MODERN WIRELESS

September

1/6

Vol. III. No. 4. Edited by JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E. September, 1924.

Vol. III.

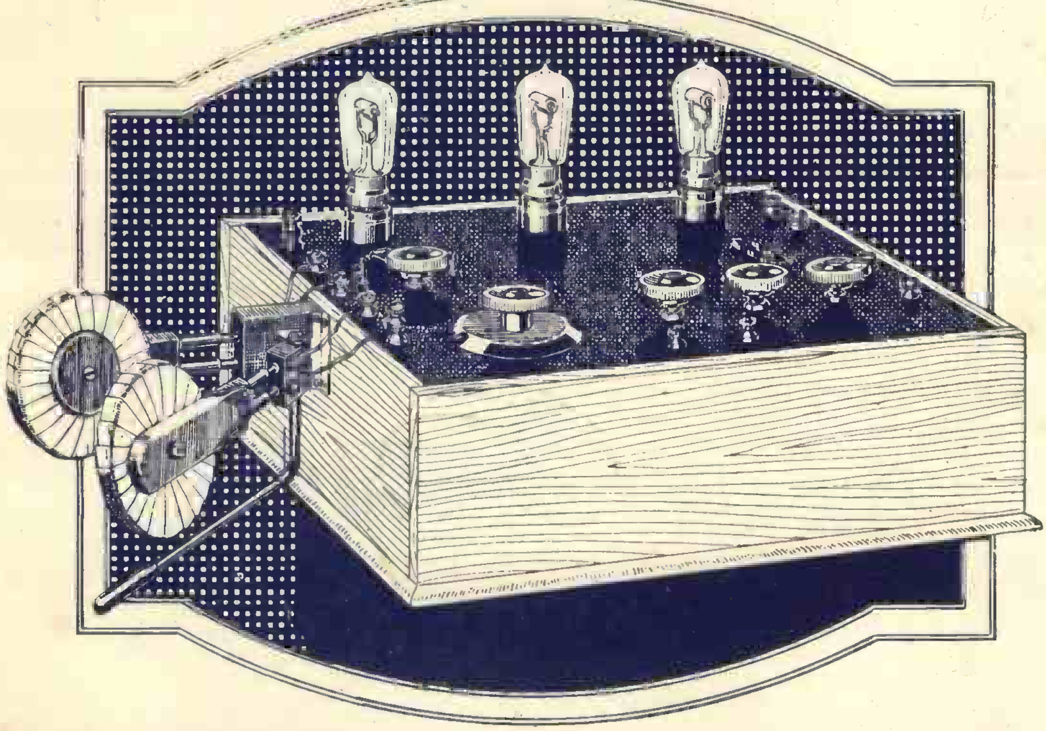
No. 4

HOW TO MAKE:

TWO DIFFERENT CRYSTAL SETS
A SINGLE VALVE NOTE MAGNIFIER
A NEW SINGLE VALVE REFLEX
A TWO VALVE DOUBLE REACTION RECEIVER
A HIGHLY SENSITIVE THREE VALVE SET
A NEW TYPE FOUR VALVE RECEIVER
A MULTI-PURPOSE TUNER

SPECIAL ARTICLES FOR THE BEGINNER.

HOW TO TUNE YOUR SET. NEW LIST OF AMATEUR CALL-SIGNS.



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 £5 to £6 (excluding Valves and accessories, of course) using the best components. 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 G. P. Kendall, B.Sc., Staff Editor, and which has received all B.B.C. Stations in London—three of them on an indoor aerial. Upon a medium-sized outside aerial it picked up the Madrid, Konigswusterhausen, Petit Parisien, Eiffel Tower, and Radiola broadcasting stations, the last-named at very fair loud speaker strength. The American station WGY has also been received at good 'phone strength. 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.

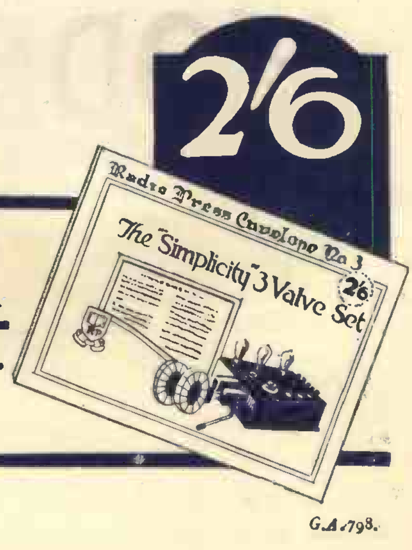
Envelope No. 3 contains blue prints showing panel lay-out (front and back) and full wiring diagram, together with the most explicit instructions for assembly. It is practically impossible for even the most complete novice to go wrong in building up this Set. Photographs showing finished instrument in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

2/9, post free.

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

How to build the "Simplicity" 3 Valve Set

Radio Press Envelope No 3.



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MODERN WIRELESS

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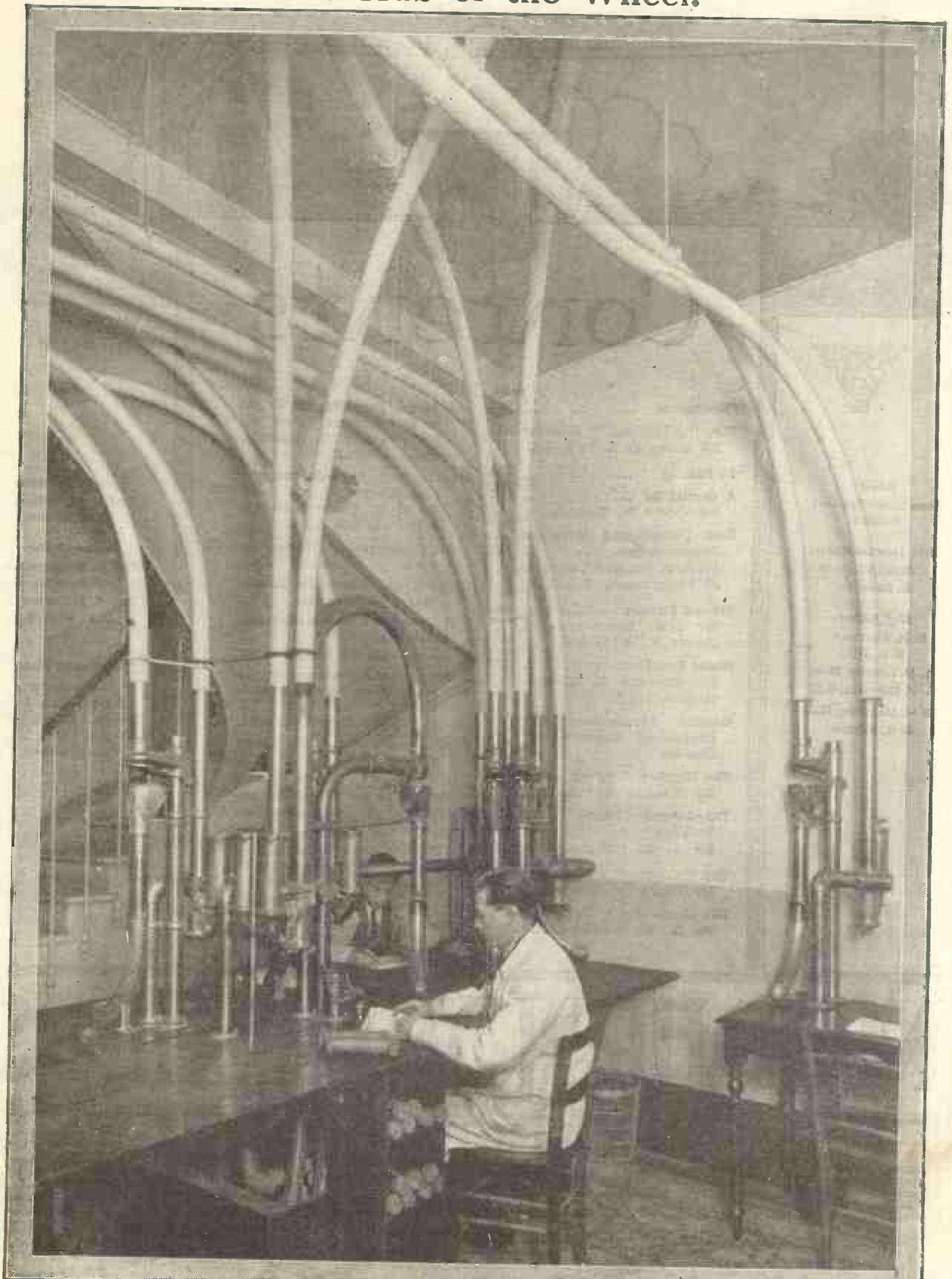
• STRAND.W.C.2 •
Tel.—Central 3763.

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

The Hub of the Wheel.



Sitting quietly in the basement of a large building in Paris, this man attends to the distribution of the wireless messages of Radio Central, the great French high-power station. With the aid of the pneumatic tubes, messages are sent from the public receiving office to the particular circuit desired, with the minimum of delay. Our photograph shows the "tube exchange."

The "All-Britain" Receiver.

By HERBERT K. SIMPSON.

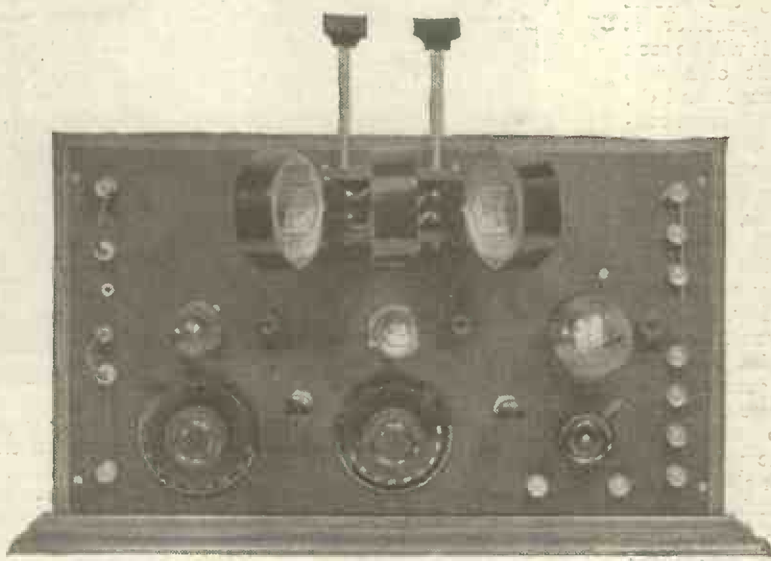


Fig. 1.—The All-Britain, ready for work.

This remarkable three-valve receiver, utilising the new Tri-Coil principle, is certainly the most interesting yet described by Mr. Simpson. We predict that many hundreds will be used this coming winter, not only for general broadcast reception, but also for picking up those elusive American signals.

A METHOD of coupling a high-frequency valve, seldom used in the present day, is that in which two coils, conveniently of the plug-in type, are employed, one being in the anode circuit of the high-frequency amplifier, while the second is in the grid circuit of the next valve, transference of energy being obtained by coupling the two coils closely together. Using this method of coupling, several alternative arrangements are possible. For example, either or both of the coils may be tuned, or alternatively both may be left untuned, the latter method resulting in a very stable circuit at the expense of a slight loss in signal strength. Tuning one winding will result in a very sensitive arrangement, and in the receiver about to be described the coil in the grid circuit of the second valve is tuned by a variable condenser of 0.0003 μF. maximum capacity shunted by a small vernier condenser.

It will be remembered that such a method of coupling was used with great success in amateur transatlantic working, and the results obtained with the present receiver are quite in accordance with results previously obtained with this arrangement. Excellent reception has been obtained from all the British stations, while Continental transmissions are regularly heard.

The Completed Receiver

A photograph of the finished receiver is seen in Fig. 1, from which it will be seen that the panel is mounted vertically in a polished mahogany cabinet, the coil-holder being at the top, with the tuning handles projecting above the receiver. Below the coil-holder the valves are situated, each with its own filament control, while the variable condensers are located at the bottom of the panel. The small knobs to the right of each condenser dial are those controlling the vernier condensers, which are of a new pattern manufactured by the Radio Communication Company, Ltd. To the right of the panel, at the bottom, a knob is seen, which controls a switch, of the Utility type, by means of which the third, or low-frequency, valve may be thrown in or out of circuit at will. The aerial and earth terminals are situated on the left-hand side of the receiver, while various arrangements, such as series, parallel, or constant aerial tuning may be employed by connecting the correct sockets by means of the Clix plugs, seen in the photograph.

Separate High-Tension Terminals

On the right of the panel is seen a row of seven terminals, these being the terminals to which the batteries are connected. The three top terminals are those for the positive high-tension supply to each of the three valves respectively, enabling the correct voltage to be applied to each valve. This is a refinement, and should in no case be omitted, as it is not possible to obtain the best results from each valve unless the anode voltage for that particular valve can be adjusted to the correct working value.

The fourth terminal from the top in the right-hand row is the common high-tension negative, while the remaining three, in order, are L.T.+, L.T.−G.B.+, and G.B.−. The terminal for grid bias is provided in order that the experimenter may be certain that his third valve is acting properly as an amplifier, but if no extra grid bias is used the bottom terminal in the row must be connected to the terminal immediately above it by means of a piece of wire. The telephones are connected to the two terminals at the bottom of the panel to the right of the variable condensers. It will thus be seen that all the controls and terminals are close at hand, while the whole presents a very neat appearance owing to the design and lay-out of the component parts.

Circuit Diagram

A diagram showing the circuit arrangement of the receiver is given in Fig. 6, and it will be seen that the aerial circuit comprises the variable condensers C_1 and C_2, the coil L_1, and the small fixed condenser of 0.0001 μF capacity, by means of which the constant aerial tuning system may be introduced. A and E are terminals, to which the aerial and earth leads are joined respectively, while the points marked X, followed by a numeral, are Clix sockets, enabling, as far as those in the aerial circuit are concerned, the three chief forms of aerial tuning to be employed at will. A rubber-covered flexible lead is fastened to the aerial terminal A above the panel, and this lead terminates in a Clix plug, the lead being of sufficient length to enable the plug to fit comfortably into any of the first three sockets in the left-hand row counting from the top. A piece of flex about 4 in. long has a Clix plug secured at each end, and is used in the aerial circuit to facilitate the connections for parallel tuning and constant aerial tuning. A table of connections for the various forms of tuning will be found below.

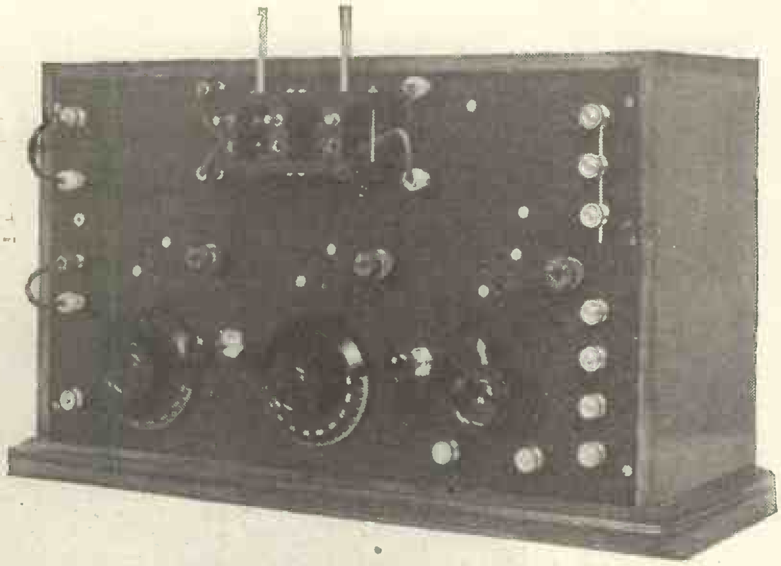


Fig. 2.—Flush-valve sockets and vernier condensers help to give a distinctive appearance to the set.

Vernier Condensers

The condensers C_2 (in the aerial circuit) and C_4 are vernier condensers, and are a necessity for fine tuning on weak signals. The type used in this receiver is known as the micrometer condenser, and gives a fine control of tuning. They are to be recommended, if only on account of the small space which they occupy.

System of Tuning.	Aerial.	Earth.	Other Connections.
Constant aerial tuning	A, flexible lead to X_1	E	X_3 to X_4
Parallel tuning, no C.A.T.	A, flexible lead to X_2	E	X_3 to X_4
Series Tuning . .	A, flexible lead to X_3	E	—

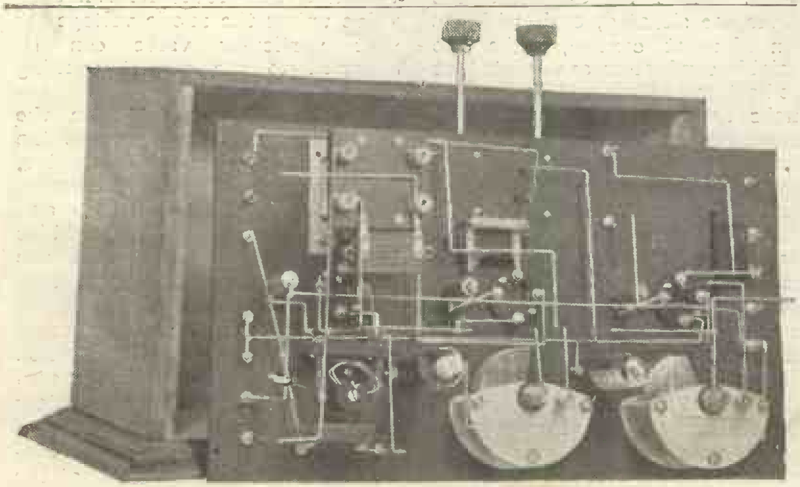


Fig. 3—Taken from its cabinet, the panel reveals the simple wiring.

