusting the crystal detector will vary the damping of the circuit L_4 C_5, and so vary the degree of unintentional reaction introduced into the circuits L_2, C_2 and L_4 C_5. It may thus happen that a light contact on the crystal detector, although unsuitable from the point of view of actual rectification, will result in less damping on the circuit L_4 C_5 and so cause an increase in signal strength.

(Continued on page 87.)

RAYMOND VARIABLE CONDENSERS



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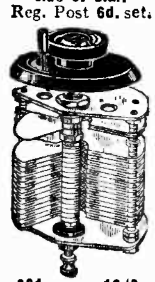
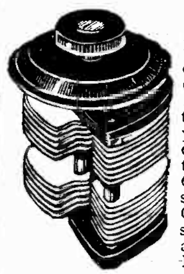


.001 .. 12/6
.0005 .. 10/6
.0003 .. 8/6

DUPLEX CONDENSERS



This Condenser is composed of two equal units, of ·00025 mfds. operated by one Knob and Dial, thereby enabling you to tune two circuits by one turn of the dial. Can be used in series or parallel. Complete, as shown with aluminium end. Knob and dial.

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·0005	25	4/11	2"
·0003	15	4/6	1 3/8"
·0002	11	4/-	1 1/2"
·0001	5	3/6	1"
·00005 (Vernier)		2/6	

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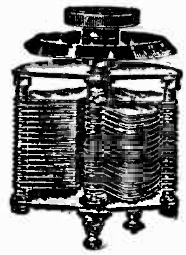

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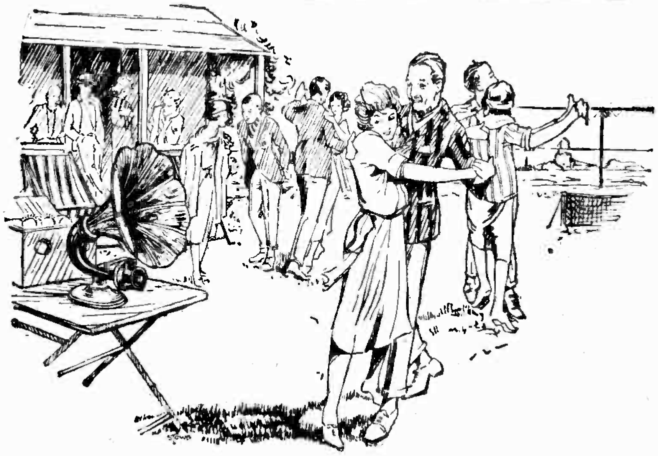

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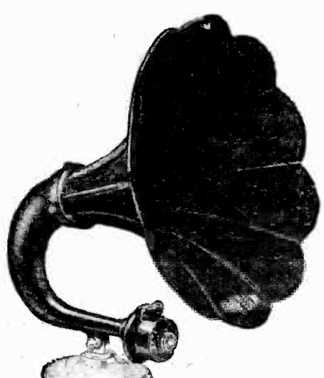

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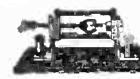

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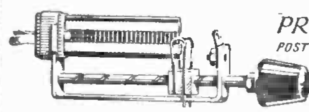

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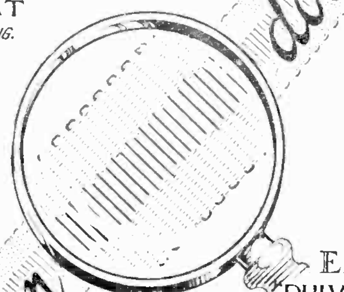

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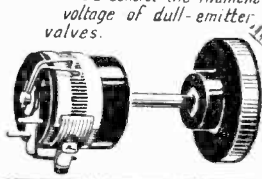

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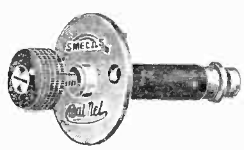

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Another point to notice is that, the detector having a different impedance at different adjustments will alter the tuning of the circuit L_4 C_5, principally by altering the unintentional reaction introduced into the circuit L_4 C_5. Any variation of reaction, whether intentional or otherwise, should always be accompanied by retuning of associated circuits, and, consequently, it is desirable, when operating the Fig. 11 circuit, to retune the condensers C_1, C_2 and C_5 after adjusting the crystal detector.

It will be noticed that a condenser C_4 is shown in dotted lines across the primary of the step-up intervalve transformer T_1 T_2. The writer's experience indicates that this condenser may always be left out without any loss in signal strength, owing to the self-capacity of the primary T_1. If a condenser is used, its value should not exceed 0.002 μF.

As regards the connections to the primary and secondary, it is desirable that the left-hand side of T_2 should be the O.S. terminal, and the right-hand side the I.S. terminal. As regards the primary, the connections are not so important as the experimenter will usually care to try reversing the connections. If a rule is desired, it might be suggested that the right-hand side of T_1 should be the O.P. terminal, while the left-hand side, which is connected to one side of the crystal detector D, is the I.P.

As regards the fixed condenser C_6 across the secondary T_2, the value of this condenser may be quite low, say, 0.0003 μF, and in any case should not be greater than 0.002 μF. Even when a 0.002 μF condenser is used, there is a certain reduction in the low-frequency potentials established across the secondary winding T_2, and for general purposes the writer would recommend a condenser of 0.001 μF. A grid battery could be inserted in the point X in the Fig. 11 circuit for the purpose of giving the grid a negative bias.

A few additional connections may be tried by the experimenter. It is usually desirable, in all cases, where a loose-coupled input high-frequency transformer is used, such as L_1 L_2, to connect the negative terminal of the accumulator to earth.

Another arrangement worth trying when a transformer L_3 L_4 is used in the output circuit of the valve, is to connect one side of the primary T_1 to the negative terminal of the filament accumulator; adhering to the note regarding the I and O terminals of primary and secondary, the right-hand side of T_1 may be connected to the negative terminal of the accumulator B_1.

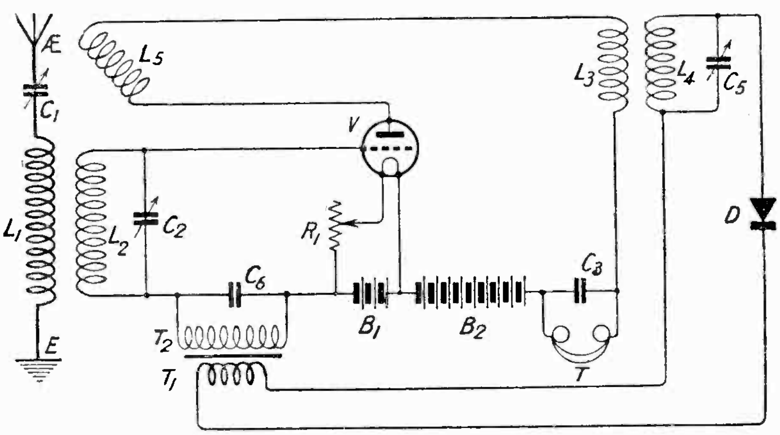

Fig. 12.—A similar circuit with reaction introduced.

Signals with the Crystal Off

Many experimenters will have found that when the catswhisker, or upper crystal, is removed from the lower crystal, signals very frequently come in quite well, and this may prompt some to imagine that dual amplification is not effective. What really is happening, of course, is that the valve is acting purely and simply as a detector. It is, in fact, almost impossible to prevent a valve acting as a detector, whatever the conditions may be under which it is operating.

In Fig. 11 the telephones T are included directly in the anode circuit of the valve, and consequently, if there is any rectification, signals will be heard in the telephones. There will, however, be no dual amplification effect whatsoever, the secondary T_2 in the grid circuit having no effect on the operation of the circuit. As a matter of fact, it is rather a good test to see whether signals may be heard with the crystal off in order to ensure that the valve is functioning properly as a low-frequency amplifier. If good signals are heard in the telephones it is an indication that the valve V_1 is acting as a detector, and will consequently probably distort the low-frequency currents which are fed into its grid circuit by means of the transformer T_1 T_2. The rectification effect may be eliminated, or practically eliminated, by giving the anode a suitably high anode voltage and giving the grid a negative potential to bring the operating point about the half-way point along the characteristic curve. Under these conditions signals will not be received in the telephones T when the crystal D is raised, or if there are signals, they will be very weak. If, however, no grid battery is connected in the grid circuit signals will usually be stronger, indicating that distortion will occur on the low-frequency side.

Sometimes the signals obtained by raising the contact from the crystal in dual circuits are as loud, or sometimes even louder, than when the crystal is employed, and this is a sure indication that something is wrong with the circuit. One of the probabilities is that an inferior crystal detector is employed.