Change-Over Switch

A switch is provided, as seen in the circuit diagram (from which the connections may be followed), by means of which the last valve may be cut out if desired. The switch, which is of the Utility type, controls the filament of V_3 as well as changing over the telephones from the anodes of V_2 and V_3. When the switch is over to the side marked (2) the filament of V_3 is switched off, and the 'phones are included in the anode circuit of V_2, the low-frequency transformer being out of circuit. In this position the connections for H.T.+ are somewhat altered, as the terminal H.T.$_2$ is now disconnected, the anode supply for V_2 being therefore obtained at the terminal H.T.$_3$. When using two valves only, therefore, some slight alteration to the supply to terminal H.T.$_3$ may be necessary. When the switch is turned to the side marked (3), all three valves are in use, the filament of V_3 being automatically switched on and the low-frequency transformer placed in circuit, while the telephones are moved to the anode circuit of V_3 by the same movement of the switch.

Reversal of Coils

The three coils L_1, L_2, and L_3 are mounted in a three-coil holder, and provision is made by means of Clix whereby the movable coils may be reversed. Reaction is obtained by coupling L_1 to L_2, the latter being the fixed coil in the

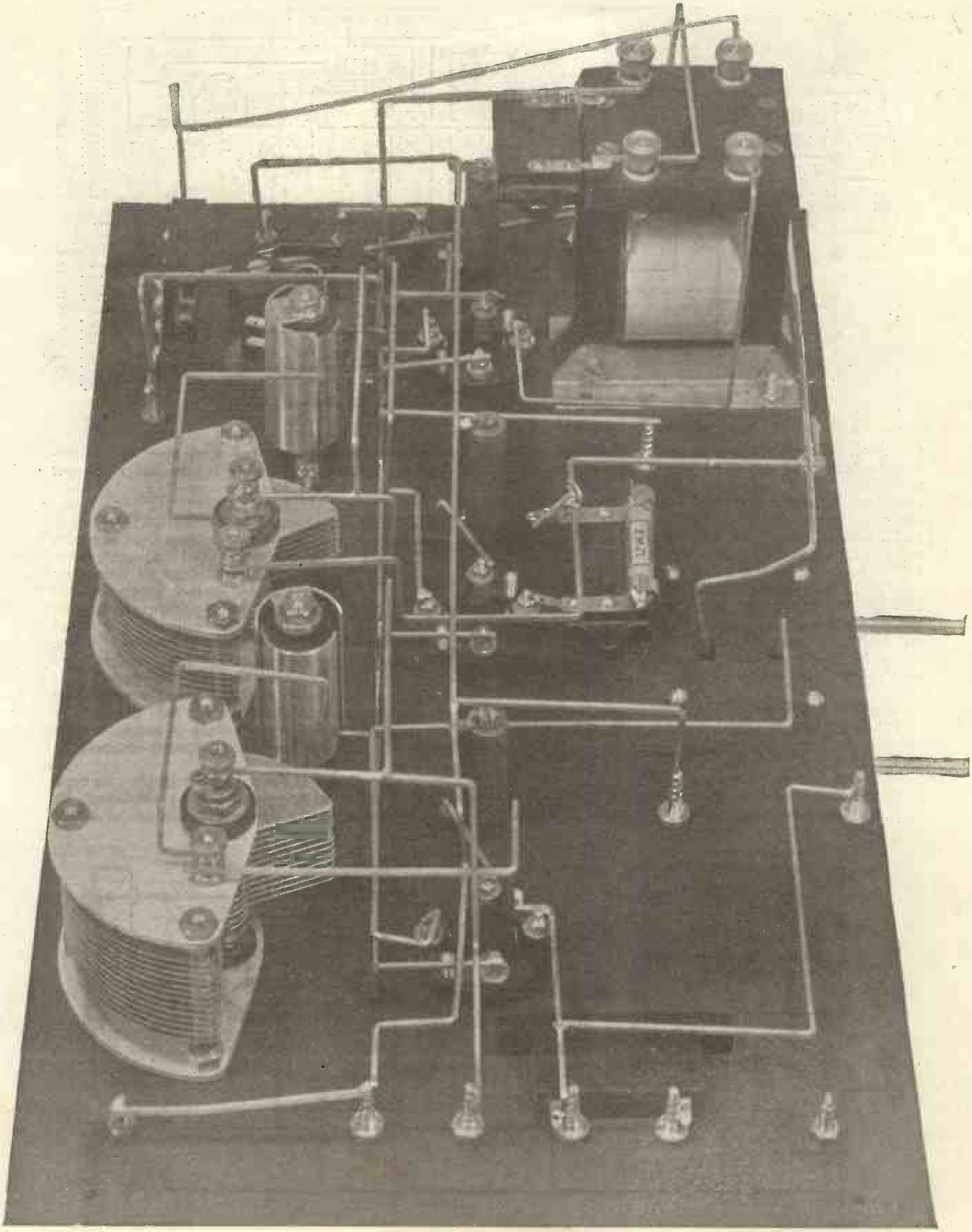


Fig. 4.—Everything revealed to the light of day.

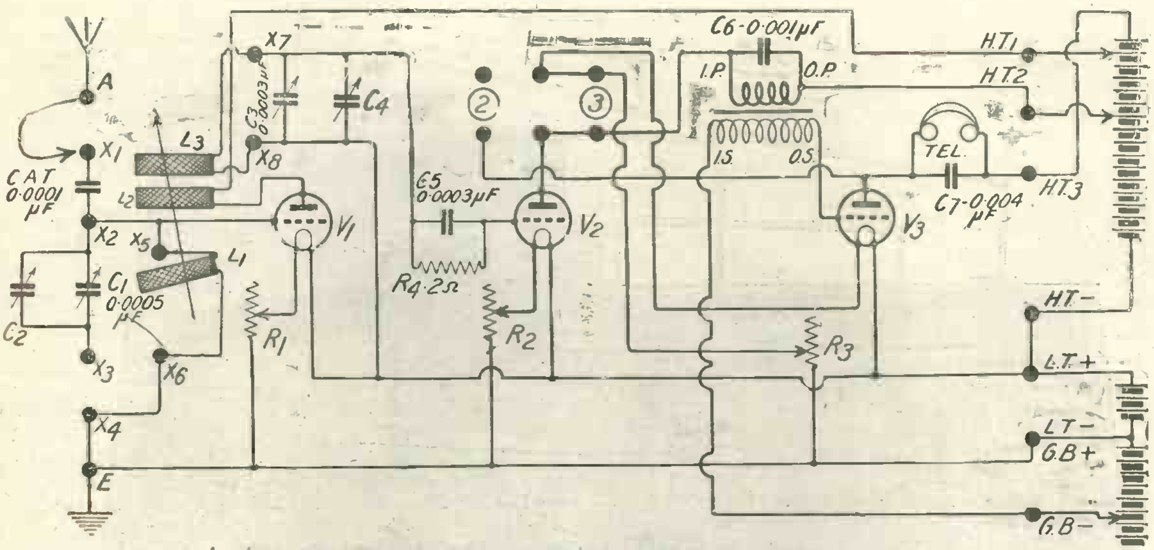


Fig. 5.—The circuit joined up to use all three valves.

three-coil holder; thus reversing the connections to L_1 has the effect of reversing the reaction. The coupling between the first and second valves is obtained by means of L_2 and L_3, the latter being the right-hand movable coil. These coils may be coupled closely together, but greater selectivity will be obtainable by separating them to some extent. A reversal of L_3 may be desirable, and provision for this is made in the same way as for L_1.

Components and Cost

A list of the component parts required to build this receiver will be found below, together with the retail prices, and it will be seen that all parts used are of the best quality, and the constructor is therefore advised to adhere as closely as possible to the specification given. He may, however, use such parts as he may already possess, provided they are of unquestionable repute and in proper condition.

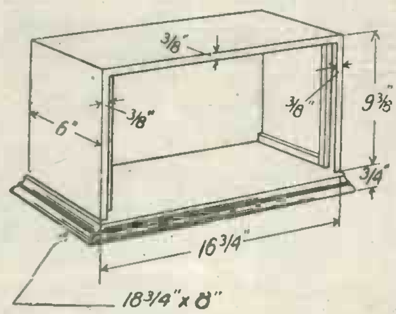


Fig. 7.—The box.

Notes on Components

The valve holders used are of a particularly good design, there being no possibility of damaging a valve by surface contact of its pins with metal parts of the socket, while capacity between the brass contact pieces is reduced to a minimum. The holders are mounted below the panel, the valve plugging into the usual four holes drilled in the panel. A drilling template is supplied with each holder to ensure accuracy of drilling.

If desired, any suitable wire type resistances may be employed, as these are now available for either

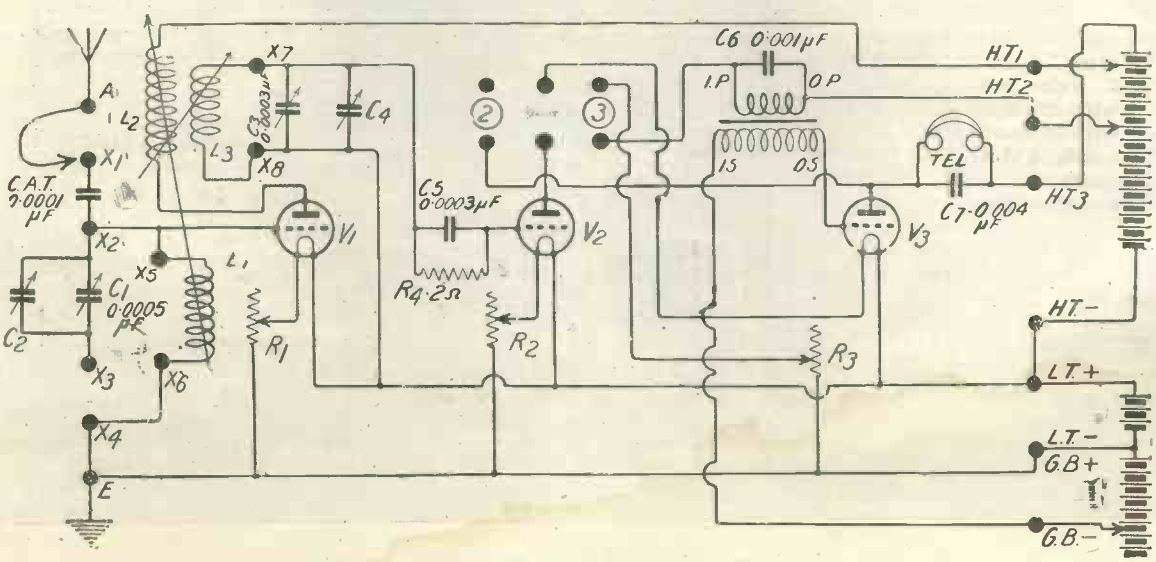


Fig. 6.—Simplified theoretical circuit.

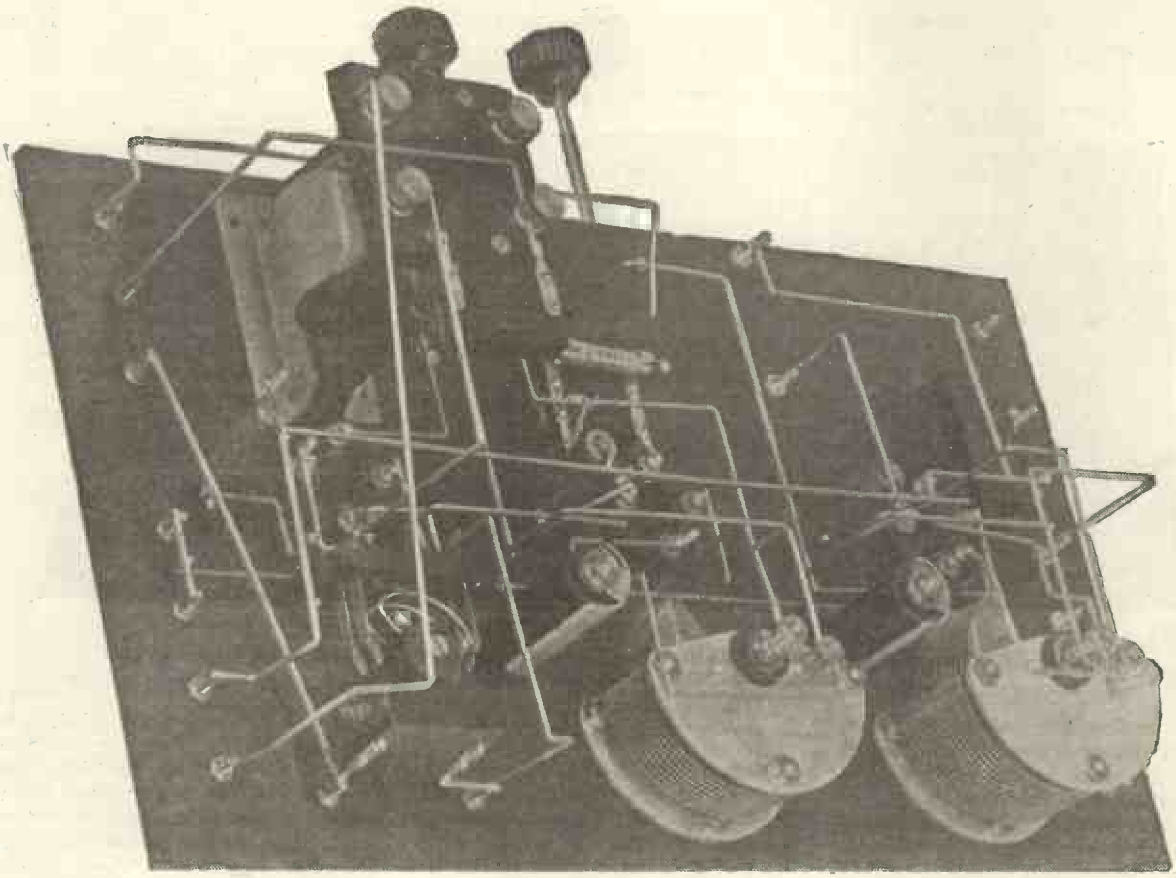


Fig. 8.—A perspective photograph for use when wiring-up.

Components.

Cabinet.
Panel, 9 in. by 16 in. by ¼ in. (Paragon, Peter Curtis, Ltd.)
2 0.0005 variable condensers (K. Raymond, new type with knob and dial).
1 Three-coil holder (Goswell Engineering Co., Ltd.)
3 Lissenstat minor filament resistances (Lissen Ltd.)
2 " Polar " micrometer condensers (Radio Communication Co.).
1 " Utility " 2-pole, 2-way switch (knob type) (Wilkins and Wright.)
1 " Tangent " L.F. transformer (Gent and Co.).
3 H.T.C. valve holders, type C (H.T.C. Electrical Co.).
7 Clix, with insulator and locknut, (Autoveyors).
8 Clix, with locknut only (Autoveyors).
11 Terminals, 4 B.A. W.O. type, (K. Raymond).
14 ft. square wire.
Dubilier condensers : one 0.0001 μF.
one 0.0003 μF.
one 0.001 μF.
one 0.004 μF.
Screws, rubber leads, etc.

bright or dull emitters. The panel, which is of ebonite, measures 9 in. by 16 in. by ¼ in. thick, and should be of the best quality. Unless the ebonite is guaranteed free from leakage the glossy surface skin should in all cases be removed, as it is most detrimental to the results obtainable. This skin forms a semi-conducting layer, and will seriously impair the efficiency of the receiver if allowed to remain on the ebonite. Fig. 11 is a scale drawing, showing the lay-out of the parts on the panel, and all the necessary dimensions are given for drilling the required holes. It is desirable to have all the component parts at hand before drilling is commenced, in order to ensure all the holes being of the correct size. Do not use a pencil on the panel when marking out, as the graphite will form a series of leakage lines across the panel ; use a sharp-pointed instrument, and mark out on the back of the panel, but do not become confused and mount up the parts the wrong way round ! Make a small ring round each hole of the smallest size to be drilled, and when these are finished, proceed in the same way with the next size hole. Much time and confusion is saved, and there is less likelihood of a wrong size hole being drilled. Fig. 2 is a photograph of the panel, showing how the parts are arranged, which should clear up any points of difficulty which may arise.

Mounting the Parts.