In the Fig. 11 circuit, the raising of the crystal by relieving the circuit L_4 C_5 of a considerable amount of damping, may result in more capacity reaction in the valve, and this reaction will strengthen the oscillations in the circuit L_2 C_2. The result is that the valve V_1 is now acting as a detector with reaction, and the results may be quite good compared to the normal arrangement of Fig. 11 with the contact on the crystal, the reaction effect being probably very small. This brings us to the question of how we may improve the signal strength of a circuit of the Fig. 11 type by means of reaction.

Adding Reaction to a Dual Receiver.

The desire for obtaining the maximum output from a minimum number of valves will prompt every experimenter to try and obtain better results by the application of reaction to his reflex receiver. The application of reaction to a reflex receiver introduces innumerable problems which require solution and the application of reaction is usually accompanied by the setting up of loud buzzing noises of audible frequency which are extremely unpleasant to the operator of the set. Ordinary reaction may cause self-oscillation of an ordinary receiver, but this generally troubles the receiving operator very little; on the other hand, those who have sets in the neighbourhood have very good cause to complain owing to the heterodyning of the radiated oscillations with the incoming signals. The average user of a reflex circuit, however, finds that on tightening the reaction his own set produces an extremely unpleasant noise, and he consequently has to make an immediate adjustment to prevent it. He is, therefore, generally far less troublesome to his neighbours than he who employs an ordinary straight circuit.

Fig. 12 shows a reaction reflex circuit which only differs from Fig. 11 in that a reaction coil L_5 is coupled to the inductance L_2. The coil L_5 is connected in series with the primary L_3 of the transformer L_3 L_4. The warning that should be given here is that if the reaction coil L_5 is made of a certain size, the natural wavelength of the anode circuit, due to the inductances L_5 and L_3 in series and the capacity between filament and anode and the self-capacity of the two coils, is near to the wavelength being

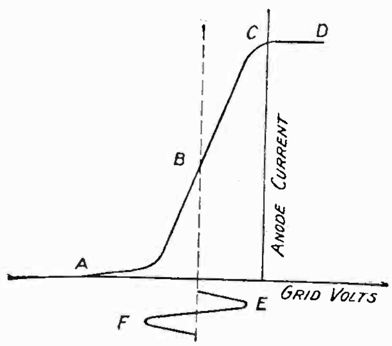

Fig. 13.—Characteristic curve of valve adjusted for reflex amplification.

received, and the valve will oscillate too readily. It is therefore desirable that the coil L_5 should be kept as small as possible, and since a separate aerial circuit is employed a small reaction coil is all that should be necessary owing to the natural damping of the circuit L_2C_2. The reaction coil L_5 should, of course, be connected the right way round.

The circuit is not recommended as a particularly good one to start with, but most of the troubles experienced with reflex circuits are absent in a simple arrangement such as shown in Fig. 11 and Fig. 12.

Fig. 11, particularly, is calculated to avoid any tendency towards the low-frequency buzzing which is so prevalent in reflex circuits generally. In Fig. 11 we are more likely to get the buzzing because reaction is employed, and it will usually be

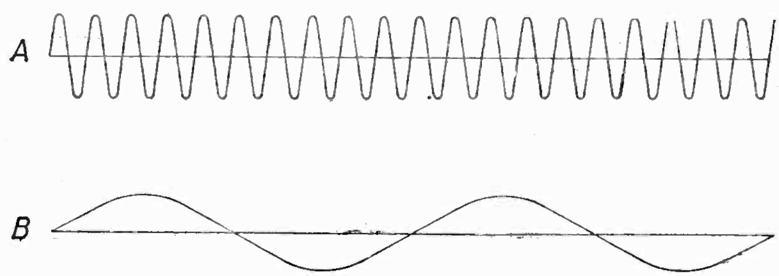

Fig. 14.—The high and low-frequency currents separated out.

found that as the reaction is increased a certain point is reached when buzzing takes place. This buzzing is due to low-frequency reaction, amplified low-frequency currents produced in the output circuit of the valve being conveyed back to the input side, the degree of low-frequency reaction being sufficiently great to cause low-frequency oscillation. If the low-frequency reaction is not sufficiently great to produce low-frequency oscillation, a big build up of signal strength is often obtained, but nearly always at the sacrifice of purity of reproduction.

All reflex circuits tend to oscillate, whatever precautions may be taken. The reason is that, although no low-frequency reaction is produced through the low-frequency output currents of the valve being directly coupled to the input circuit of the valve, there is, in between, a stage of high-frequency amplification, the high-frequency oscillations being modulated by the low-frequency input currents.

We may consider this matter best by considering that the valve in Fig. 12 was oscillating and producing high-frequency oscillations of a frequency determined by the values in the circuit L_2 C_2. If, when the valve is oscillating we feed low-frequency currents into the grid circuit by means of the transformer T_1 T_2, we will vary the grid potential at low-frequency, and these variations of grid potential are liable to vary the amplitude of the high-frequency oscillations generated by the valve. This, in fact, is a common method of modulating the high-frequency oscillations of a valve for telephony transmission; but certain conditions are necessary. The modulation effect is not present if the characteristic curve of the valve is absolutely straight, and only a small portion of its straight part is used. In this case the high-frequency currents are amplified by the valve without any distortion or rectification, assuming, of course, that a negative potential is applied to the grid to prevent the establishment of grid current. If, however, the representative point on the characteristic curve, *i.e.*, the point representing general conditions at any given moment, moves along a curved portion of the characteristic curve, modulation will occur. For example, if the whole of the characteristic curve is being traversed up and down due to the oscillating of a valve, and we apply a positive potential to the grid, it will be fairly obvious that the tops of the high-frequency current half-cycles will be clipped and distorted. Owing to the valve becoming saturated, the positive half-cycles will not be fully developed because the base line potential for the high-frequency oscillations has been raised by the application of a positive potential to the grid. If a negative potential is applied a similar effect may be obtained at the bottom bend of the anode current characteristic curve.

Fig. 13 shows a characteristic curve of a valve adjusted correctly for reflex amplification. It will be seen that the anode current curve, A B C D lies to the left of the ordinate passing through zero grid volts; this means that no grid currents will be established. A complete cycle of oscillating current is shown varying the grid potential above and below an average value which results in the middle point of the anode current curve being employed. If a low-frequency potential is now applied to the grid, either in a positive or negative direction, high-frequency currents will travel beyond the bends, and the high-frequency currents will consequently be modulated.

This is probably best explained by Fig. 14. The top line A shows the high-frequency currents generated by the valve, and the line B shows a low-frequency alternating current which is applied to the grid.

Fig. 15 shows, on the top line C,

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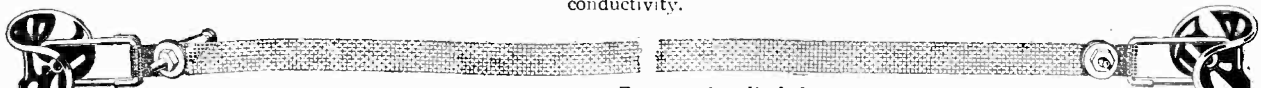

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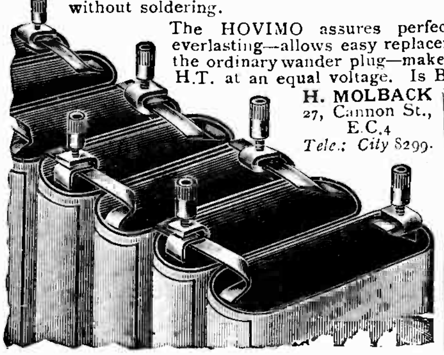

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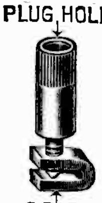

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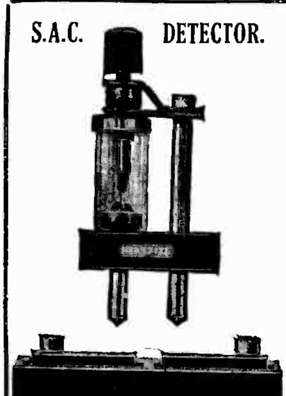

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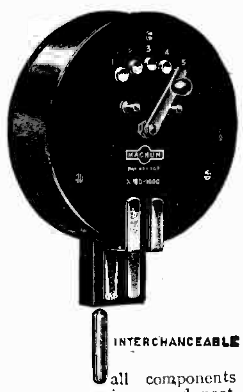

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the sort of modulated high-frequency currents produced by the valve as a result of the alternating potentials on the grid. These high-frequency currents generated by the valve are rectified by the crystal detector in Fig. 12, or by any other detector used in a dual amplifi-

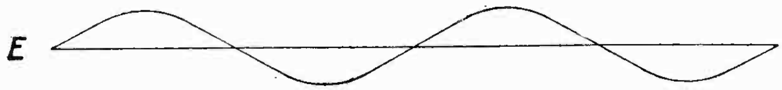

Fig. 16.—Alternating currents produced by the transformer.

cation circuit, because the remarks made here apply equally to all dual amplification receivers. The high-frequency currents shown in line C of Fig. 15 are rectified and produce uni-directional currents as shown in line D, and these produce an average current in the form of uni-directional pulses which pass through the primary of the transformer T_1 T_2 in Fig. 12. The transformer converts these uni-directional impulses to alternating currents of the kind illustrated in line E, Fig. 16. These currents are now fed into the grid circuit and reinforce those which we have already assumed are already being introduced into the grid circuit by T_2.

We thus have a chain of low-frequency reaction which, while quite different from the ordinary kind of chain of low-frequency reaction, yet possesses the same

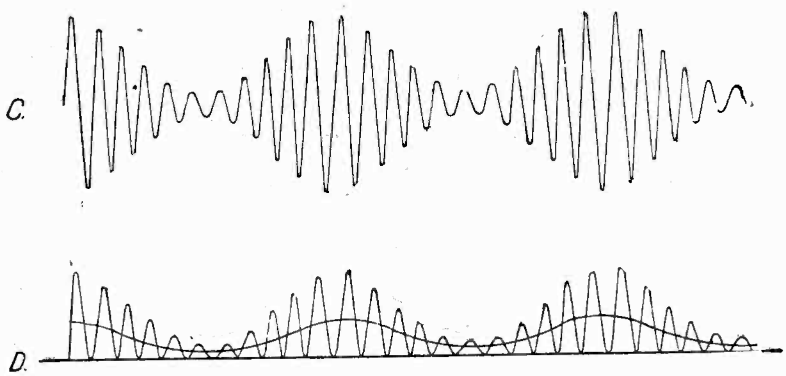

Fig. 15.—High-frequency, rectified, and uni-directional currents shown graphically.

properties of enabling low-frequency oscillation to take place. The low-frequency currents are, in fact, carried by the high-frequency currents generated by the valve, and only appear again after rectification by the crystal detector D.

When considering the generating action of an oscillating valve, we always presume that something has set up a momentary oscillation which is rapidly built up and maintained by the valve. So, in the same way, we may assume, in a circuit of the Fig. 12 kind, that there is some momentary low-frequency potential applied to the grid of the oscillating valve. This will modulate the high-frequency currents generated by the valve; these high-frequency currents are rectified by the crystal detector, and the original impulse is reproduced again on a larger scale which reinforces it and a process of low-frequency oscillation is set up.

This presumes that the valve V has oscillated, and it will always be found that the effect of low-frequency buzzing is always more likely to occur when the valve is on the verge, or is actually oscillating, due to using too tight a reaction coupling. The same effect, however, may be started even though the reaction is not sufficiently tight to produce self-oscillation. In this case the incoming currents of the carrier wave are modulated by the low-frequency currents in the grid circuit. When the carrier wave is very strong this effect may be obtained, and the introduction of reaction, of course, increases the strength of the carrier wave.

Another thing which starts the circuit buzzing is the actual incoming signal when receiving telephony. The modulated incoming signals are rectified by the detector and produce a low-frequency current which modulates the carrier wave and so perpetuates the low-frequency oscillation.

Very often a valve may have the reaction so tight that an incoming strong signal will set the valve oscillating, and once the valve oscillates at high-frequency it is very liable to start oscillating on low-frequency, due to the effect which has just been described.

To be continued.

S. T. 100 Star.

To the Editor of MODERN WIRELESS.

SIR,—I have recently constructed the "S.T. 100 Star," as described in the March number, and am delighted with the results. The following remarks may be of interest. My station is ten miles from 5IT, and I can get all B.B.C. Stations and Ecole Supérieure, Paris, very clearly on ear phones. With the exception of Paris, Aberdeen and Glasgow, all stations came through at the same strength during 5IT's transmission. However, I can get the above three all right, but cannot cut 5IT right out. 5IT is very loud on G. E. Co. loud speaker, and 2LO can be heard faintly. After the B.B.C. Stations closed down last Thursday night, I heard a dance band playing loudly. They finished up with the Austrian National Anthem, followed by the announcer speaking clearly in German. The station turned out to be "Leipzic Mitteldeutche Rundfunk A.G."—some 600 odd miles away. Last Sunday night I got Petit Parisien, Paris, very clearly on earphones. Recently I tried an indoor aerial of 15 ft. of 28 gauge tinned copper fuse wire. 5IT was loud on phones and was audible on loud speaker at 12 ft. 2LO was faint on earphones. My tuning is rather fine, and unless I move my condenser very slowly I pass over stations.

The following components were used:—G.E. Co. variable condensers and fixed condensers; Burndept enclosed crystal; Silvertown transformer; home made choke coil; Igranic 2-coil holder, coils 35-50-75, valve-holders; Igranic filament rheostats; Watmel variable resistance; Marconi Osram 'R' type valves; G.E.Co. H. T. battery 60 volts and 6 volt accumulator; single aerial 7/22: 90 ft by 30 ft high. I have not soldered any connections.

Wishing MODERN WIRELESS every success.

Yours faithfully,

W. PERCY MCGEOCH.

Knowle, Warwickshire.

Trouble Corner

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Adventures with Valves

A GOOD many things may happen to a receiving valve, some of which may rather puzzle the user if he does not know what symptoms to look for. A comparatively rare occurrence with valves of good quality is a considerable softening of the vacuum within the bulb after a period of use. This happens, as a rule, because the plate and grid, as well as their supports, have not been properly cleaned up in the process of manufacture. All metals contain certain quantities of occluded gases which are given out under the influence of heat. In a well-made valve the processes of bombardment and of cleaning up are so thoroughly carried out that the occluded gases are driven off, with the exception of the minutest traces, which are not sufficient to make any marked difference to the vacuum. But if you examine a cheap foreign valve carefully you will see that the inner metal parts are dirty-looking. This means that the cleaning up process has not been very thoroughly carried out, and there is a distinct possibility that when the valve is under use the occluded gases will gradually be given out. A new valve should always be tested for hardness by the application of a high anode voltage. If the valve shows no signs of blue-glow with 100 volts on the plate, it may be taken as being hard enough for practical receiving purposes. Some of the foreign valves are purposely made rather soft, for which reason they make excellent rectifiers. In testing these out in the first instance the blue-glowing point should be noted, and if the valve is suspected of softening it should be tested again. Should softening have taken place, it will now blue-glow with a smaller voltage upon the plate. Very soft valves, by the way, work excellently as rectifiers when there is not more than one stage of H.F. amplification in front of them, but they are of little use when two stages are used. An English valve which

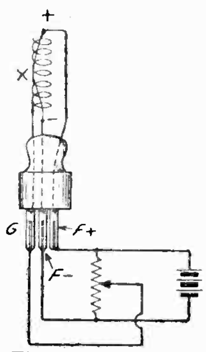

Fig. 1.—Test for displaced filament. The anode is not shown for the sake of clearness.

shows slight traces of softening—that is, one which just begins to blue-glow when the anode voltage is raised to 100 or more with the filament potential at its normal working point—should not be employed as an amplifier, though it will probably give quite good services as a rectifier. In no case should a valve be worked at the blue-glowing point, for if this is done distorted reception will result. Dutch valves will give best results when the plate or filament potentials are adjusted so that they are just short of blue-glowing.

Displaced Filaments

Another mishap which may occur to a valve is that the filament may become so strained that it comes into contact with the spiral coil of the grid at some point. With the "R" type of valve it is usually quite easy to detect this by examination if the valve is held between one's eye and the light; but with many other types, and particularly those whose bulbs are covered upon the inside with a metallic layer, it is not at all easy to see whether the filament is out of place. A simple test when a valve is suspected of not being up to the mark will show whether the trouble is to be found in a displaced filament. Place the valve in a holder on the high-frequency side of the set where the grid potential is controlled by a potentiometer. Move the slider of the potentiometer backwards and forwards and notice whether anything happens to the brightness of the filament. If it is touching the grid, first one portion of it and then the other will glow with unusual brilliance as the slider is moved. Fig. 1 shows the reason why. In the drawing the top end of the filament is the positive one, and the lower the negative. The filament is touching the grid at the point X. If the potentiometer slider is moved right over to the negative side, the full voltage of the battery passes from the top end of the filament to the point X. When it travels to the positive end the full voltage is again applied to a portion of the filament, this time between the point X and the lower end. If then the movement of the potentiometer makes any difference to the glowing of the filament, it is certain that it is in contact with the grid at some point. As a rule a valve so affected is a hopeless case, but one can sometimes bring about a cure in the following way. Fit up a special holder for the valve, arranging it so that the valve can be placed in such a position that the force of gravity will act upon the distorted filament; that is to say, fix up the valve so that the bowed portion is concave to the horizontal. Then let the filament run rather brightly for some time and give the bulb an occasional tap. This may have the effect of forcing the filament to straighten out a little, but the process is not always successful. The only radical cure is to send the valve to a firm of repairers for a new filament to be fitted.