When all the necessary holes have been drilled, the various parts may be secured in position on the panel. To facilitate working, mount up the smallest parts first, leaving such relatively heavy parts as variable condensers and low-frequency transformer until the last. In this way the panel does not become so awkward to handle

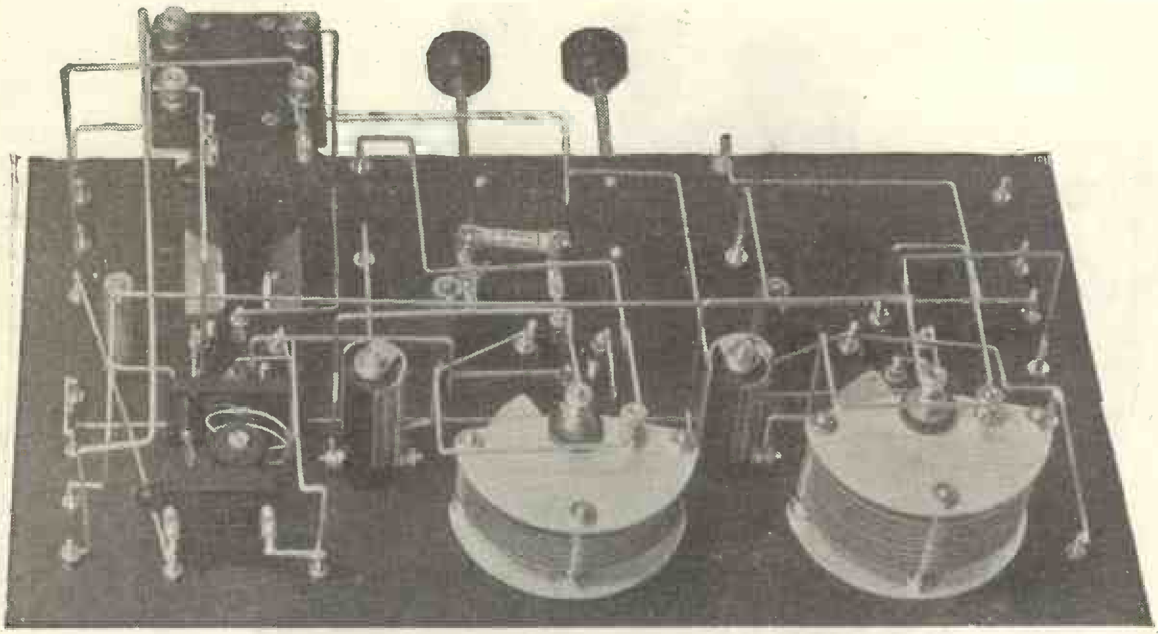


Fig. 9.—By providing pictures taken from several angles, we are able to help the constructor to make a faithful copy.

n the earlier stages of construction. The positions of the fixed condensers may be seen in the photographs of the back of the panel.

When everything is in position, it is advisable to run over all nuts with a spanner and make certain that all are tight, as ebonite contracts slightly under pressure, and a nut which was previously quite tight may be found to have worked loose in a relatively short time.

Wiring Up

Before the actual process of wiring up is commenced, tin thoroughly all places, such as terminal shanks, to which wires are to be joined, as this will make the actual soldering a much easier task. The wire, which is of square section, should be bent to the correct shape to fit exactly between a given number of points, using as little solder as possible consistent with safety and a good joint. A detailed wiring diagram of the receiver is given in the drawing, Fig. 12, and the wiring, seen from several angles, is made clear in the large photographs of the back of the panel, Figs. 8 to 10.

The Cabinet

The cabinet is of a very simple design, and will be found easy to construct from the dimensioned

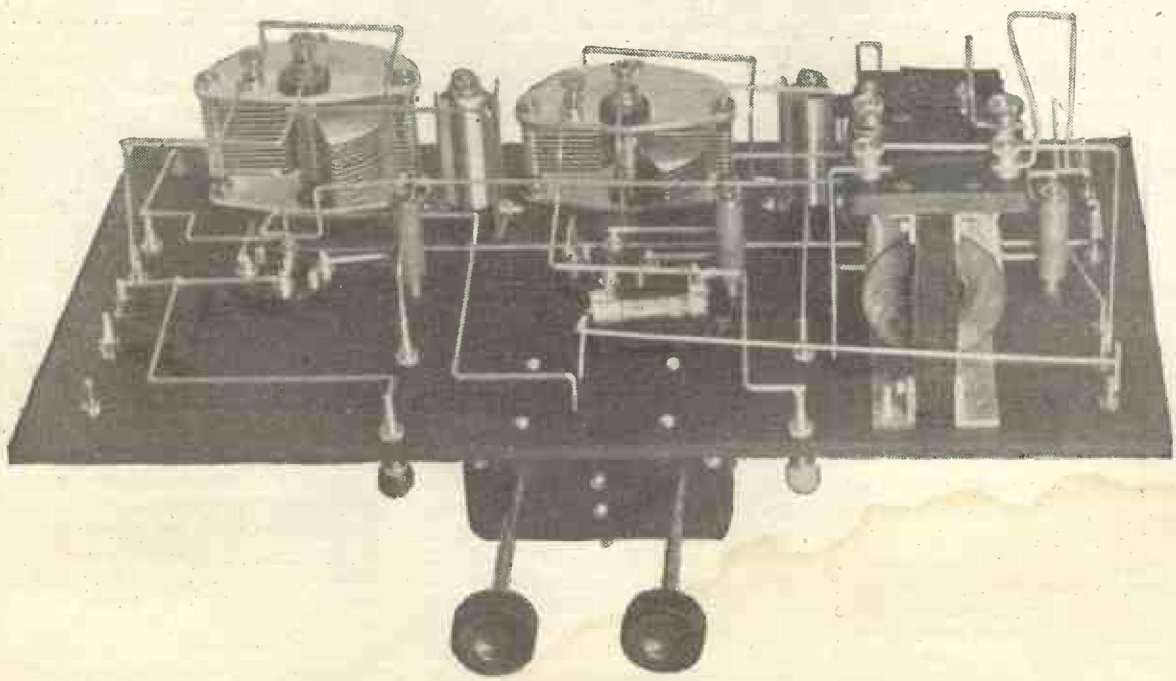


Fig. 10.—This shows just which wires need spacing and how.

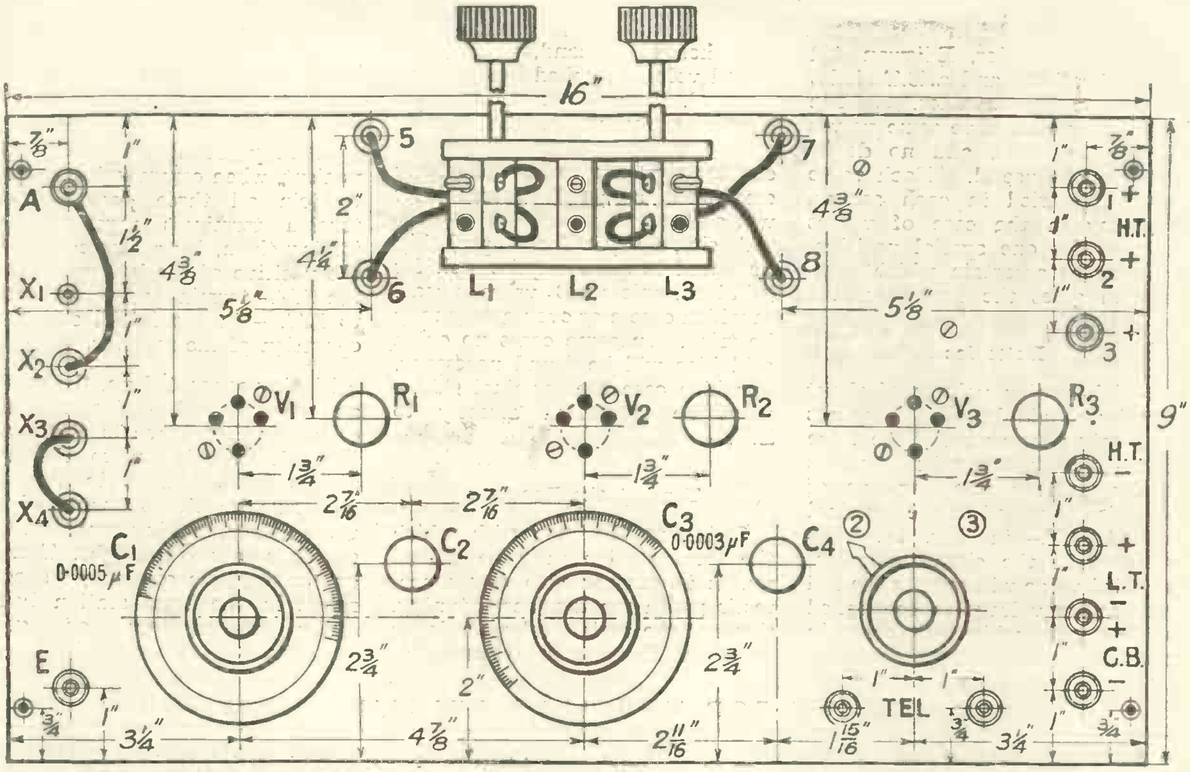


Fig 11.—The engraving chart and drilling diagram. You will find it worth while to use the new panel transfers.

drawing given in Fig. 7. Those who prefer may purchase the cabinet ready made. The work is carried out in ⅜ in. finished mahogany, and two ledges are provided at the sides, to which the panel is secured by means of wood screws, the holes for which are seen in Fig. 11.

Coils and Valves

For broadcast reception, when using constant aerial tuning, the aerial coil L_1 may be a No. 50 for wavelengths up to 420 metres, above which a No. 75 may be tried. This is the left-hand movable coil in the three-coil holder, the fixed coil being L_2, and the right-hand moving coil L_3. L_2 may be a No. 75, while L_3 may be a No. 60 or 75.

Any good make of valve may be used, and dull emitter valves will be found quite satisfactory. The writer found the following combination to give excellent results. Red Top Cossor for the high-

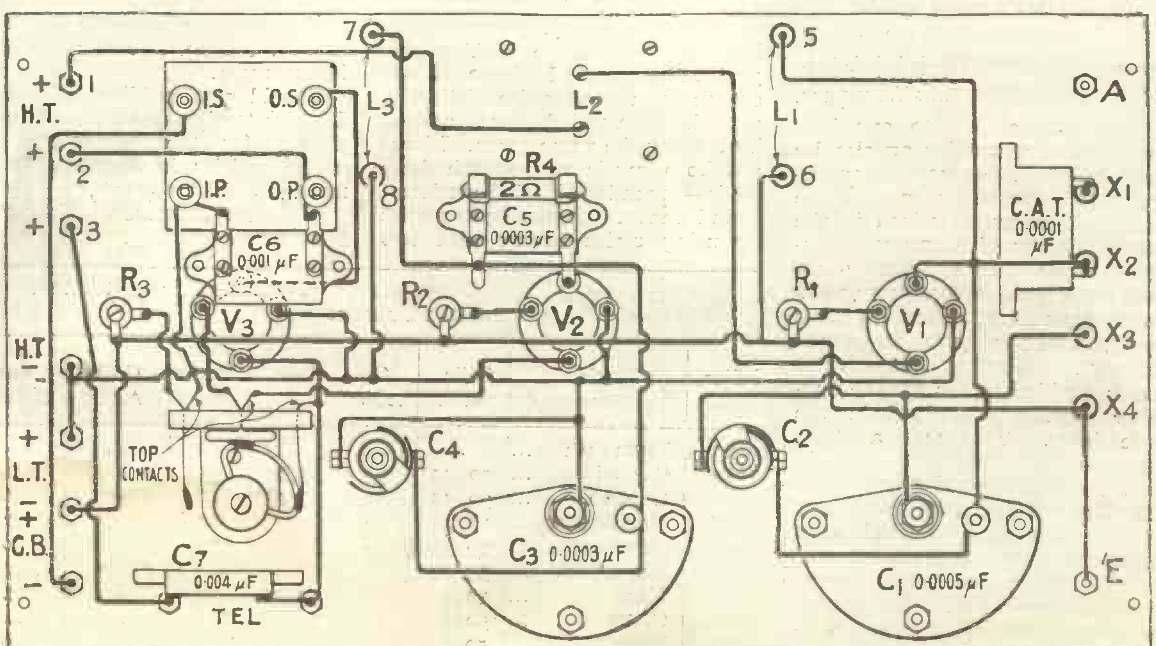


Fig. 12.—Practical wiring key to be used in conjunction with the previous photographs. Blueprints of Figs. 11 and 12 (Nos. 51a and 51b) 1s. 6d. each, post free).

frequency amplifier, Ediswan AR for the rectifier, and a B.T.H. B_4 for the note magnifier. The constructor may have some valves already on hand, and no doubt these will be useful. Each valve should be tried in each socket, excepting in the case of valves designed for one special position, in order to ascertain which combination gives the best results.

Batteries

A high-tension voltage of about 80 volts should be used, tappings being taken from each of the three H.T.+ terminals to suitable points on the battery, the negative of which is connected to the terminal marked H.T.– in Fig. 11. As indicated in the circuit diagram, the third valve will require the full high-tension voltage to be applied to its anode, while the next, in decreasing order, will be the first, and then the second, valves, the actual voltage applied being found by trial. A 6-volt accumulator should be used, with bright emitter valves, while if those of the dull emitter type are to be exclusively employed, a 4-volt accumulator will suffice.

A single dry-cell will probably be found to answer quite well for grid bias, unless a B_4 valve is used, in which case 2 or even 3 cells may be tried. In some cases no extra grid bias will be found necessary, in which case the terminal G.B.– must be connected directly to L.T. –.

Testing the Receiver

Owing to the ease with which the local station may be picked up, it is advisable to commence testing with constant aerial tuning. Connect the aerial and earth leads to A and E respectively, and join the flexible lead from A to X_1. The Clix sockets X_3 and X_4 must be joined together by means of the link previously mentioned.

It may be found more convenient, when commencing testing, to join all three *positive* high-tension terminals together, and joining them, by a single lead, to the positive of the battery; also, the G.B.– terminal may be shorted to L.T. – in the initial stages of operation of the receiver.

Having connected up, the valves and coils should be inserted, the coils being as shown in the table. Join the telephones to the terminals marked TEL in Fig. 11 and turn on the filaments of all three valves, making sure that the switch is over to the right. Tuning on the variable condensers should result in the local station being easily picked up at good strength.

TEST REPORT FOR THE "ALL-BRITAIN" RECEIVER.

Stn.	Aerial Coil.	Anode Coil.	Sec. Coil.	A. Cond.	Sec. Cond.	2-Valve.	3-Valve.
Radio Paris	150	250	200	114	154	Good Phone	Mod. L.S.
5 XX	150	250	200	90	135	Mod. L.S.	V. Loud L.S.
2 BD (C.A.T.)	50	100	75	85	78	Good Phone	Aud. L.S.
5 IT ,,	50	75	60	80	150	Weak Phone	Mod. Phone.
5 SC ,,	50	50	75	65	50	Mod. Phone	Aud. on L.S.
5 NO ,,	50	75	60	45	100	Good Phone	Mod. L.S.
6 BM ,,	50	75	60	42	85	Good Phone	Aud. L.S.
2 ZY ,,	50	75	60	40	82	Weak Phone	Weak L.S.
5 WA ,,	50	75	60	25	72	Weak Phone	Just audible on L.S.

GOOD RESULTS WITH A SIMPSON SET

To the Editor of MODERN WIRELESS.

SIR,—Just a line to say how much the construction articles by Mr. Herbert K. Simpson are appreciated. I started by building the Crystal Receiver, described in the March number of MODERN WIRELESS, and by listening intently in a quiet room could follow speech quite clearly from Birmingham (35 miles away), using a 100 ft. aerial outdoors. Wanting the signals louder I added to the set the one-valve amplifier described in the same issue. This was a great improvement, and 2LO came in faintly. When your June issue came out and I read Mr. Simpson's article, entitled "An Efficient Single-valve Receiver," I felt that I could get much better results with my one-valve. I therefore constructed that set, using a Marconi D.E.R. valve. Birmingham now comes in almost too loud on the 'phones, and I have received speech from all the British stations except Sheffield, Liverpool and Edinburgh—the lower wave lengths. My longest distance is Aberdeen, 315 miles, and I have heard speech from there quite distinctly, and have verified that station by hearing the name given. I have got both music and speech from Paris—310 miles—Ecole Superieure. I find that I get the best results by using series tuning with two 75 coils. By reference to the chart enclosed you will see I have given the three methods of tuning a good testing. The chart may interest you.

Should you publish this letter I desire to sign myself, with many thanks for the interesting and useful articles in MODERN WIRELESS—Faithfully yours,

AN INTERESTED NOVICE.

Leicester.

		Constant Aerial Tuning.		Parallel.		Series.	
Miles.	Station.	Coils A.R.	On .0005.	Coils A.R.	Deg. on .0005.	Coils A.R.	Deg. on .0005 Condr.
205	Plymouth ...	...	...	35/75	20	...	...
120	Cardiff ...	50/75	32	35/75	34	75/75	20
90	London ...	50/75	42	35/75	46	75/75	26
75	Manchester ...	50/75	50	35/75	62	75/75	32
140	Bournemouth	50/75	56	35/75	78	75/75	40
310	Paris, E.S. ...	35/75	86	...	...	75/75	44
160	Newcastle ...	50/75	66	35/75	96	75/75	52
255	Glasgow ...	50/75	78	35/75	118	...	...
35	Birmingham ...	50/75	112	50/75	48	75/75	150
315	Aberdeen ...	50/75	122	50/75	60	...	...
	6MJ Leicester	...	...	...	...	75/75	62

In passing

A Beauty Chorus

NO doubt you spent long hours in rapt contemplation of the portraits of the Staff which appeared in last month's issue of MODERN WIRELESS. But did you realise that as you gazed upon that galaxy of manly beauty you were beholding in one of the pictures the features of the Listener-in? I do not expect that you did, for quite between ourselves that photograph does not do me justice. I wish to make a point of this on account of the exceedingly rude remarks which it evoked from the assembled Staff when I bore it into the office one day in response to an urgent telephonic request from Mr. Hercy Parris. If you will believe me I was told, just like that, (a) that it has been very skilfully touched up; (b) that my nose had been improved out of all recognition; (c) it made me look years younger than it had any right to do; (d) that I looked in fact quite a decent fellow in it. Naturally one met the majority of these demonstrations of jealousy merely with a lift of the eyebrows, with a well-bred shrug of the shoulders, or with a graceful wave of the hands. Still, when they had all finished, which did not occur for some time, I explained that I at any rate was not one of those who were perpetually running round to the photographer. When I was asked for a photograph I made a hasty search into the family chamber of horrors and could discover only four portraits of myself taken during the last few years. The first showed me helping my family to enjoy themselves by assisting in the construction of a castle on the sands. This, though the likeness was excellent, seemed hardly suitable for inclusion in a gallery containing a staff of serious-minded experts (though with a few slight alterations it might have been made to represent me burying my earth!). The second I fear was quite hopeless. It was taken by an ex-friend during a short leave in the Great War. I had just returned to the deck of his sailing-boat after a refreshing plunge in the ocean when he snapped me garbed in a cap, khaki, field service, officer's, a cigarette and a fishing rod. The third, which showed me mounted upon my steed and about to depart for a chase on a hunting morning, had neither a wireless nor an intellectual atmosphere and there was therefore nothing for it but the fourth. This I must tell you in confidence was a real studio portrait taken several years ago. In it the photographer had certainly done his best, and I was duly grateful to him. I do not think though that the outburst which I have already reported was called for. It is strange to notice how jealousy can warp even the sunniest natures.