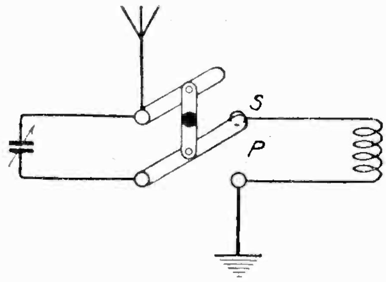

Fig. 2.—Series-parallel connections with parallel arm switch and three studs.

Broken Leads

A filament that is actually broken is usually easy enough to spot, though there are occasions when a valve is unjustly condemned as useless. If the filament will not light up in its own holder always try the valve in another, for the reason may be that there is a disconnection in its own low-tension circuit. See that the pins are properly splayed so that they fit tightly into the legs. A puzzling symptom is occasionally met with: the valve lights up when the rheostat is moved but suddenly goes out and then comes on again if the bulb is tapped. Sometimes the symptoms are not quite so marked; there may be no actual extinction of the filament, but it will glow more brightly if a hand is placed on the top of the bulb so as to push it hard down. In either case the cause is the same; one of the filament leads inside the cap is broken. The ends may be held so closely together that the disconnection is only partial, in which case the valve will be extremely noisy and will, as has been said, brighten up when the bulb is pressed down. Or there may be actual disconnection when the bulb is pressed a little to one side or jarred. When this is the case the filament will light up and go out altogether at intervals when the bulb is moved. The only cure for this is to have the valve recapped, and this will be possible only if the break has occurred at a point some way from the surface of the glass. Should the break be in the grid and filament leads within the cap tapping or pressing the bulb will produce loud crackling noises in the receivers.

A Condenser Problem

A correspondent sends a problem

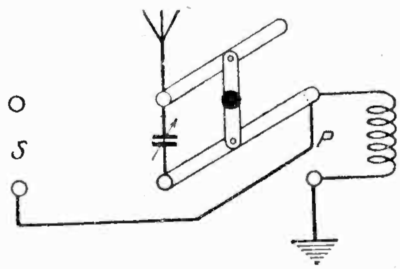

Fig. 3.—Series-parallel connections with double-pole change-over switch.

which has very much puzzled him. A new set had been made up which included a series-parallel switch for the aerial tuning condenser. When it was tested out with the condenser parallel, excellent results were obtained, but as soon as the switch was thrown into the series position, nothing at all came through. Coils of various sizes were tried but the result was the same in every case. The wiring was carefully examined, but no disconnection or faulty connection could be found. It seems probable that the cause of the trouble is to be found in incorrect wiring of the switch. There are several ways of wiring up a series-parallel switch, one of the most convenient of which is given in Fig. 2. This is for a parallel-arm switch with three studs. If a double-pole change-over switch is used, connections may be as shown in Fig. 3. It is possible, of course, that the wiring in the case under review was correctly done, but that the switch arm did not make proper contact when its studs were in the series position. The only other thing that could possibly account for such a failure would be the use of a very small condenser indeed for the A.T.C. If this were done the impedance offered to oscillations in the aerial circuit would be so great that the set would be practically disconnected when the condenser was thrown into series. One would expect, however, that even if the condenser were too small, signals of some kind would come through, though their strength would be very small. It is a safe general rule when working with the

(Continued on page 97).

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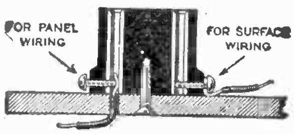
Yours faithfully,
ARTHUR O. MILNE.



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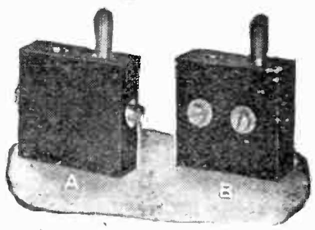

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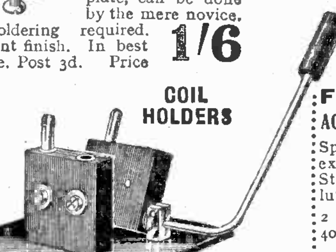

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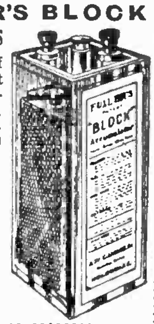

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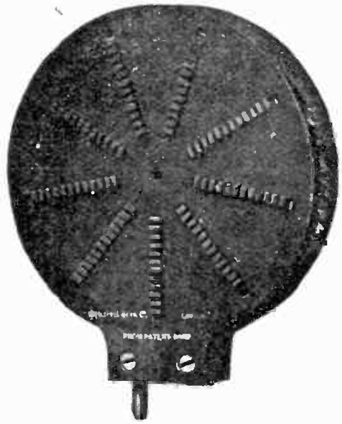

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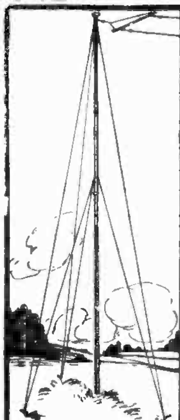

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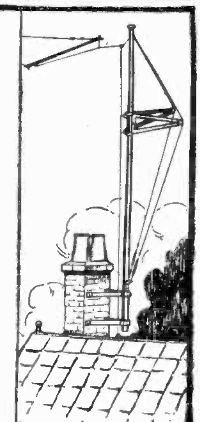

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(Continued from page 94).

A.T.C. in series always to use inductances of such a size that the capacity is never below .0003 μF. That is to say, if you have a .001 μF condenser in series the A.T.I. should always be such that the condenser pointer is not below the 60 degree mark on a 180-degree scale. With parallel condensers the rule is exactly reversed. Here one should strive to use as little capacity as possible.

When Crystal Detectors Work Badly.

It happens sometimes that a crystal detector which has been doing excellent work for a long period begins to show signs of a marked falling off in the strength of its signals. Even the most painstaking search for sensitive spots and the most careful adjustment of the pressure between the contact point and the crystal fail to give the results that we formerly obtained. As a rule the inductances, the condensers and the telephones are suspected by turn of being at the root of the trouble, but it is nearly always the detector itself which is at fault in such cases. The reduction in signal strength may be due to one of several causes, but in every case save one it is a matter of bad contact. It should be remembered that the crystal has to make two contacts: the first with its cup and the second with the catwhisker. Many people take infinite pains over the second without bothering much about the first of these. Things are most likely to go wrong where the crystal is held between the points

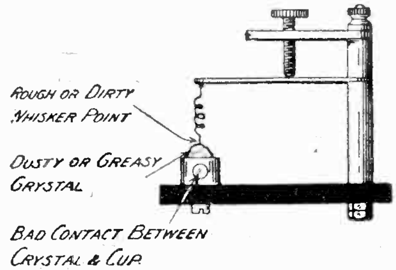

Fig. 4.—Points to inspect in a faulty detector.

of three setscrews. It is always difficult to insert an awkwardly shaped piece of crystal so that it is properly held, and as time goes on a loosening may easily occur. If the detector seems to be working unsatisfactorily always begin by prodding the crystal, using a bodkin or something of that kind for the purpose and not the fingers. Should it show any signs of loosening you have probably found the cause of its misbehaviour at the first shot. It is rather a good tip to wrap the crystal in bright clean copper foil before inserting it into its cup, when screw contacts are used. By pressing copper foil tightly round the crystal you ensure that a good contact will take place. The foil is scraped away with a knife from the upper surface of the crystal after it is in position. Better still is to dispense with the screws altogether and to embed the crystal in Wood's metal, which has a very low melting point. Never use solder for the purpose, for its melting point is high enough to injure certain delicate types of crystal. Suppose that the crystal is found to be quite firm in its cup, it is possible that its surface is greasy or dusty, either of which is sufficient to impair its working to a very great extent. Never handle crystals, for even the cleanest fingers have a slight film of grease which is transferred to the crystal. For this reason it should always be picked up with a pair of tweezers. To remove dust and grease give the crystal a bath in absolute alcohol and replace it in the holder without touching it. Do not use petrol or methylated spirits, both of which leave solid deposits after evaporation. Should neither of these expedients effect a cure attend to the point of the cat-whisker which may be rough or dirty. Smooth it off with a fine file and try the detector again. If no sensitive spot can be found it may be taken that the crystal has "gone off." Some of them do deteriorate with use, especially if the set has been subjected to the effects of powerful atmospherics. It will sometimes be found that fresh sensitive points will be disclosed if the surface of the crystal is chipped with the point of a penknife, but often it is advisable to discard the crystal and to fit a new one.

Coil Holders.

It happens occasionally when coil holders are purchased, especially those of the cheaper makes, that the set refuses to function when they are used. The symptoms may be rather mystifying. Place a coil in the holder before it is mounted in the set and touch the screws intended to secure the connecting wires with the ends of two leads coming from a battery and a pair of telephones in series. A reassuring click will take place in the phones, which shows that all is well. Now mount the coil holder on the panel, secure wires to the screw connections and insert an inductance.

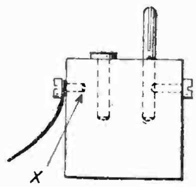

Fig. 5.—How a coil holder may play up after being connected. Owing to the thickness of the wire the screw does not reach plug at X.

You switch on and nothing at all happens. The last thing that you suspect is naturally the coil holder, which has already been tested out, but actually the fault is there. Fig. 5 shows how it occurs. In these coil holders the contact screws run through the ebonite into a plug or socket. Sometimes the screw is not long enough to allow for the insertion of a fairly thick wire and a washer below its head. Hence when the wire is connected the tip of the screw does not reach the shank of either plug or socket as the case may be. The remedy is quite obvious—substitute a longer screw. But unless one knows what to suspect, trouble due to a faulty coilholder may take quite an amount of running to earth. Before mounting any coil holder always remove the contact screws entirely and measure them to see that they are long enough to do their job properly.

Results on the 3-Valve Dual Receiver.

To the Editor of MODERN WIRELESS.

SIR,—I thought that you might be interested to hear what results have been obtained on your 3-valve Dual Receiver, described in your April issue.

I have had it in use about a week. I am 13 miles from Birmingham, and it comes in on the loud-speaker really *too* strong for the average-size room. I have also succeeded on several evenings in getting London, Bournemouth, Manchester, Newcastle and Glasgow on the loud-speaker easily. Cardiff is just off the range of my H.F. transformer. Aberdeen I have not yet been able to separate out from Birmingham. All these were obtained without a reaction coil in. I really think the results and the quality of reception is excellent, and so far as I am concerned better than the usual four-valve combination.

I find results are best all round when using constant aerial tuning, and the .0004 series condenser with the H.F. variable condenser.

I have not had time really to do much experimenting with the circuit. By the way, I can tune all the stations in on the loud-speaker without using telephones. With regard to H.T. I am using 120 on 1st, 40 on 2nd, and 120 on 3rd, with $3\frac{1}{2}$ volts negative bias on 1st and $4\frac{1}{2}$ on the L.F. valve.

I should really like to congratulate you on adding yet another circuit to your famous collection, which does all and more than you indicate.

Yours sincerely,
A. J. DAVIES.

Birmingham.

P.S.—Paris comes in almost as loud as Birmingham.

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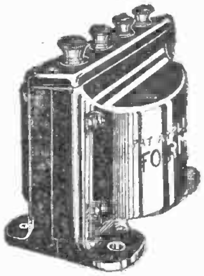

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This Condenser is a Perfect Instrument, of ORIGINAL and EXCLUSIVE DESIGN and FINE WORKMANSHIP.
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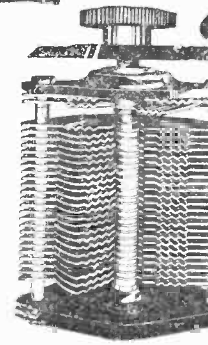
Complete with Knob, Dial and Vernier.

.001 ..	10/6
.0005 ..	9/6
.0003 ..	8/6

One hole fixing



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GUARANTEE. We agree to replace or return cash if Phones do not give complete satisfaction subject to Phone being returned to us within 7 days of purchase undamaged.

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Post free

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These Headphones are similar in construction to the standard BONTONE, and purchaser is guaranteed

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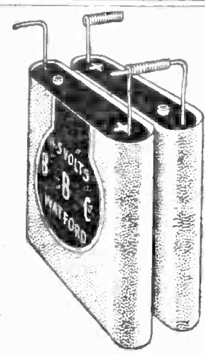
Standard Pocket Lamp Size—4½ volt *with* patent spiral wire terminals *and* plug sockets to take Wander Plugs.

Note — 1 doz. = 54 volts

Used units replaced easily.

Connect as illustrated.



To connect in Series insert straight Terminal in Spiral of next battery. Bend spiral and thus ensure permanent electrical connection without soldering.

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Patent applied for.

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The BRITISH BATTERY Co. LTD.
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In the Wireless Telegraph Service the commencing salary at the present time is about £90 per annum, plus free maintenance on board Ship, which makes the total remuneration approximately £150 per annum, and Operators when qualified by holding the Postmaster-General's Certificate of Proficiency are nominated by the College for appointments, of which there are a considerable number available at the present time. Positions are also obtainable in the Royal Air Force.

The College has never given "Guarantees" to obtain appointments and parents are warned against persons who do so as it is manifest that any such "Guarantee" must be of a fraudulent character.

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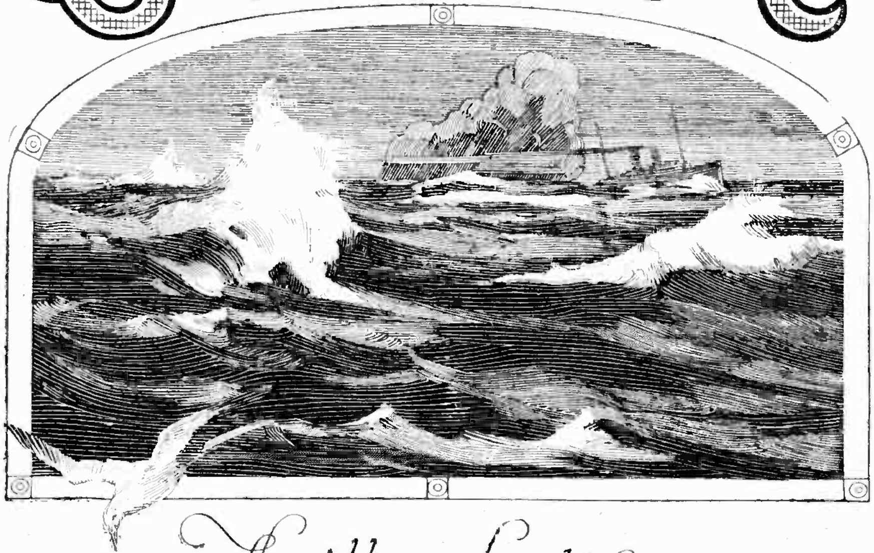


Thrills of distance

IF Radio has done nothing else, it most certainly has made us realise that we are no longer an island. Such is the rapid progress of international Broadcasting that anyone can—in one evening—hear French, Dutch, German, Italian, and Spanish spoken by natives in their own language.

A tour of Europe in one hour! Such thrills of distance are available for anyone with a good Valve Set and a knowledge of its use.

But long-distance work demands a careful selection of apparatus. Just as prismatic binoculars have rendered the telescope old-fashioned, so the Cossor P.2.—the valve with the red top designed specifically for long-distance work—has superseded the ordinary Valve with long straight filament and open-ended Anode.

There is a reason for this. When a Valve glows it emits a stream of negative particles—electrons—which travel from the filament towards the Grid and the Anode.

This electron stream is the whole basis of valve amplification and rectification—turn your filament current off, electrons cease to flow and your Set becomes dead.

Obviously, therefore, the greater the percentage of these electrons we can capture and put to a useful purpose the more efficient will be our Valve. Compare the construction of the Cossor and the ordinary Valve.

In the one case the filament is almost totally enclosed by the hood-shaped Grid and Anode—what chance has the electron stream to leak away here? On the other hand where the Anode is in the shape of a tube quite a considerable percentage of electrons travel direct to the glass without touching either Grid or Anode—a typical case of wasted energy.

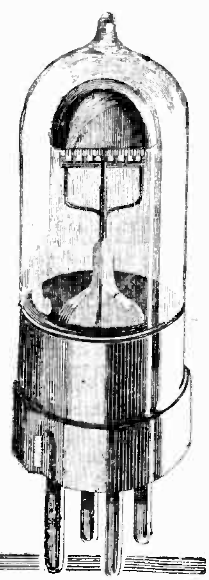
If you are dealing with the almost infinitesimal currents generated by a Broadcasting Station in, say, Madrid, you can't afford to take chances with inefficient valves. Be wise, therefore, and see that every Valve in your Set is a Cossor—and your results will be consistently good.