How to Distinguish

But you, reader, who are a person of taste, discrimination and refinement, will not have the slightest difficulty in identifying me at once. You will naturally select the most intellectual of the dials depicted: your eye will fall upon the lofty brow and the nobly shaped head which marks me out at once from all the rest. If Nature has bungled a little over the rest you will say in your kindly way, "Ah, well, we cannot have everything. It would be too much to expect a combination of such a brain and perfect beauty." That is just what you did say? I thank you very much. It is pleasant to come across kind words now and then, even if one has to write them oneself.

More Portraits

It occurred to me that if you were given merely the portraits of the official Staff and no more, a great gap would be left, for I am sure that you would wish to be able to visualise the features of what I may call the unofficial Staff who have done so much for the advancement of wireless in these pages. I refer of course to those great and noble fellows the members of the Little Puddleton wireless club. Is Professor Goop to be to you a name and nothing more? Are you never to know anything of the appearance of Poddleby? Would life be worth living if I were not to give you portraits of General Blood Thunderby and Admiral Whiskerton Cuttle? "No!" I hear you answer, "No, a thousand times no!" and with this reply ringing in my brain I have taken immediate steps to remedy the omission in our last number.

Our Need

It is unfortunate that Little Puddleton possesses no photographer. We are a thoroughly go-ahead town in most respects, for we have seventeen wireless shops, and I believe that there is a grocer, a butcher and other necessary if unpicturesque people of that kind. But personal vanity has never been a local characteristic, and though many photographers have made an attempt none of them has even succeeded in flourishing among us. The *Little Puddleton Gazette* did at one time start a series of portraits of local celebrities, but as its printing plant is not very up-to-date there were of the smudgy order, which made the photograph appear as though it had been taken at long range in a London fog. In fact, I am not sure that the same block was not used for all of them. The matter was therefore rather difficult The only thing for it seemed to be to call in the services of an artist fellow to ply his pencil. Little Puddleton cannot boast one amongst its inhabitants, but in the neighbouring township of Bilgewater Magna dwells no less a person than Sempronius Vandyck Tittlesworth, whose flowing mane points him out at once as no small potatoes in the great world of art. I know that Tittlesworth is a first-rate artist, for on the few occasions on which we have met he has told me so most emphatically. Only the other day he bore off against all comers a prize of £50. The prize, it was true, was given by one of our popular newspapers for supplying the last line of a limerick, but that is beside the point. If it proves any-

thing it proves that the really great are always versatile.

Our Difficult Warrior

I suggested therefore to the members of the club that we should hire a charabanc and journey to Bilgewater Magna in order that Tittlesworth might immortalise them. This proposal I regret to say met with very poor response, everyone pleading either modesty or a previous engagement. The only thing for it was to invite Tittlesworth to stay with me for a day or two and to turn him loose into the streets of Little Puddleton so that he might catch our celebrities on the wing, so to speak, and transfer his impressions to paper. The process was a little trying to myself, since I had to harbour the artist and whilst I wished to converse about wireless and of sensible topics of that kind, his only desire was to talk of Tittlesworth and art. However, by driving him forth as often as possible in search of victims I managed to survive. The results of his labours are here for you to see.* I can assure you that each is a lifelike portrait of the subject. The only person who has so far seen Tittlesworth's sketch of him is General Blood Thunderby, who, instead of being flattered, went off into one of his nasty tantrums on beholding it. The things that he said produced an unparalleled outbreak of atmospherics in the neighbourhood. He departed hot foot for Bilgewater Magna in search of Tittlesworth, but the artist having had some experience of the effects of portraiture upon the human temper had wisely decided to spend his fees and his summer holiday in Iceland, to whose distant shores he had removed himself before the General descended like a wolf on the fold. I understand that a barricade is to be erected in Devereux Court on Wednesdays for the next few weeks, that being the day upon which cheap return tickets are issued from Little Puddleton to the Metropolis. If the General should happen to get through or under the barricade a loud-speaker demonstration will no doubt take place.†

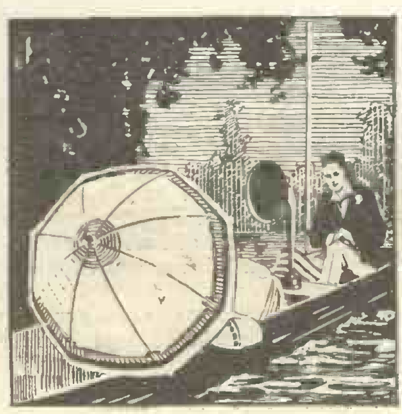
You will I think agree that Little Puddleton has produced in her sons a wondrous company of noble types. Gaze upon the noble brow of Professor Goop. Observe how the constant application of the telephones has eradicated his once flowing locks. Notice how his trousers bag at the knees, a sure sign of the true scientist, produced in his case chiefly by grovelling under the table to find a wanted socket in the high-tension battery with a wander plug. His shoulders have the academic stoop and on his forefingers and thumbs are condenser corns. General Blood Thunderby's countenance shows you that he has lived in Eastern climes,

sacrificing his liver for his country. You see that he is a man who will never allow himself to be defeated by any wireless fault, however abstruse. I have known him dismember entirely a five-valve set to discover what was wrong with it, and I have fled before his wrath when he found that its dumbness was due to his failure to connect the aerial. But I will say no more of the fine portraits which I present to your delighted eyes. They speak for themselves and will show you just what the members of a go-ahead wireless club ought to look like.

Ambition

The kind of fellow I admire more than I can tell you is the chappy who wrote to a wireless paper not long ago to ask them to give him full particulars of the wavelengths and call signs of the Australian broadcasting stations. This was a really kindly thought for that genial and ingenious soul the radio-longbowist, who has been having rather a rotten time of late. When the reception of broadcasting from across the Herring Pond first occurred splendid fields w re opened to him, for he could always astonish you by wonderful tales of what he had accomplished in the chilly small hours of the previous morning. But then this kind of thing became commonplace. Everybody did it. Even the one-valve set was found to be capable of picking up transatlantic items. As no one was bold enough to claim to have heard WGY on a crystal it seemed as though all wireless men would have to confine themselves willy-nilly to the straight and narrow path of strict truthfulness, which would have been a thousand pities, for if you cannot give your imagination a loose rein at times all romance vanishes. There was a sad period of depression when there were practically no wonderful feats left for the radioliar to report. Things brightened up a little when Jugo-Slavia and Czecho-Slovakia and places like that began to broadcast, for you can always arouse a little enthusiasm by reporting that you had received Kczw.spskoff most clearly on the previous evening. In fact you could invent all sorts of names that sounded like atmospherics, and if your audience said that they had never heard of these stations you had only to glance pityingly at them and say that they were rather behind the times. But now even this source of supply has been cut off, for all European stations have been tabulated, and everybody is getting them. But Australia! Surely this is a stroke of genius, and new hope arises in our breasts. I am wondering who will be the first man to report that he has heard a concert from Melbourne or Sydney. He will be a brave fellow, and I think that a huge statue of him should be erected to form one of the aerial masts of Bush House. I only wish I dared.

THE LISTENER-IN.



* "No, they are *not*."—ED.
"Why not?"—CONTRIB.
"My good man, we cannot print *those*."—ED.
"Oh!"—CONTRIB.

† That's why we are not taking risks.—ED.

A Crystal Set.

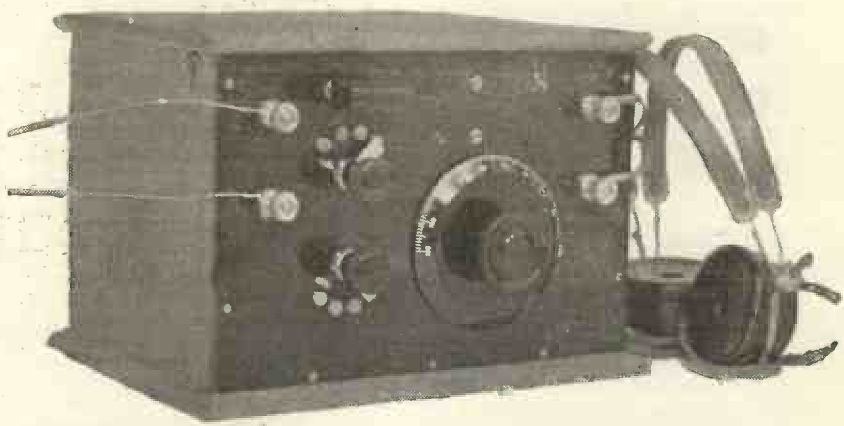
By PERCY W. HARRIS.

An article in which the author describes a new receiver with which he has obtained louder signals than with any other crystal set.

A READER who prides himself on the turn of a phrase remarked recently that the chief charm of Wireless lies in its infinite variety. Of the making of sets there seems no end, and even the humble crystal receiver is capable of many variations. Those of us who spend a great deal of time in experimenting are naturally prone to modify our ideas from time to time as new facts come to light, or as new emphasis is thrown upon some aspect of the subject by the latest experiments. The new crystal receiver about to be described is really well worth making, even if you already have a crystal set, for it includes several new ideas and possibilities without any great complication.

Most experimenters are beginning to realise that there is no one set that will give first-class results on every aerial. So far as crystal receivers are concerned one man may find a variometer instrument suits his case, and another will swear by a condenser-tuned arrangement. As a receiving station must be considered as a whole, including aerial, earth and every part of the apparatus, accurate comparisons are difficult, so that the fact remains that sometimes a set seems to "match" an aerial in quite a remarkable way, whereas in other circumstances it might not work quite so well.

The chief virtue of the present crystal receiver is that it is capable of several different adjustments to suit different aerials. It can be used, for example, as an ordinary circuit crystal receiver in which the whole of the inductance is in the aerial circuit, shunted by a variable condenser across which the crystal and telephones are connected. If with a given aerial the whole of the inductance is too great for the wavelength it is desired to receive, a portion of it can be cut out, and either two-thirds or one-third of the whole inductance used. Furthermore, by an equally simple change we can arrange for the whole of the inductance to be in a closed circuit and only a portion of it (one-third or two-thirds, as is desired) in the aerial circuit, thus providing us with an aperiodic or semi-aperiodic coupling which in many circumstances proves highly efficient. The particular switching arrangement used also facilitates connecting the aerial directly to the earth—always an advantage when the set is left for some time. All recent experiments have indicated the importance of low-resistance and low capacity coils for reception.



The crystal detector itself is contained within this box.

In the present instance the coil is of low ohmic resistance and very low self-capacity, while compactness is achieved by winding the coil in three slots on the special former which I first introduced to the wireless public in *Wireless Weekly* some months ago. The former is very simply made from two strips of ebonite $1\frac{1}{2}$ in. wide, 6 in. long by $\frac{1}{4}$ in. thick. In the middle of each of these pieces is cut a $\frac{1}{4}$ in. slot for half of the width of the strip so that the two pieces can be fixed together at right angles, egg-box fashion.

After the strips have been cut and before they are joined together it is necessary to make three cuts at each end of each strip for a depth of $1\frac{1}{2}$ in. These slots must be wide enough to admit of a single turn of No. 16 D.C.C. wire. (Do not try and substitute a finer wire for this, as much of the efficiency of the set depends on the use of this thick wire.) You will find that if you take two hack-saw blades side by side and grip them in the hack-saw frame that the double width slit now made will just take the wire. If it is not convenient to use two hack-saw blades together then you can

The coil is specially wound with very thick wire.

make the slit wide by making two cuts very close to one another.

Winding the Coil

No. 16 D.C.C. wire is best bought in a large hank and not wound on a small bobbin, as it is very thick and easily bent out of shape. There is quite a knack in using this thick wire for winding coils. The best way to proceed is to invoke the aid of an assistant who can take the coil in his hand and rotate

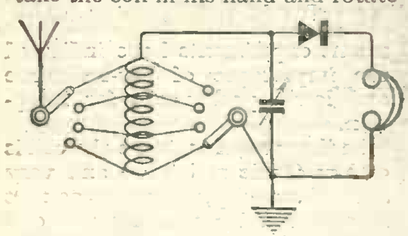


Fig. 1.—The theoretical diagram.

it slowly, paying it out to you as you need it. With your assistant handy, take one end of the wire, pass it through one of the outer slots and give it a sharp bend at right angles to grip it in position.

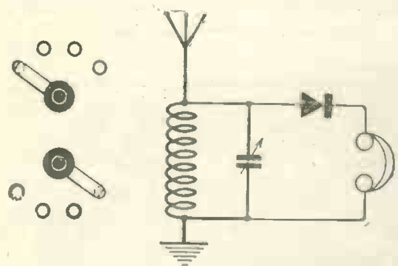


Fig. 2.—For longer waves.

Now rotate your coil and wind in 20 turns in the first slot. When the 20th turn is reached carry on in the second slot, and when you have wound a further 20 turns, pass on to the third slot, into which the last 20 turns is wound.

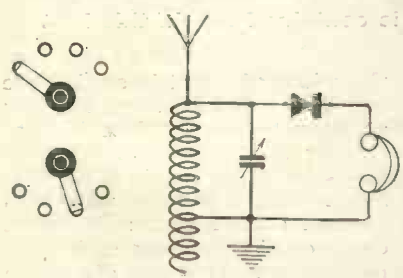


Fig. 3.—For shorter waves.

All three coils are of course in series, wound in the same direction. At the end of the third set of 20 turns cut off the wire, leaving a few inches projecting and bent to the right to keep the coil in place.

Coil Tapping

You should not use any shellac or wax on this coil. Leave it quite dry. Now scrape a little of the cotton covering off the wire at the end of the first 20 turns and at the end of the second 20 turns. When the insulation is scraped away for about a ¼ in. clean the wire and tin it with the soldering iron. Tin also the ends of the coil. Now set the coil aside while you proceed with the other work.

Components Required

So far I have not given you a list of components. Here they are :—

One box with lid as shown in the illustration, measuring 9 in. by 5¾ in. by 5¾ in. (interior).

One ebonite panel for same 9 in. by 5¾ in. by ¼ in.

One variable condenser .0005 mfd. (Sterling square law is used here, but any good make will do).

One good quality crystal detector with cat-whisker and crystal (that used is a pattern known as the "Kupee" made by Quality Products of Hyde).

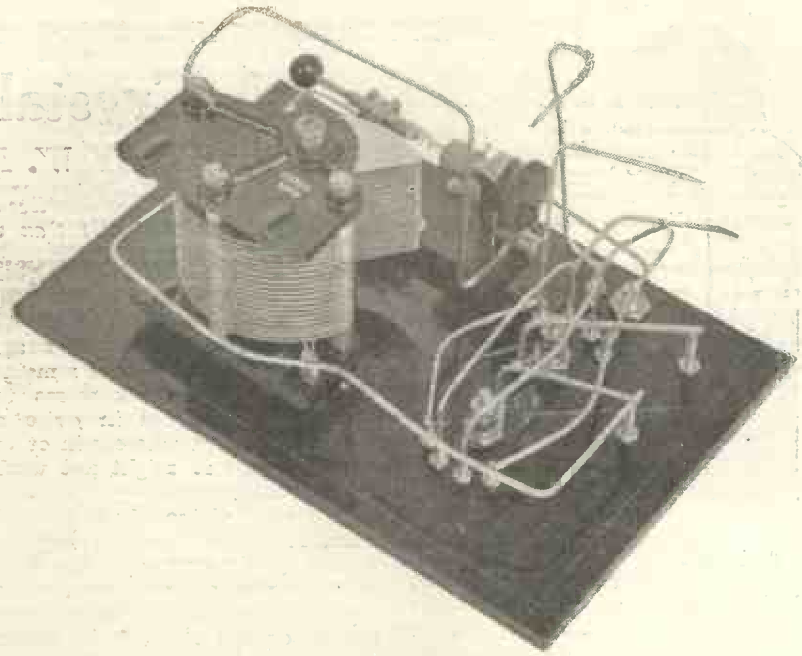
Four terminals.

One socket for plug-in coil.