Manufactured in two types:

P.1. (For Detector and L.F. use) - - - 12/6

P.2. (with Red Top) for H.F. use - - - 12/6

From all Dealers.



Advertisement of A. C. Cossor, Ltd., Highbury Grove, N.5. *Gilbert Ad. 887.*

3 good R.P. Books you should read

Twelve Tested Wireless Sets

Series No. 14. By Percy W. Harris.

A first-class Book for the home Constructor. Embraces a wide range of Sets from a Crystal Receiver costing but half-a-crown to an S.T.100, an All-Concert Receiver and an improved Reinartz. In addition, a new Set using two stages of high frequency which can be relied upon to pick up American Broadcasting with the greatest ease when conditions are favourable. A special chapter is devoted to wave-traps and devices to enable interference from the local B.B.C. Station and ships to be eliminated. **2/6**

How to Make a Unit Receiver

Series No. 7. By E. Redpath.

The idea of expanding Bookcases as applied to Wireless. The particular Receiver described in this Book consists of four Units which, when coupled together, will receive every B.B.C. Station and will work a Loud Speaker from the nearest one. Yet the first Unit by itself will enable Broadcasting to be enjoyed if you are within 30-40 miles from a B.B.C. Station. The other Units can be added at your leisure. This economical system will commend itself to the man of moderate means. **2/6**

Tuning Coils and How to Wind Them

Series No. 18. By G. P. Kendall, B.Sc.

There is probably no single Component in any Receiving set able to exert so much influence as an Inductance Coil. A highly efficient Coil (or Coils) will often make all the difference between mediocre results and really clear and loud reception.

Even if you feel that your present set is giving tolerably good results, the chances are that it will be worth your while—presuming that you are using plug-in coils—for short wave-lengths to use a set of home-made basket coils. Such coils as these have particularly low self-capacity.

This new Book by G. P. Kendall, B.Sc. (staff editor), contains concise details for making every type of Coil used in Wireless to-day. All necessary data, such as diameter of tubes, gauge of wire, number of turns, etc., are given—the results of the author's own experiments. **1/6**

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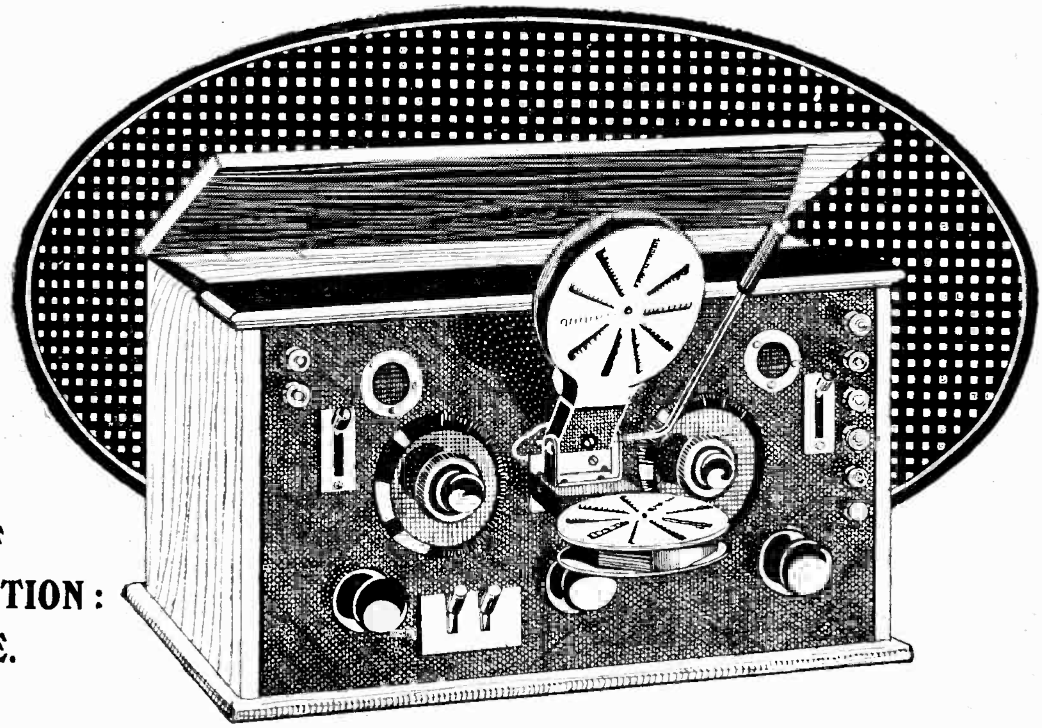


DATE OF PUBLICATION: 7th JUNE.

The Famous All-Concert Receiver

—designed by Percy W. Harris (Assistant Editor of this Magazine)

THE All-Concert Receiver was described in one of the first Constructional Articles ever written for MODERN WIRELESS by Mr. Percy W. Harris.

From the very beginning its undoubted merits—it was one of the earliest 3-Valve Sets—gripped the imagination of wireless enthusiasts and a very large number built it up and got excellent results.

Here, however, is the first opportunity of seeing it in its new guise—that of a superlative Receiving Set, beautifully designed and made up with plated fittings into a polished mahogany cabinet — truly an aristocrat among Sets and fit for any drawing-room.

This Receiver is astonishingly sensitive yet very simple to handle—to its credit stands a formidable list of Stations heard in North London on an average aerial—commencing with all the B.B.C. Stations (London, of course, in immense volume on a Loud Speaker) and continuing with all the better known Continental Stations and also KDKA — the well-known American Broadcasting Station, which operates on 100 metres.

The secrets of its construction are now available to all who purchase the Envelope containing full details, wiring diagrams, blue prints, etc.

If you are contemplating building a good all-round Set you can't beat the All-Concert de-luxe.

Published by Radio Press, Ltd., and sold by all Booksellers

2/6

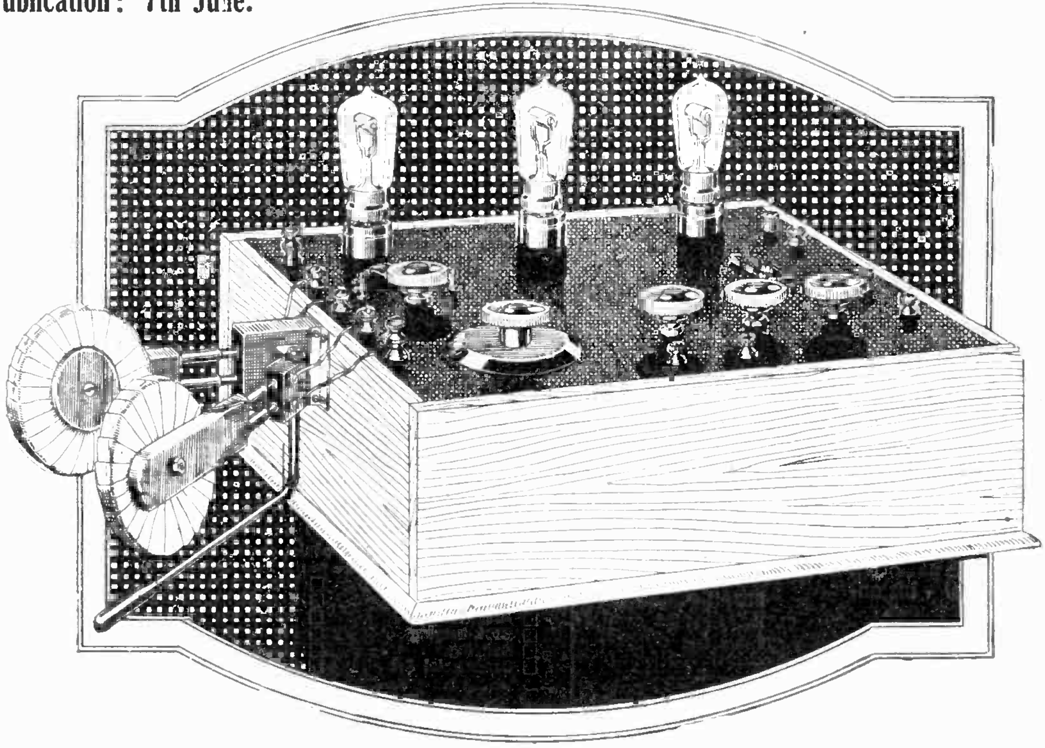
or post free direct, 2/9.

How to build the All·Concert de·luxe Receiver

RADIO PRESS Envelope Series No. 4.

G.A. ,683

Date of Publication: 7th June.