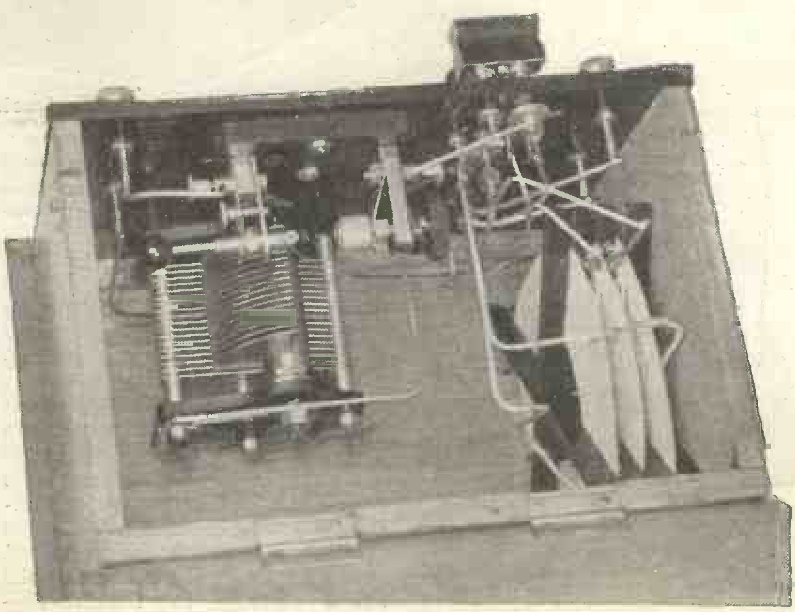
One short-circuiting plug (Ediswan).

Four terminals.

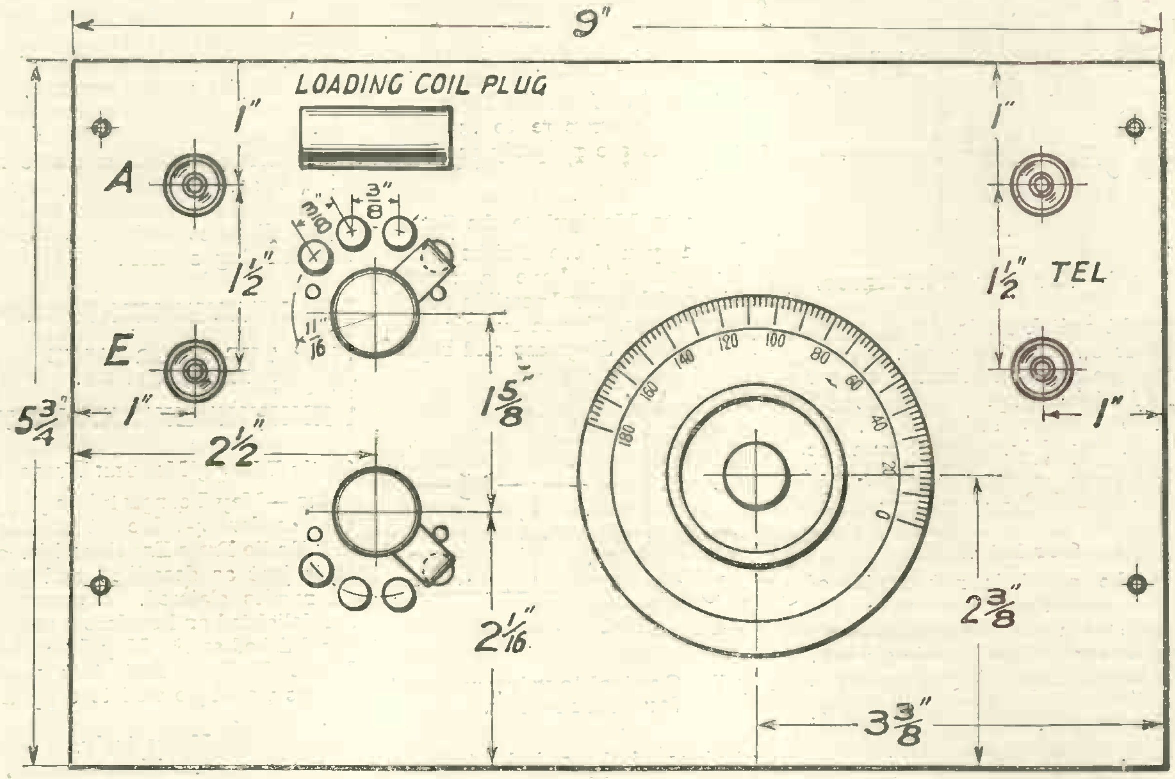
Two switch arms.



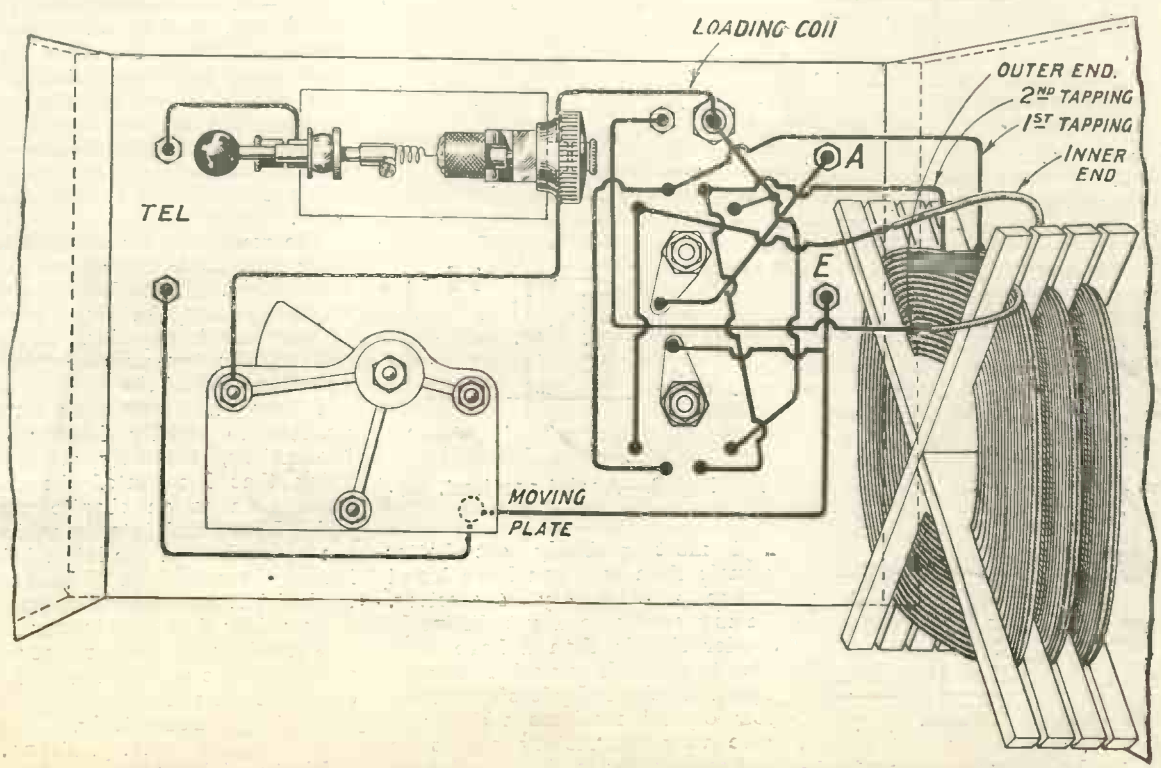
Back of panel without coil.



The complete assembly with lid open.



Drilling chart for front of panel. The loading coil short circuiting plug is withdrawn and a No. 150 coil of any recognised make inserted in the socket when it is desired to receive 5XX.



Back of panel and wiring diagram, showing the connections of the coil. Notice that the upper and lower switch studs are in parallel. The moving plates of the condenser should be connected to earth.

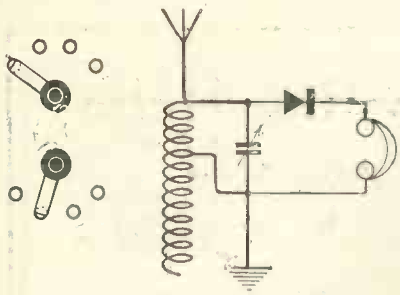


Fig. 4.—For very short waves.

Eight switch studs.
Four switch stop studs.
Square section tinned copper wire for joining up.
Two ebonite strips 6 in. by 1½ in. by ¼ in. (wood can be substituted if desired here).
No. 16 guage D.C.C. wire.

Starting Work

If the panel is not made of guaranteed ebonite remove the surface skin on both sides with fine emery before starting work. The actual disposition of parts can

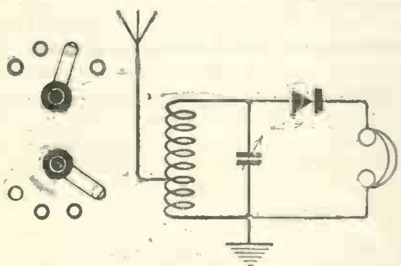


Fig. 5.—Semi-aperiodic aerial coupling.

be seen from the illustrations. It will be noted that the switch study on the upper and lower switches are in parallel. When all of the parts on the panel are mounted and joined up you will have four further connections to make to the square coil. You can now screw the ebonite panel to the front of the box and stand the square coil within the box as shown, not troubling to attach it to anything. If you now take

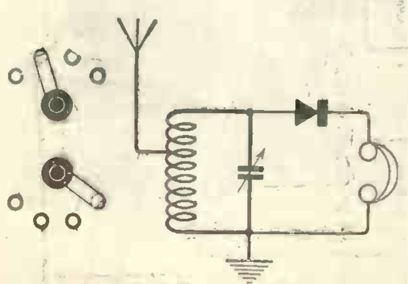


Fig. 6.—Another semi-aperiodic arrangement

the four wires indicated to the coil itself the stiffness of these wires will hold the coil in position. Notice that the coil is joined at each end and at points one-third and two-thirds from the beginning. Take particular care to see that connections are properly made as shown.

How to Manipulate the Set

When you have finished this work you will have a crystal receiver with several possible circuit arrangements. From examination of the simple diagrams and repre-

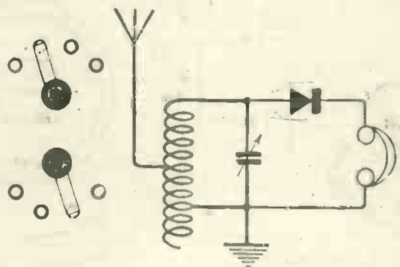


Fig. 7.—Central tapping method for short waves.

sentations of the switch studs to be used, you will gather what can be done. You are recommended to try out every arrangement to see which is the best on your aerial. The set has been tried out by several members of the staff of Radio Press as well as myself, and different switch arrangements are found to suit different aerials.

If you make the set exactly as described with good quality components and with No. 16 wire, you

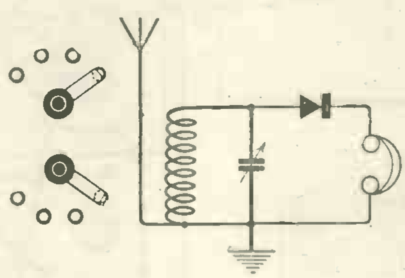


Fig. 8.—Aerial earthed.

will most probably get better signals than any you have heard before with a crystal receiver. In my own case I get distinctly louder signals than I have been able to get with any other arrangement. Incidentally it is one of the few crystal receivers which will give very satisfactory results on 200 metres, for receiving which the arrangement No. 7 is recommended.

Let Us Know Your Results

All readers who satisfactorily construct this set are invited to report the results they obtain, and which of the several arrangements best suits their own conditions. When reporting it will be of value if readers will give particulars of the aerial used, (whether it is indoors or outdoors) and the exact distance from the nearest broadcasting station.

THE FOUR-VALVE FAMILY SET.

To the Editor of MODERN WIRELESS.

SIR,—May I congratulate you on the excellent 4-valve set explained in "Radio Press Envelope No. 2." It is just as described and gives all results claimed. I personally am delighted and enclose a snap of my finished set.* May I add that I got Radiola first test made. Others would do well to copy this set.

Yours truly,
E. MITTERSHEAD.

Erdington,
Birmingham.

[*Not reproducible.—ED.]

To the Editor of MODERN WIRELESS.

THE 4-VALVE FAMILY SET.

SIR,—In accordance with your request on page 12, of "How to Make and Use" the above set, I have much pleasure in informing you that I have recently constructed the set and am highly delighted with it, particularly in view of the fact that this is my first attempt at wireless constructional work.

The results so far obtained are truly remarkable, the volume being tremendous. I have had a 3-valve set since January, but the "Family" is very much superior. In fact reception on two valves is almost equal to that of the 3-valve set.

I have endeavoured as far as possible to strictly follow your instructions, the only alteration being that I mounted the components on to an ebonite panel which I have sunk into the cabinet, the dimensions of the latter being increased accordingly. I have also used "Eureka" transformers.

I consider that your instructions and drawings are so clear that anyone should be able to successfully construct the set.

Yours truly,
A. J. FARRA,

Wentworth Road,
York.

How Broadcasting Helps the Experimenter.

By A. R. BURROWS, Director of Programmes, British Broadcasting Company.

Many people are under the impression that broadcasting has placed many restrictions upon experimenting. In this article Mr. Burrows removes a number of doubts on this matter.

DO you find as an experimenter that broadcasting hinders you in your research ? I ask this because we have been from time to time the recipients of complaints concerning the hours and length of our transmissions.

Whatever may be your answer, I am certain that broadcasting will prove in the long run to have been the experimenter's greatest friend.

My belief is based on two main facts.

Broadcasting has already popularised wireless science generally to an extent undreamt of even by those intimately associated with wireless development.

New Fields

Broadcasting has created many new problems for the experimenter. It is providing new fields for conquest, and in so doing is training many in a way which will prove helpful in after life.

Some, perhaps many, who are reading this may be looking forward to a wireless career. Has it occurred to you how much larger will be the field for your activities now that every other person has a wireless interest ? How few persons, relatively speaking, have sent their messages to foreign countries by wireless, being ignorant and, therefore, suspicious of the claims made for wireless transmission. In future wireless will be a popular channel for communication. It will, therefore, provide employment for engineers and operators and inventive minds. That there is almost unlimited scope for research on the commercial side is instanced by the fact that whereas until recently the majority of wireless engineers were concentrating their energies upon the building of high-power stations, employing long and lofty aerials and ever-increasing wavelengths, there is now a growing interest in the possibilities of short wavelengths and low-power transmitters, used in conjunction with reflectors. If the new practice justifies itself, then it would appear that Senatore Marconi was at no time nearer success than in his very earliest days when he employed metal reflectors behind his transmitting and collecting surfaces.

Outstanding Problems

I think you will agree that broadcasting has stirred up a very useful interest in wireless generally. What, then, are the problems requiring solution ? Let us take those which broadcasting has emphasised.

Standing high above all others is the question of interference—interference between the broadcasting stations themselves, and the interference with the broadcast programmes by spark stations and harmonics from continuous-wave stations.

Could one wish for greater scope for experiment than the elimination of this trouble ? It covers aerials, tuners, the design of valve detectors, amplifiers and what not.

Aerial Design

Do not think for one moment that the last word has been said on aerial design. There are many aerials in use to-day which, although theoretically non-directional in character, are giving most marked directional effects. It is not so many years ago that a high aerial and good earth were regarded as absolutely essential for receiving purposes, when, to the astonishment of nearly everyone, it was found that, provided an amplifying instrument was employed to compensate for the weakness of the received signals, there was no absolute necessity for high aerials and good earths, but that excellent reception could be obtained by means of a few turns of wire around a wooden frame, provided that the edge of the frame was turned in the direction of the oncoming signals. This discovery was followed, as one would naturally expect, by all sorts of experiments to ascertain how small a frame might be employed.

Early Broadcasting

I remember well the excellent results obtained in London when listening to the Chelmsford high-power station of 1920 with a frame aerial which could be secreted in the back of one's coat. The amplifier, however, was one of seven valves, and, despite the fact that it was fitted in a small suit-case, was really outside the limit of portability. To-day, of course, there are several designs of really portable sets which would give good signals with such an aerial.

The directional properties of the frame aerial led to all sorts of other important developments, notably the construction of direction-finding stations for navigational and warlike purposes. The heavy curtain which has been drawn about the part played by wireless in the Great War may never be fully lifted, but we do know, on the authority of Admiral Sir Henry Jackson, who was then Admiral of the Fleet, that the observations made with wireless direction-finding stations, by Capt. Round and a body of highly-skilled assistants, were indirectly responsible for the Battle of Jutland—an event which had been sought by our Fleet for nearly two years.

Frame Aerial Limitations

Whilst the frame aerial has many uses, it also has limitations. It is valueless, for instance, for cutting out interference when the interfering station lies, say, in a westerly direction and the station which it is desired to receive in an easterly direction. The frame aerial, therefore, gives little assistance to an experimenter at Eastbourne who wants to receive Bournemouth and cut out Boulogne.

This form of aerial, however, proved to be a stepping stone to something still richer in possibilities, an aerial which is highly sensitive to signals coming in one direction but almost insensitive to those coming in the diametrically opposite direction. It is actually a combination of a frame aerial with a vertical aerial, and has what are described diagrammatically as "heart-shaped characteristics." These aerials are being constructed for commercial purposes, but so far have played only a small part in the work of the amateur experimenter.

The point I would drive home in this connection is that even this latter aerial is by no means the last word, and there is a most useful field for research not only along "highly directional" lines, but in the simplification of these, at present, somewhat complex devices, so as to bring them within the requirements of the man in the street. The establishment of broadcasting stations at almost all points of the compass within these islands cannot be otherwise than of assistance to the experimenter who cares to concentrate upon aerial problems.

Then we come to tuning processes, and particularly to the tuning which is possible between the several valves used in a receiving circuit. It is well known that intervalve transformers can be constructed so as to be particularly efficient on a specific wavelength. What fascinating work is offered to the experimenter who concentrates on "the Himalayas of the transformer world"! What useful assistance is given by the many broadcasting stations operating in the 300-500 metres wave band!

A recent wireless outing by the combined Golders Green, Hendon, Hounslow, Hampstead and St. Pancras Wireless Societies. On the left: A portable set. Above: The transmitting car.

Time Signals

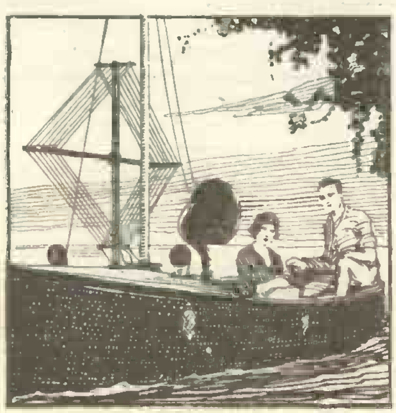
How fine a field, too, our broadcast time signals open up for research in wireless control. To what number of persons has it occurred that a device might be constructed which, responding only to the six squeaks from Greenwich, will operate all sorts of mechanism? Is it too much to anticipate the day when some ingenious experimenter in this country will come forward with a "calling device" which will secure wirelessly a prompt "turnout" by everyone to whom

early rising is essential? In that day the B.B.C. will undoubtedly be willing to play its part and commence its programme with the cock crow. Don't run away with the idea that thousands of pounds are required for the production of models. It is astonishing what can be done with a metal-cutting fret-saw, a few files, a soldering iron and the infinite capacity for taking pains which is said to constitute genius.

True Experimenter's Work

The true work of the experimenter, as I see it, is to welcome difficulties with a view to mastering them. He should not moan because a new station in which he has no interest puts in an appearance next door but one. He should argue rather, "I am going to cut that fellow out," and should work unceasingly until he has succeeded. Close application to one task is the finest possible training for an inventive mind.

So far I have dealt only with the problems set by broadcasting for individuals. I feel that there are others in which team work could show to advantage. We still know very little about the source of atmospherics, the relation of these disturbances to local weather, the causes of fading, and such like. I can imagine that in the not distant



future experimenters will be detailed off by their local wireless societies to take part in national schemes for the collection of data bearing on these things. How much more interesting will this research become through the broadcasting of weather forecasts and other factors related to the work in hand.

Useful Hints

Useful hints could also be given in the regular broadcast bulletins from the Radio Society of Great Britain and the Radio Association. Is it too much to suggest that valuable data can be collected by the experimenters of Great Britain in connection with the shortwave developments now attracting so great attention? If I remember rightly the American Radio League collected some most interesting and surprising information about three years ago upon the behaviour of short waves at certain times of the day and in certain directions across the American continent.

So much for the views of a broadcaster on the increased scope given by broadcasting to the experimenter. Let me now come to a matter which more nearly concerns the broadcast programmes.

Lessons in Morse

From time to time we have been asked to arrange for the broadcasting of lessons in Morse. So far nothing worth mentioning has been done in this direction, not because we are opposed to the idea, but for the reason that we are not satisfied that a method of teaching has yet been submitted which will justify the time set apart to it. We have to keep in mind the fact that Morse practice from the broadcasting stations in regular programme hours would have but a very limited appeal, and that for each ten persons interested annoyance would probably be given to one thousand others. There is also the difficulty that Morse transmission at ten words per minute would be valueless to beginners, and irritating for those who pride themselves on a good average of eighteen.

Emergency Possibilities

A training in Morse is useful if only as a new exercise for the brain. It may even be of national value in time of emergency, so that there are good grounds for considering regular transmissions in Morse characters provided they can be arranged so as not to interfere with present programmes. The question then arises, when and for

what period? Here the views of the readers of MODERN WIRELESS will be welcomed. Only, when addressing them to your Editor, do try to visualise the position of fellow experimenters—who may not leave business until 7 p.m.—and of those to whom music alone hath charms.

THE FIVE-CIRCUIT RECEIVER

To the Editor of MODERN WIRELESS.

SIR,—A few days ago, I made up the five circuits one-valve receiver, of which the constructional details were given in the April issue of MODERN WIRELESS, and have come to the conclusion that it is by far the best one-valve circuit that I have handled. I only use it as a Flewelling super, and these are some of the results I have had.

On a twenty-foot indoor aerial I have heard KDKA quite distinctly and also WGY. I have also heard Chelmsford so loud that it would have easily worked a loud-speaker.

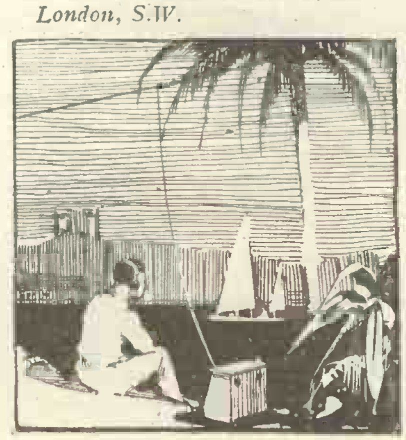
In addition to these I have heard several amateur transmissions.

I am going abroad very shortly and intend taking the set with me.

Yours truly,

MICHAEL NENTSKY.

London, S.W.



Tri-coil Circuits

By JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.
Editor of "Wireless Weekly" and of "Modern Wireless."

THIS article describes a method of coupling likely to prove highly popular. The name "tri-coil" has been given to a method of coupling which I have employed with great success in a great variety of circuits.

The arrangement to be described is applicable to so many different classes of circuits that it is not possible to use the name for any particular circuit, but rather for a system of coupling.

The method is really a combination of other well-known arrangements, but possesses many advantages over the more common anode couplings.

An examination of the advantages of the tri-coil system, given on this page, will indicate that the system has very distinctive features which will tend to popularise it amongst all classes of valve users.

A Popular Circuit

Probably the most popular coupling method in use to-day is the S.T. 34 circuit shown in Fig. 1. This circuit, in spite of its general effectiveness, is going to meet a serious rival in the tri-coil circuit for a number of reasons. In the first place, the S.T.34 does not lend itself to reflex circuits with the same success. The S.T. 75 circuit seems to have met with a rather mixed reception. Those using loud-speakers are generally very pleased, but those using 'phones experience the troubles pointed out when the original article dealing with this circuit was written. Consequently, the Fig. 1 method of coupling has distinct limitations as regards its adaptability to reflex methods. Another trouble is that if efficiently designed the first valve will tend to oscillate even when no reaction is applied to the anode inductance L_2 by means of a coil L_3. This, of course, is due to the inherent coupling between the circuits L_1 C_1 and L_2 C_2. If the second valve is switched off, the first valve will frequently oscillate of its own accord, due to this inherent coupling. If the first valve is switched off and the coupling between L_3 and L_2 is sufficiently tight, the second valve will oscillate, the reason, of course, being that the circuit L_2 C_2 is not only the anode circuit of the first valve, but also the grid circuit of the second. It is therefore sometimes difficult, when the whole circuit is oscillating, to tell which valve is causing the trouble. If, when the set is heterodyning an incoming signal, a slight adjustment of C_1 immediately makes a big difference in the beat note, then the first valve is oscillating. If the beat note is only slightly changed, then it is the second valve that is causing the trouble. It must not be imagined that because self-oscillation is produced only when the reaction coil L_3 is brought closer to L_2, it is therefore the second valve that is oscillating. In many cases, introducing reaction to the anode circuit of the first valve will cause that valve to oscillate.

> **ADVANTAGES OF THE TRI-COIL SYSTEM**
>
> 1. The efficiency of the tri-coil method is unexcelled.
> 2. Adjustable reaction may be introduced independently into the aerial circuit and into the tuned inter-valve circuit. The reaction, in each case, may be adjusted to the critical value.
> 3. Increasing the reaction to too great an extent will cause only the first valve to oscillate. There is no ambiguity as to which valve is oscillating, as in the case of the tuned anode coupling method.
> 4. Almost any degree of selectivity may be obtained owing to adjustable coupling.
> 5. Self-oscillation, if accidentally set up, may be stopped immediately by the simple movement of one coil. This often does not apply in the case of the tuned anode circuit method of coupling.
> 6. Signal strength may be adjusted from minimum to maximum with the greatest ease by a single movement.
> 7. The method of coupling is the only satisfactory one in many reflex circuits where a reaction effect is desired as well as reflex action.
> 8. Reflex circuits using tri-coil coupling are more stable.
> 9. The arrangement may be employed in all cases where a plug-in transformer is now used. A very fine adjustment of reaction is possible.
> 10. The system is absolutely fool-proof, and while long ranges are obtainable the circuit may be worked with a minimum of adjustment.

Since a tendency of the second valve to oscillate is entirely controlled by the reaction coupling between L_3 and L_2, it is frequently usual to introduce damping into the aerial circuit so as to be absolutely certain that the trouble is not being caused by the first valve. This is usually done by connecting the bottom of the aerial circuit, not to the negative terminal of the filament accumulator, but to the positive side. This, of course, involves considerable losses, and in many cases it means that practically no reaction effect is being applied to the aerial circuit where it is really of very great value.

Damping

In many S.T. 34 circuits, as constructed, the whole of the reaction is communicated to the tuned anode circuit, and although there is always a certain amount of inherent reaction between the tuned anode circuit and the grid circuit of the first valve, yet, owing to the chance of complication due to one or other of the valves oscillating, and one valve acting on the other, many experimenters "tie down" the first valve by introducing heavy damping into the grid circuit, which, of course, includes the aerial circuit.

Regarding the Fig. 1 circuit, we must remember that, while it is desirable to introduce the maximum reaction into the L_2 C_2 tuned anode circuit, yet there is no real necessity for this reaction to be introduced from the anode circuit of the second valve. If it comes from the first valve, just as good results will be obtained, but if we dispense with L_3 and couple L_2 to L_1, although a good circuit is obtained, yet, due to troubles from capacity coupling, the circuit tends to be unstable and somewhat erratic to operate.

Another point in connection with the Fig. 1 circuit is that we are dealing with the tendency of two separate valves to oscillate. Any alteration of the adjustments of one valve will affect the tendency of the other to oscillate, and this effect is always noticed unless very heavy damping is introduced into the grid circuit of the first valve. If, when operating the Fig. 1 circuit, we couple L_3 as closely as possible to L_2 without producing self-oscillation, and then reduce the filament current of the first valve, the chances are that the second valve will immediately proceed to oscillate.

Another trouble is that it is impossible to alter the voltages of the second valve without modifying the reaction effect. An increase of voltage across the filament, for example, while it may be desirable from the point of view of the rectifying action of the valve, will alter the reaction effect obtained in the receiver. In the case of a tri-coil circuit, however, the detector valve may be adjusted to its best operating condition without regard to the effect of these alterations on other parts of the circuit.

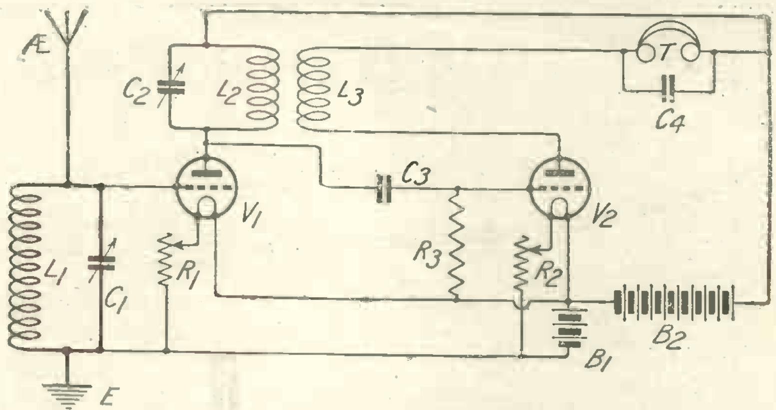


Fig. 1.—The popular S.T. 34 circuit. Here L2 is tuned.

practically zero, whereas in the Fig. 1 arrangement it is not possible to reduce the natural reaction effect, but only to mask it by introducing damping which, moreover, cannot readily be made variable.

Another advantage possessed by the tri-coil method is that it is possible to get very high selectivity, the degree of this selectivity being, at the same time, variable. It is also possible in the tri-coil circuit to vary the signal strength within very wide limits without altering filament adjustments or detuning.

Fig. 5 shows the simplest tri-coil circuit, in which one stage of high-frequency amplification is followed by detection. This circuit is undoubtedly the best one to try when first carrying out experiments. The Fig. 9 circuit is similar to Fig. 5, but has an additional valve acting as a low-frequency amplifier.

In Fig. 5 it will be seen that there is an aerial and grid coil L_1 in the grid circuit of the valve. This valve acts as a high-frequency amplifier, and the amplified currents pass through the untuned anode coil L_2. This coil is coupled to a coil L_3, which is shunted by a variable condenser C_2. The circuit L_3 C_2 is the grid circuit of the second valve which acts purely and simply as a detector, the usual grid condenser and leak being provided. The telephones are shunted by a 0.002 fixed condenser, although this condenser makes little difference. The use of a condenser will generally be found to lessen the tendency to self-oscillation.

The coils L_1, L_2 and L_3 may be mounted in a coil holder, as shown in Fig. 6. In order to be sure that the reaction effect is the right way round on the aerial circuit, the leads going to L_1 may be made reversible,

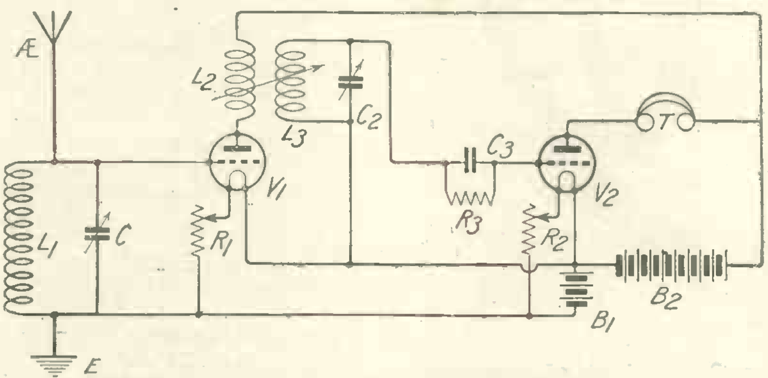


Fig. 2.—In this circuit L2 is aperiodic and L3 tuned.

Another advantage which the tri-coil circuit has over the Fig. 1 arrangement is that the reaction on the grid circuit may be adjusted within very wide limits when the tri-coil method is employed. The reaction applied to the aerial circuit may, in fact, be reduced to

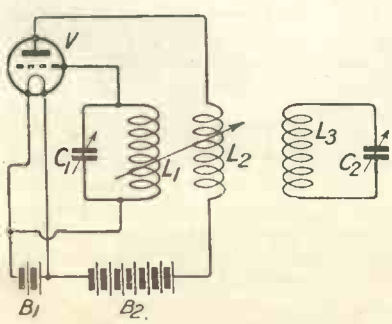


Fig. 3.—Explaining the tri-coil principle.

General Theory

I propose to give in this article some of the circuits which particularly lend themselves to the employment of the tri-coil system, and I have also suggested circuits to some of the constructional authors on the Radio Press staff; their sets are described elsewhere in this issue.

Before giving the actual circuits, however, it would be as well to give some general idea of the operation of the tri-coil system. As its name implies, three coils are used, and these three coils are coupled together.

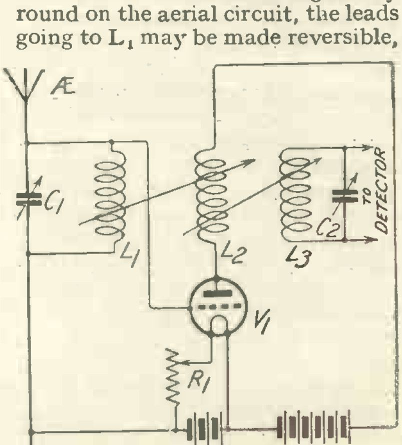


Fig. 4.—A single valve H. F. amplifier.

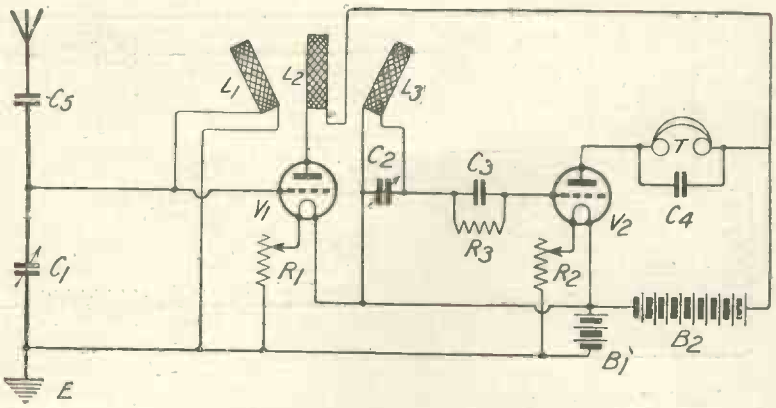


Fig. 5.—The simplest tri-coil circuit.

the leads from the coil going to two terminals on the panel; these leads may then be reversed. A similar reversal should be provided for in the case of the coil L_3, although this is not so necessary. It will be found, however, that there is usually a best way round for the leads to the coil L_3.