All the B.B.C. Stations on one knob—

THE usual three-valve Receiver presents rather a difficult problem in tuning (to obtain the best results) to the beginner. Almost invariably there are two condenser dials to be rotated simultaneously and coils to be adjusted. The 'old hand,' of course, makes light of such difficulties, but to the novice, undoubtedly they are certainly quite formidable.

The Set shown above, although using one stage of H.F., is tuned entirely by one variable condenser and one switch and has been designed throughout to give the best results with the greatest possible ease. At the same time, however, simplification in design has also resulted in marked economy in outlay. Any experimenter can now build this splendid 3-Valve set under the new Radio Press Envelope System at a total cost of but £3 to £4 (excluding Valves and accessories, of course) using the best components. This Receiver covers all wavelengths—for 1,000 metres and under it uses a tapped anode coil and for above 1,000 metres it uses resistance coupling—and any Station is immediately found by setting the switch and tuning on one variable condenser.

If required the L.F. Valve can be cut out instantly by means of a switch. Why not make up this efficient Set, designed by a member of our own Editorial Staff, and which has received all B.B.C. Stations in London—three of them on an indoor aerial. If you have hitherto been afraid to build up a multi-valve Set here is just the Receiver you should build—order a copy from your Bookseller to-day.

Envelope No. 3 contains blue prints showing panel lay-out (front and back) and full wiring diagram together with the most explicit instructions for assembly. It is practically impossible for even the most complete novice to go wrong in building up this Set. Photographs showing finished instrument in different positions also included.
2/9, *post free*.

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How to build the "Simplicity" 3 Valve Set

Radio Press Envelope No 3.

G.A.798.

Don't worry it out yourself —let an expert help you

PERHAPS you have built a Set and you cannot get it to work—don't worry, let a Radio Press expert help you. Probably you have made some little slip in the Circuit—maybe you have mis-read the wiring instructions. All you need is a copy of

Pictorial Wireless Circuits

By Oswald J. Rankin.

(*Radio Press Series No.* 8.)

This Book contains scores of different Circuits, each one of which is shown in pictorial form instead of the more technical diagrammatic manner.

Thousands of beginners have bought it and have been able to appreciate for the first time how easy it is to wire up a Set when the Circuit diagram is understood.

No matter which type of Set you are building, whether Crystal or multi-valve, and whichever type of tuning you will use, variometer or plug-in coils, you will find a wide variety of practical circuits shown in a manner even the veriest novice can readily understand.

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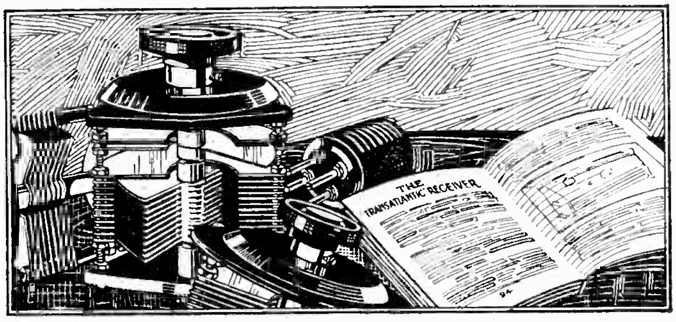

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There is a Bowyer-Lowe Square Law Condenser for every wireless occasion. Standard, Double and Vernier types are in stock in the usual capacities. Special capacities can be made to order. In the double type, the two halves are guaranteed accurately matched. In the vernier type accurate setting of both vernier and main portion is always a simple matter because the main portion is always engaged in the same position relatively to the vernier.

POINTS ABOUT THEIR QUALITY.

Dials of Blackened Brass to obviate hand capacity effects. Soldering lugs on all models. Positive rubbing contact to moving plates adjustable for pressure, resulting in very low resistance.

FOR PORTABLE SETS.

Where weight is a consideration Bowyer-Lowe Square Law Condensers are a big help. A smaller condenser will yield a given wavelength range equal to that of a larger condenser of the ordinary type.

OBTAINABLE from all good dealers. In case of difficulty write direct.

EVERY experimenter who seeks to obtain from his set the maximum wavelength range, selectivity and volume must use Bowyer-Lowe Square Law Condensers as Mr. Percy Harris has done in his new Transatlantic Five.

Though no larger than the ordinary type these Condensers have greater wavelength range and higher capacity ratio than any yet made. They can easily be calibrated for wavelength. The minimum capacity of the .0005 type is only 3 Micro-micro-farads (.000003 MF), giving a ratio of over 150 to 1.

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Every Bowyer-Lowe Square Law Condenser is individually tested and is supplied with a guarantee of maximum capacity. Calibration charts and drilling template are provided with every one.

Decide to use these Aristocrats of Wireless in the set you are making.

Bowyer-Lowe SQUARE LAW CONDENSERS

Write now for our Brochure which explains exactly why these Condensers will add greatly to the efficiency of any Wireless Set to which they are fitted.

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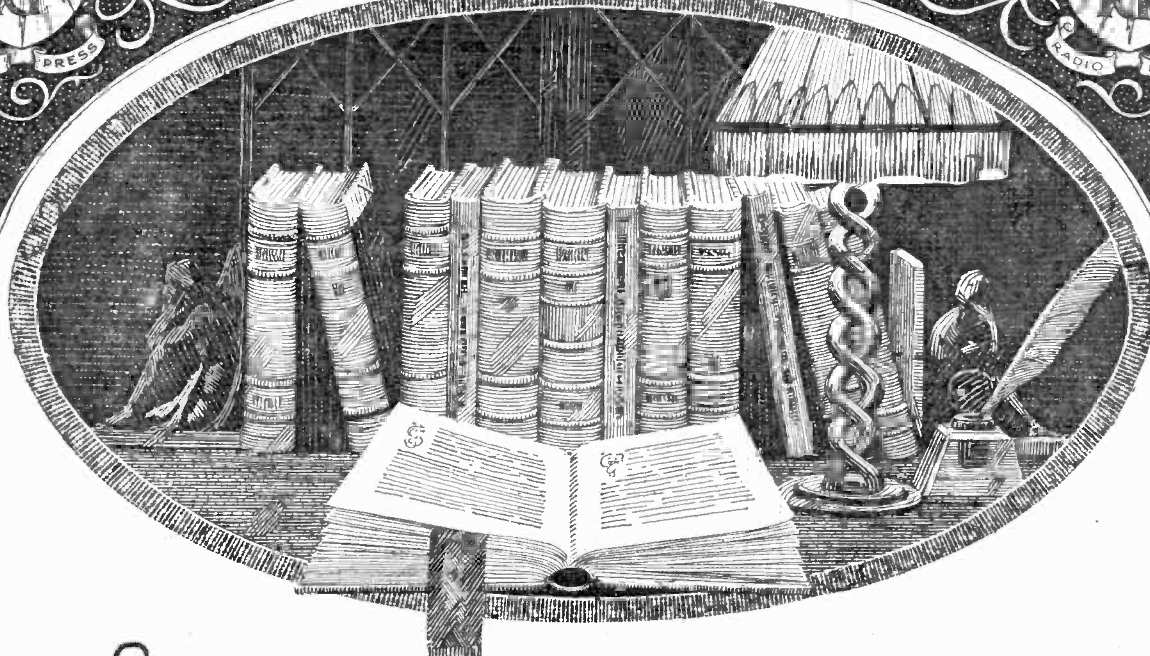