The operation of the circuit is really very simple; the valve V_1 acts as a high-frequency amplifier, and the amplified oscillations in L_2 are induced into the circuit L_3 C_2, which is in the grid circuit of the valve V_2. When L_1 is kept well away from L_2 there will be very little reaction applied to the aerial circuit. If a reaction effect is still obtained, it may be nullified by reversing the leads to L_1. When the coil L_3 is tightly coupled to L_2, the maximum amplification will usually be obtained, whereas when L_3 is loosely coupled to L_2, the transfer of energy is less, so that the potentials communicated to the grid of the second valve are smaller, and weaker signals will be obtained.

A closer examination of what happens is necessary if the proper operation of the circuit is to be understood.

Detailed Theory of Operation of Tri-Coil Circuits

Fig. 3 will assist considerably in explaining the effect of the tri-coil circuit. A valve V is so arranged that an aperiodic anode inductance L_2 is coupled to a grid coil L_1, shunted by a variable condenser C_1. The coupling is such that a reaction effect is obtained. If the valve V is adjusted to produce a reaction effect without oscillating, the bringing up of the circuit L_3 C_3 close to the apparatus will result in some of the reaction effect being communicated to the circuit L_3 C_2. The circuit L_3 C_2, due to its coupling with the rest of the apparatus, will absorb, as it were, some of the reaction effect and the damping of the circuit L_3 C_2 will be reduced.

Apart from the fact that the valve V is now reducing the damping of the circuit L_3 C_2, we also

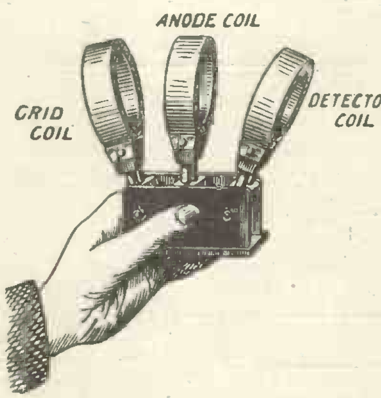


Fig. 6.—Method of mounting coils.

have the interesting effect of this circuit on the valve circuits. If the coil L_3 is coupled to L_1, it may well be that the absorption of reaction effects by the circuit L_3 C_2 may reduce the reaction effect produced by the valve, and if the valve were oscillating, it is quite possible that the coupling of L_3 to L_1 would stop the valve oscillating, provided, of course, the circuit L_3 C_2 is tuned to the same wavelength as L_1 C_1. This effect is often obtained in loose-coupled circuits in which reaction is employed.

If, however, the coupling between L_1 and L_2 is loose and L_3 is coupled closely to L_2, then when the circuit L_3 C_2 is tuned to the same wavelength as the circuit L_1 C_1, the reaction effect produced by the valve will increase and the valve will quite probably oscillate.

This effect may be better explained, perhaps, by reference to Fig. 4, which shows a single valve high-frequency amplifier working on the tri-coil principle. The arrowheads on the right go to a detector, which may be a crystal detector and telephones or a detector valve. The aerial coil L_1 is coupled to L_2, and L_2 is coupled to L_3, the three coils being arranged in a three-coil holder. If L_1 is kept right away from L_2, and L_2 is coupled to L_3, then there will be practically no reaction on the aerial and grid circuits. Such conditions are those illustrated in Fig. 8, which shows a practical two-valve circuit using the tri-coil arrangement, but with the aerial coil well away from the other two. If there is an aperiodic coil in the anode circuit of a valve and a tuned grid circuit, and these coils are separated, there will be neither magnetic coupling between the two circuits, nor capacity coupling. The capacity coupling effect is not noticeable unless the anode circuit is tuned, or virtually tuned, to the same wavelength as the grid circuit, and if this happens, a reaction effect and possibly self-oscillation will result, even though the coils in the grid and anode circuits are well separated.

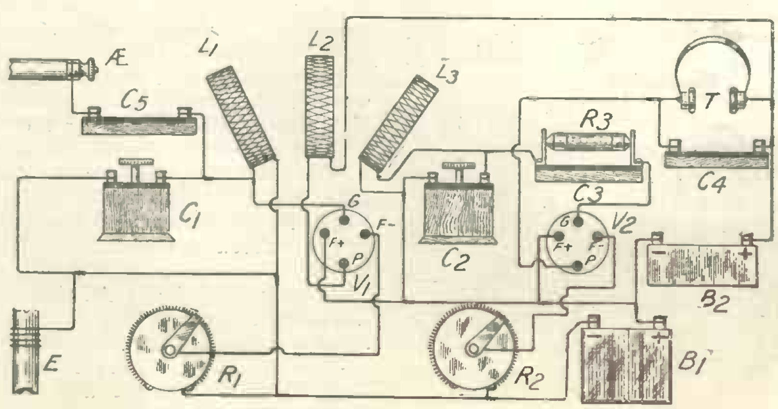


Fig. 7.—A pictorial representation of Fig. 5.

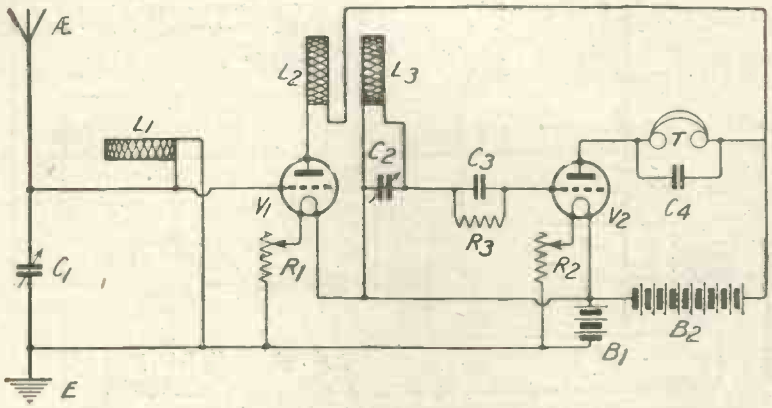


Fig. 8.—A practical two-valve tri-coil circuit.

Now in the Fig. 8 arrangement conditions existing in the circuit will depend not only on the coupling or absence of coupling between L_1 and L_2, but also on the coupling between L_2 and L_3. There is no magnetic reaction, but if L_3 is brought close up to L_2, the anode circuit will begin to act like a tuned anode circuit, even though the coil L_2 is aperiodic. In other words, the coil L_2 and the circuit $L_3 C_2$ act together like a single circuit included in the anode circuit of the valve. The closer the coupling the more does this combined circuit resemble a tuned anode circuit, and the extreme case, of course, would be where the turns of L_3 are wound directly over the turns of L_2. In such a case the results would be almost identical with those obtained with a tuned anode circuit.

Since a tight coupling between L_3 and L_2 turns the anode circuit of the first valve into what is virtually a tuned anode circuit, the arrangement will tend to have the same instability as a tuned anode circuit, *i.e.*, when the circuit $L_3 C_2$ is tuned to the same wavelength as the grid and aerial circuits, the first valve will tend to oscillate, due to capacity coupling in the valve and between the coils, even though the grid coil of the first valve and the anode coil of the first valve are well separated. This tendency for the valve to oscillate will communicate a reaction effect into the aerial circuit, and since any tuned circuit coupled to a reaction valve circuit will absorb some of the reaction effect, the damping of the circuit $L_3 C_2$ will be decreased and there will be a corresponding increase in signal strength and in selectivity. It is therefore important to remember that tightening the coupling between L_2 and L_3 and the proper tuning of $L_3 C_2$ will increase the reaction effect produced by the first valve. If self-oscillation occurs it may be at once stopped by loosening the coupling between L_3 and L_2.

Reverting to Fig. 5, it will be seen that almost any effect desired can be obtained by means of the tri-coil method used. For example, when first connecting up the set the coil L_1 should be kept right away from L_2, and L_3 brought close up to L_2. If this arrangement does not introduce quite sufficient reaction into the aerial circuit, L_1 may be brought slightly closer to L_2, the condensers C_1 and C_2 being retuned, of course.

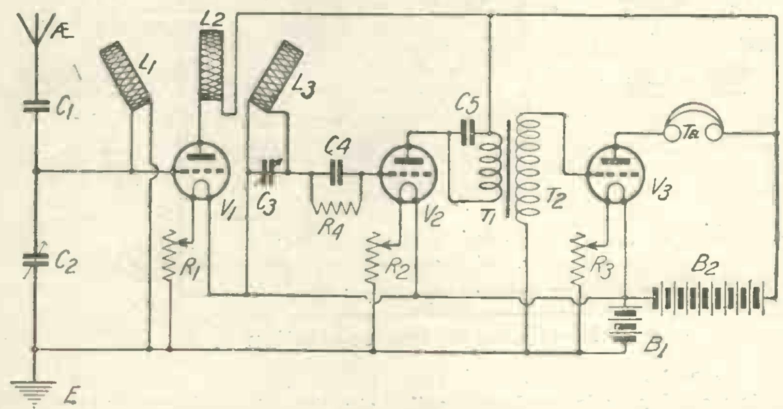


Fig. 9.—This circuit resembles Fig. 5, but has an additional note magnifier.

If it is desired to weaken the signal strength, the coil L_3 may be withdrawn from L_2. The degree of reaction introduced into the circuit $L_3 C_2$ will depend upon the coupling between L_2 and $L_3 C_2$; the coupling between L_2 and L_3, of course, must not be made so loose that signal strength suffers seriously; if the valve is too near self-oscillation point, it is much better to keep L_1 right away from L_2, and if there is still too great a tendency, L_3 may be moved a little further away from L_2. If there is still too much tendency towards self-oscillation, the emergency remedy, of course, is to loosen the coupling still further between L_3 and L_2. If, however, this reduces signal strength too much, even after retuning on the condensers, the leads to the coil L_1 may be reversed, and, of course, in extremely exceptional cases, L_1 might be brought a little closer to

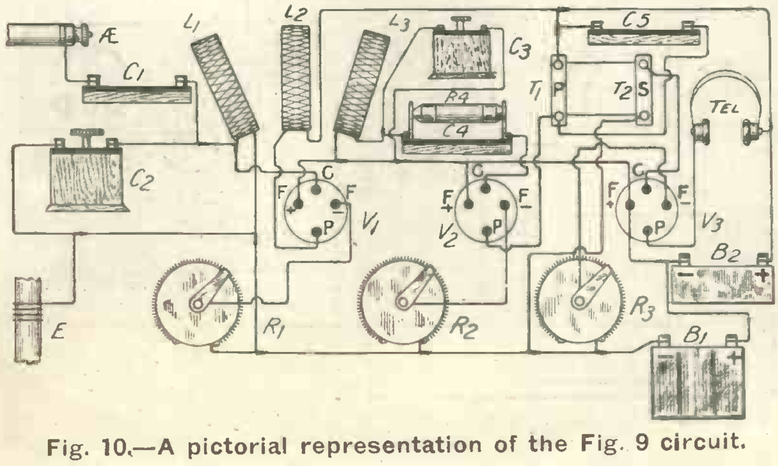


Fig. 10.—A pictorial representation of the Fig. 9 circuit.

L_2, so that a reverse reaction effect is fully developed.

The size of the three coils is rather important, especially the size of the anode coil L_2.

The size of the aerial coil, of course, depends upon the size of aerial, the method of tuning the aerial circuit, and the station to be received. When constant aerial tuning is employed, as in Fig. 5 and Fig. 9, a fixed condenser of 0.0001 μF is connected in the aerial lead, and the 300 metre to 500 metre broadcast waveband may be covered with a No. 50 plug-in coil shunted by a 0.0005 μF variable condenser. If constant aerial tuning is not employed and a parallel

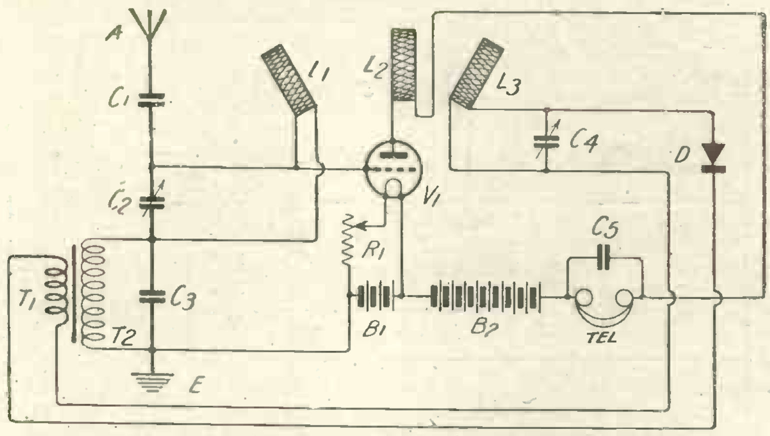


Fig. 11.—An interesting tri-coil reflex circuit.

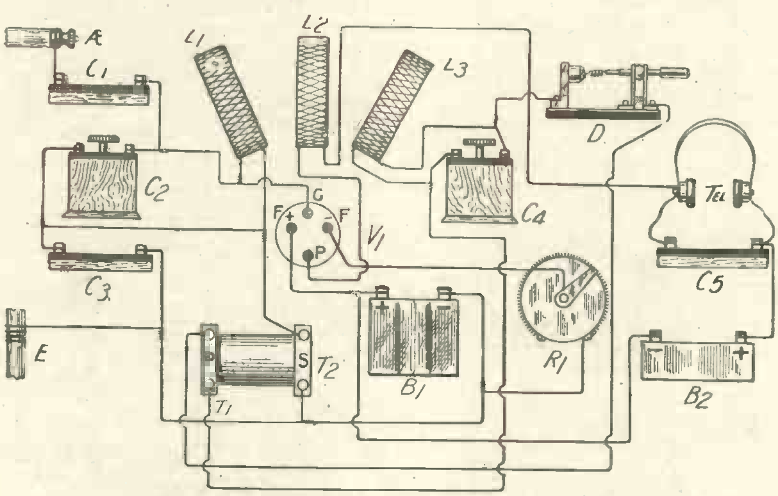


Fig. 12.—Pictorial representation of fig. 11.

tuning condenser is used, the coil will be smaller and may be, say, a No. 35. Similarly, a different size will be required if a series tuning condenser is employed. For the broadcast waveband from 300 to 500 metres the coil L_2 may be a No. 75 plug-in coil, while for the same waveband the coil L_3 may be a No. 50 shunted by a 0.0005 μF variable condenser. A No. 75 coil may be used provided a variable condenser of very low minimum is used, and, if the minimum is low enough, a 0.0003 μF variable condenser will be sufficient to cover the 300 to 500 metre waveband.

The Fig. 9 circuit is similar to that employed in the "All Britain" tri-coil receiver, constructional details of which are given in this issue. I have myself obtained excellent results with this particular receiver, which may be strongly recommended.

The main point in connection with the choice of the middle coil is to remember that if this coil is too large it may tend to resonate to the same wavelength as the incoming signals, with the result that the valve will be unstable. If the coil is too small there will be no trouble in this direction, but on the other hand the coupling between the anode circuit and the grid circuit of the second valve will be too loose to obtain the full development of signal strength. An examination of Mr. Harris's article on a modification of the Grebe circuit, which appeared in MODERN WIRELESS of March, 1924, will be of interest to those reading the present article. The arrangements described in that article provided no method of introducing any deliberate reaction into either the aerial circuit or the intervalve coupling circuit.

Fig. 10 is a pictorial form of the Fig. 9 circuit and is reproduced for the benefit of those to whom circuit diagrams are still a problem.

A Single-Valve Reflex Circuit

Figs. 11 and 12 are circuits of a single-valve reflex receiver which I have developed, and which possesses very great stability while enabling a perfect control of reaction to be obtained. It will be seen that the tri-coil system is used and is combined with a dual amplification arrangement. Here again reaction is introduced into the tertiary circuit $L_3 C_2$ by coupling L_3 to L_2. The method of feeding the low-frequency currents into the grid circuit, which I have adopted as standard for all reflex circuits, is

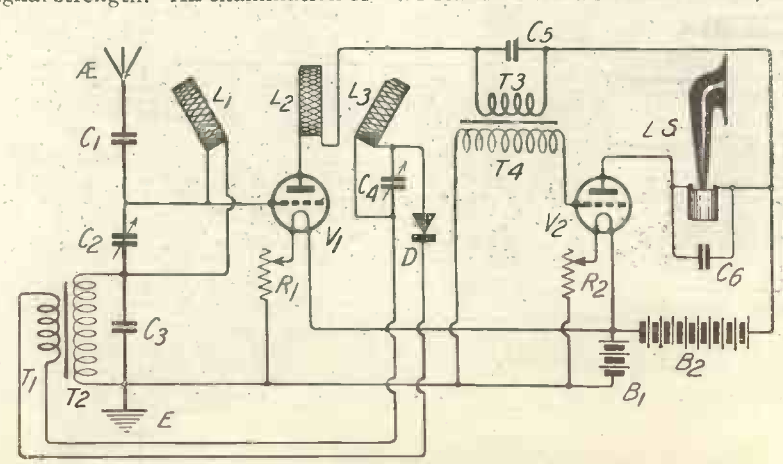


Fig. 13.—The S.T. 100 circuit modified by the adoption of the tri-coil method.