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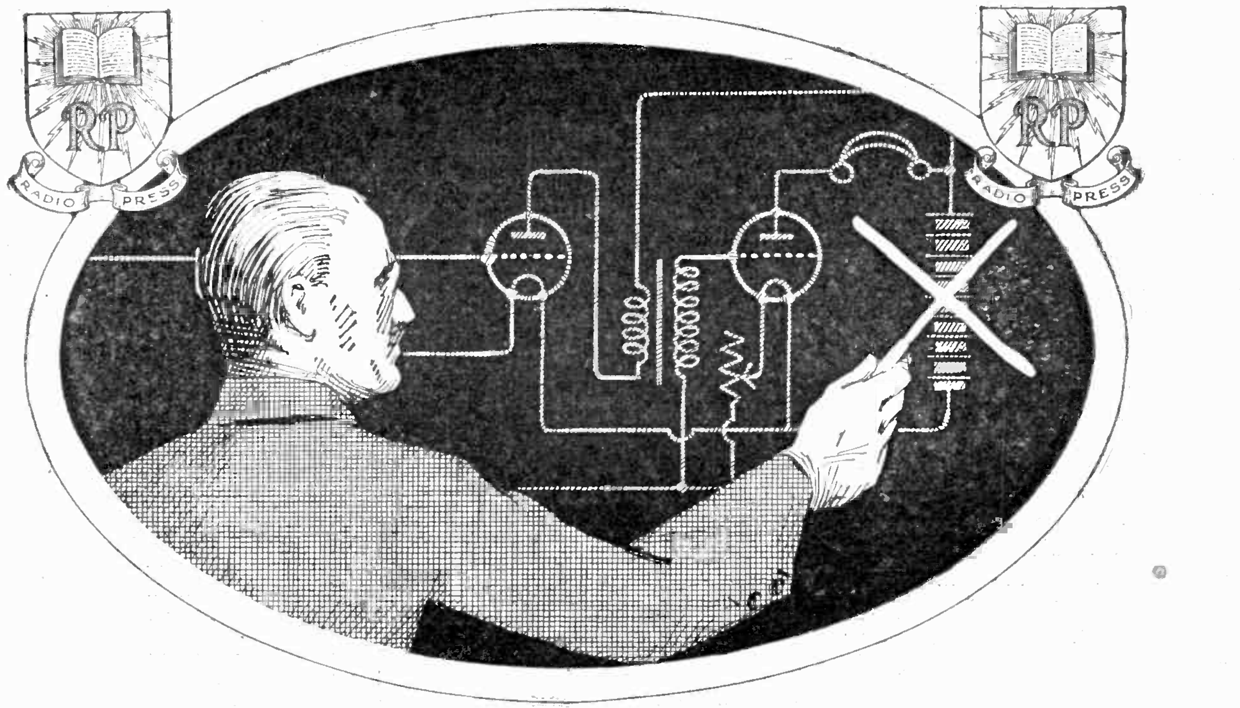

High-tensionless Receiving Sets.

— read "Wireless Weekly" for fullest constructional details of Sets using *ordinary* Valves without H.T. Batteries

If you are interested in sound technical research you must not fail to read the next few issues of WIRELESS WEEKLY which will deal specially with the question of the H.T. Battery and the possibility of its elimination.

Commencing June 4th Mr. Percy W. Harris (assistant Editor) will describe the construction of a Receiving Set which permits remarkable results (employing a new Circuit) with the ordinary 3-electrode Valve which every one has.

Obviously these articles will arouse great interest because it will be the first time that any enthusiast will be given the opportunity of experimenting with the ordinary apparatus he already possesses, instead of having to purchase more expensive 4-electrode Valves.

On no account should you miss these issues and in view of the anticipated heavy demand you will be well advised to place an order with your Newsagent at once.

Remember WIRELESS WEEKLY is published by the largest technical wireless staff in the country, and its views are accepted as being dependable and accurate.

If you are not yet a regular reader you will be surprised at its generous size, clear cut illustrations and intelligent far-seeing articles.

Certainly no other publication in the country can approach it either in appearance or its remarkable value for money.

In the adjacent column is given a selection of the constructional articles which have appeared in the last few issues—those in preparation will be quite as attractive.

Radio Press Ltd., Devereux Court, Strand, W.C. 2.

Some exceptional Constructional Articles.

Wireless Weekly has always been famed for its thoroughly practicable Constructional Articles—here are a few taken at random from recent issues. Copies are available on application to Radio Press Ltd., and will be sent post free for 7½d. each.

"A Simple Short-Wave Receiver."
By G. P. KENDALL, B.Sc. (*Feb. 6th*, 1924.)

"A Practical Neutrodyne Receiver."
By ALLAN T. HANSCOM. (*Feb. 13th*, 1924.)

"A Wavemeter on the Buzzer Principle."
By G. P. KENDALL, B.Sc. (*Feb. 27th*, 1924.)

"A Cabinet Three-Valve Receiver."
By HERBERT SIMPSON. (*Feb. 27th*, 1924.)

"The Omni-Circuit Receiver."
By JOHN SCOTT-TAGGART, F.INST.P. (*Issues of Feb. 20th and 27th and March 5th.*)

"A Power Amplifier."
By G. P. KENDALL, B.Sc. (*March 12th*, 1924.)

"The W.2 Receiver (a Selective Two-Valve Set)."
By HERBERT SIMPSON. (*March 12th and 19th*, 1924.)

"A Capacity-Reaction Three-Valve Receiver."
By STANLEY G. RATTEE. (*March 26th*, 1924.)

"A Double-Reaction Receiver."
By STANLEY G. RATTEE. (*April 16th*, 1924.)

"An Improved S.T. 100 Receiver."
By JOHN SCOTT-TAGGART, F.INST.P. (*April 23rd*, 1924.)

"The Reinartz All-Wave Tuner."
By JOHN L. REINARTZ. (*May 21st*, 1924.)

All these articles are complete with photographs, wiring diagrams, and the fullest details to enable anyone to build exact replicas of the sets described.

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From all Newsagents.

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Wireless Weekly

G.A. 890

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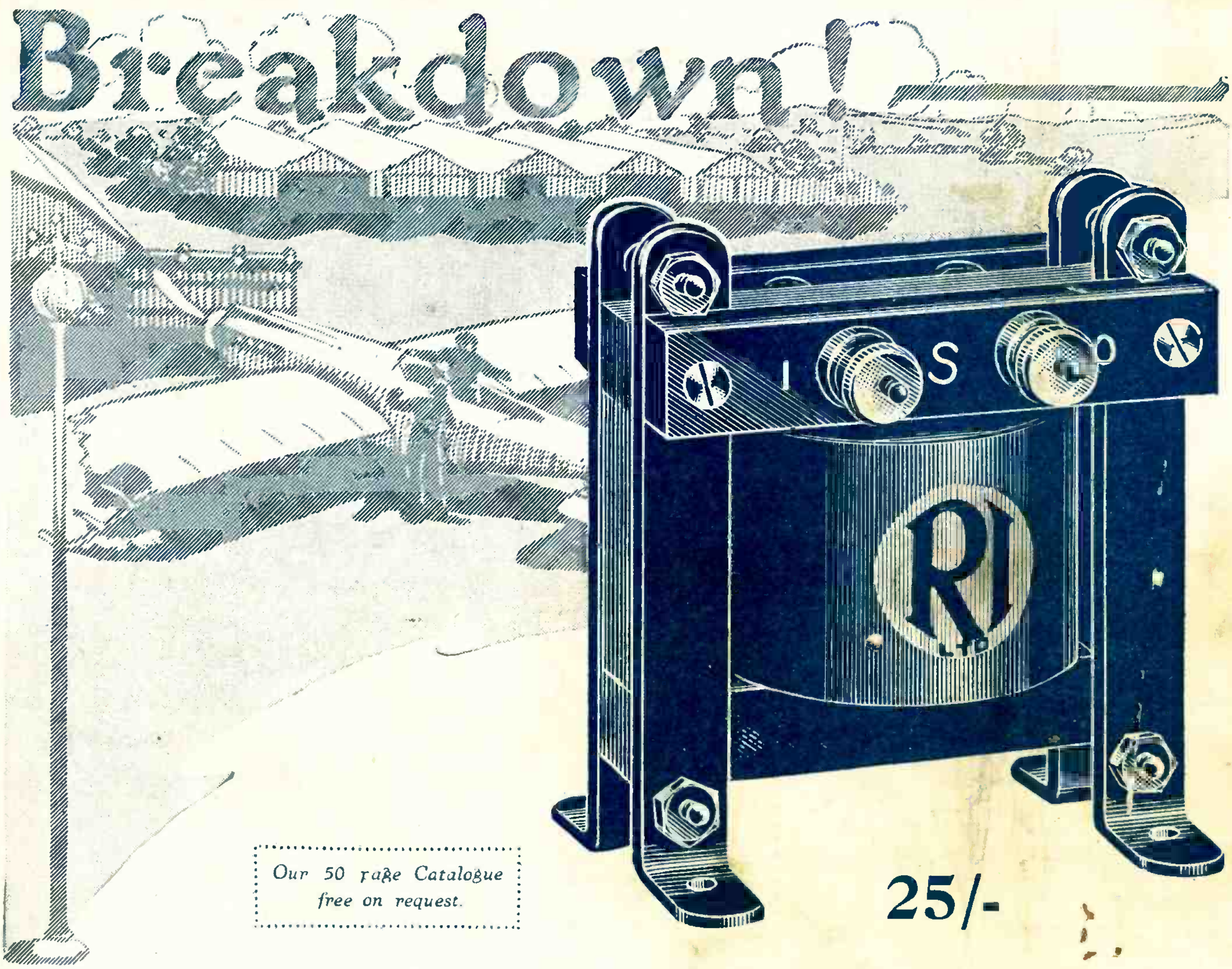

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The **R.I.** Transformer fulfils these requirements to such a degree that its use has become standard all over the world.

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