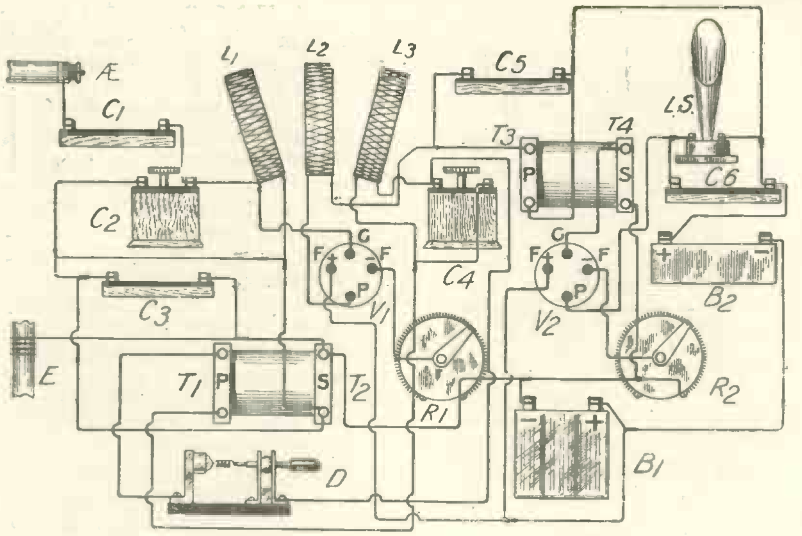


Fig. 14.—Fig. 13 shown graphically.

embodied, and greatly helps towards stability.

I have asked Mr. Percy W. Harris to describe to readers the construction of a set using this circuit, and the user of a single valve will find that excellent results are obtainable. In this receiver, as in the case of the other tri-coil circuit, it is desirable to be able to reverse the leads going to both L_1 and L_3. When first working such a circuit it is desirable to keep L_1 away from the other two coils, which, however, should be brought close together. This rule, again, applies to all tri-coil circuits.

A Tri-Coil S.T. 100 Circuit

A tri-coil circuit using principles embodied in the S.T. 100 is given in Fig. 13, while a pictorial form of the circuit is given in Fig. 14. This arrangement is similar to Fig. 11, with an additional stage of low-frequency amplification added. This circuit, while giving excellent power, is more stable than the S.T. 100, owing to the entire separation of the two transformers. It is important in this circuit, as well as the Fig. 11 arrangement, to see that the primary winding of the transformer in the aerial circuit is connected the right way round. The secondary will always have the O.S. terminal nearest the grid, and this also applies to the second transformer in Fig. 13. It will also be usual to have the I.P. terminal next to one side of the crystal detector, although both ways should be tried. It is important to remember that whenever either of the outside coils is moved the variable condensers C_4 and C_2 should be retuned. The condenser shunted across the secondary of the iron-core transformer in the aerial circuit may have a capacity of 0.001 μF.

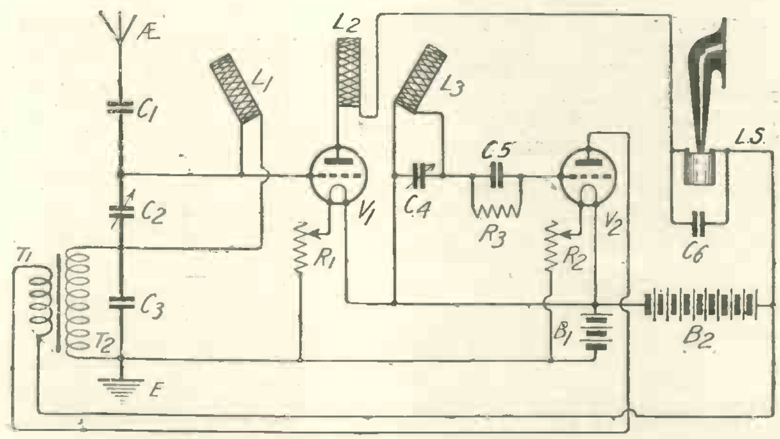


Fig. 15.—Another interesting reflex receiver.

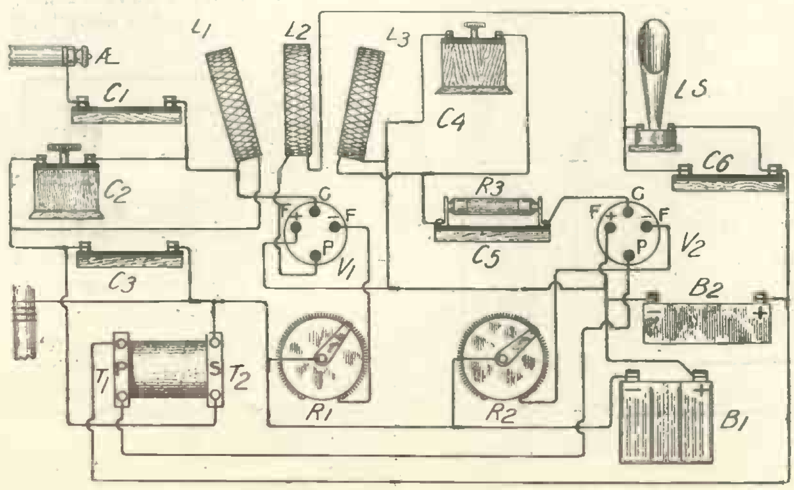


Fig. 16.—Fig. 15 explained pictorially.

In Fig. 13 the condenser across the loud-speaker may have a value of 0.002 μF or 0.004 μF. Some loud-speakers require no condenser whatever across them; this again is a matter for trial. If telephones are used in the Fig. 13 circuit there is no need to have a condenser across them, but a condenser is necessary in Fig. 11 across the phones, because it acts as a by-pass for the high-frequency currents. Its value, in this case, is 0.002 μF.

A Two-Valve Reflex Using a Valve Detector

A two-valve reflex circuit is given in Fig. 15, and, as will be seen, the tri-coil principle is employed here and the same rules and values

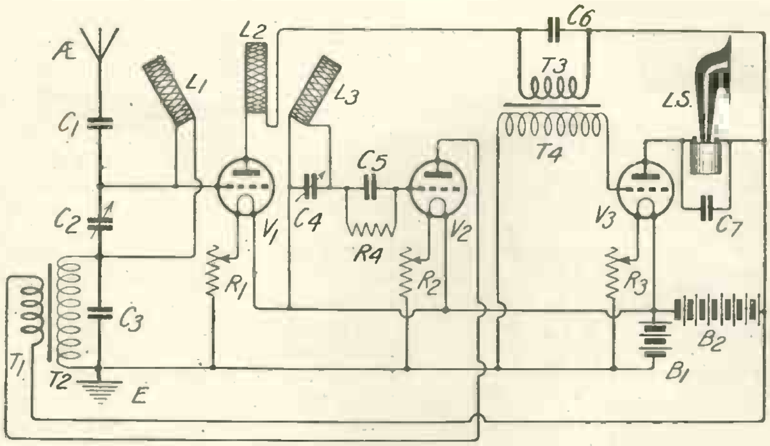


Fig. 17.—The addition of an extra stage of audio frequency amplification to fig. 15.

apply. The second valve now acts purely as a detector, the low-frequency currents being fed back into the grid circuit of the first valve, in the anode circuit of which a loud-speaker or 'phones are connected. Whichever is employed, a condenser of 0.002 μF should be connected, while for some loud-speakers a 0.004 μF will give purer reproduction. In this figure the anode voltage of the second valve may be made very much lower, and this will usually increase the stability of the circuit. The lower anode voltage is obtained by tapping off the high-tension battery B_2. I have tried one or two sets made up using this circuit, and they have given excellent results, although in one case a little trouble was experienced, due to buzzing. In this circuit a little grid bias will be often helpful in the grid circuit of the first valve, and the same remark applies to both valves in Fig. 13, and may be applied also to Fig. 11.

Fig. 16 is the pictorial form of Fig. 15. Fig. 17 is the Fig. 15 arrangement with an extra stage of low-frequency amplification. This three-valve dual circuit possesses many merits.

A Tri-Coil Puriflex

A combination of the tri-coil principle and the main features of the Puriflex receiver described in the July issue of MODERN WIRELESS is disclosed in Fig. 18, this being a two-valve reflex circuit in which there is one stage of high-frequency amplification followed by a crystal detector and two stages of low-frequency amplification. No transformer is employed and the circuit does not buzz. At the same time, the signal strength is not so great as when transformers are employed in a suitably designed reflex circuit. The coupling between the first and second valves is accomplished by means of the resistance R_3, which is shunted by a condenser C_4 of 0.001 μF capacity. The resistance R_3 may have a value of 50,000 ohms, while the grid condenser C_5 has a value of 0.25 μF, or, in fact, anything not lower than 0.002 μF. The grid leak may have a value of 250,000 ohms up to 2 megohms.

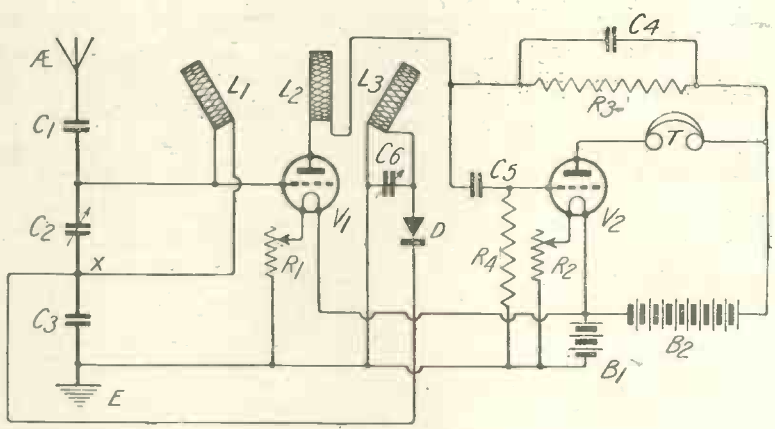


Fig. 18.—A transformless reflex.

Fig. 19 is similar to Fig. 18, but this time an additional low-frequency valve has been added and a resistance R_5, of similar value to R_4, is connected in the anode circuit of the second valve, while the same sizes of grid condenser and leak are used in the case of the third as in the case of the second.

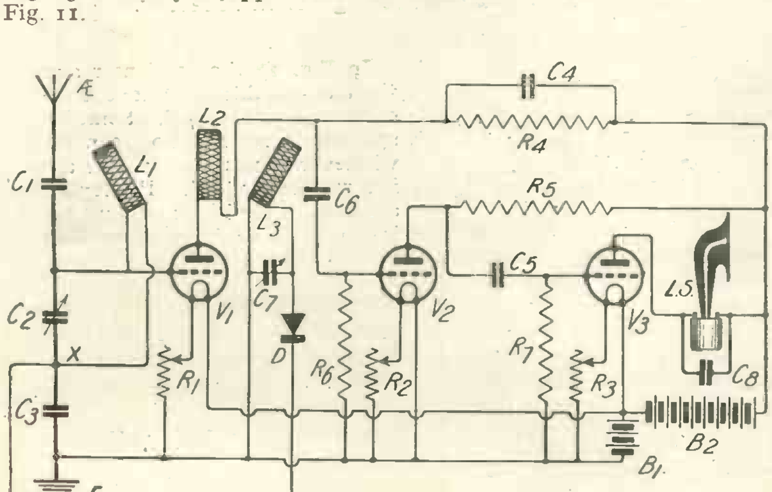


Fig. 19.—An additional valve to fig. 18 circuit.

A Single-Valve Transformerless Reflex Circuit

For the benefit of those who desire a single-valve reflex circuit using the tri-coil principle without the use of an iron-core step-up transformer, Fig. 20 is given, and it will be seen that the rectified currents from the crystal detector are applied to the grid circuit of the valve. The condenser C_6 has a value

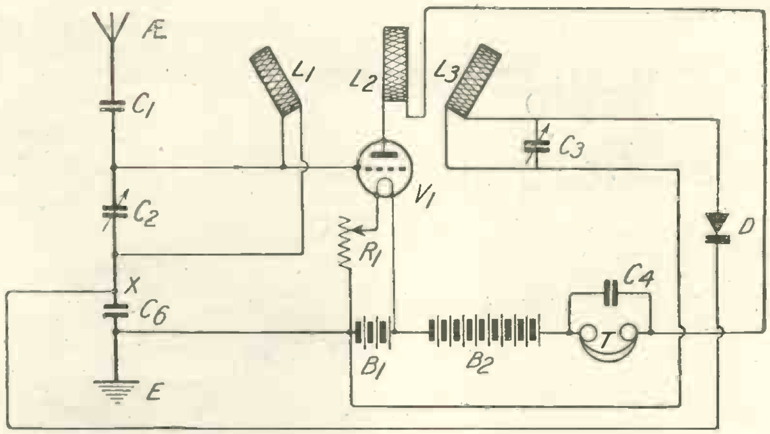


Fig. 20.—A single-valve transformerless reflex.

of 0.0003 μF. Fig. 21 is the pictorial representation of the Fig. 20 circuit.

In Figs. 18, 19 and 20 the earth connection may be made to the

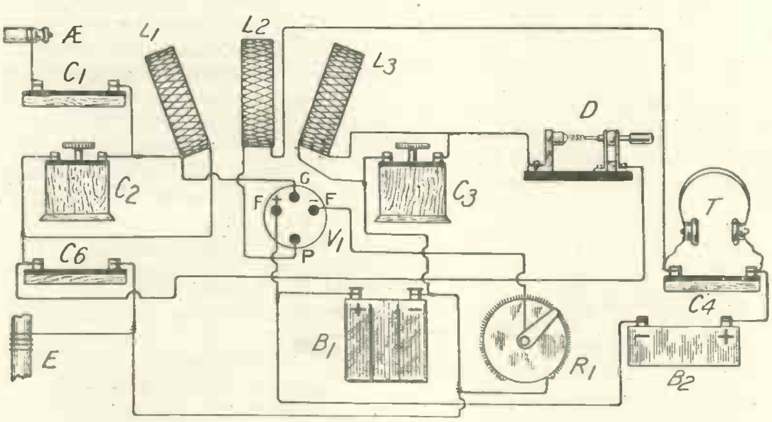


Fig. 21.—A pictorial representation of fig. 20.

point X as an alternative to the position shown in these drawings.

Conclusion

From an extensive experience both with laboratory layout and with finished receivers, using this principle, I can confidently recommend the use of tri-coil coupling, and we shall be extremely interested to obtain reports of results obtained by readers with any of these circuits. We always make a policy of differentiating between circuits of experimental interest and those of real practical proved value to the home constructor. The publication of the results obtained with sets made in accordance with some of these circuits is sufficient evidence of their value.

The circuits, of course, are very different from the double reaction circuits which I produced over 12 months ago and described in the first issue of MODERN WIRELESS. As stated at the beginning of this article, the method of coupling is really a combination of well-known arrangements, and yet possesses a large number of distinctive merits of its own.

From Our Readers.

To the Editor of MODERN WIRELESS.

SIR,—Being a reader of your excellent magazine, it will interest you to hear that I have made up my receiver according to the circuit given by Mr. Stanley G. Rattee, in your June issue, and am pleased to tell you that the results are indeed fine.

Everybody has congratulated me on the fine tone and clearness of reception.

With an indoor aerial I can hear Berlin clearly, though the reaction adjustment is of course critical. We have now two broadcast stations in Stockholm, one which uses a power of 200 watts, and the other 500 watts.

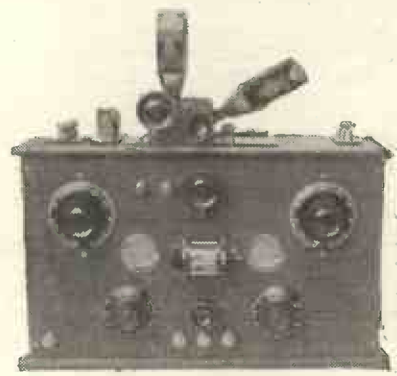
Best wishes for further success from a Swedish friend. Yours truly,

C. H. Lindblad.

Stockholm.

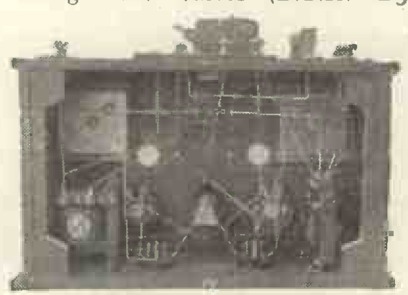
To the Editor of MODERN WIRELESS.

SIR,—I enclose two photographs of a recently completed receiving set which embodies your S.T.100 circuit. It is in a convenient form and may be of interest. An anti-capacity switch is provided so that either one or both valves may be used. Between the filament rheostats another high



Mr. Legat's set.

resistance rheostat of the pull-out type serves the purpose of a gradual switch for filaments—very useful when leaving the set to unexperienced hands. The three terminals below knob of this rheostat in centre are for grid bias connections. Results with this set, using D.E. valves (B.T.H. B5



The interior.

and Mullard D.F.A.2) are very pleasing indeed. Using the first valve only, all B.B.C. stations can be obtained at fair strength on 'phones, even under summer conditions and using a single wire aerial not more than 23 ft. in height.

Wishing continued success to MODERN WIRELESS.—Yours truly,

E. S. LEGAT.

Birmingham.

A typical Chinese pagoda. A somewhat similar erection may be seen at Kew Gardens, London.

Radio Recollections

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

A sunset scene on the Pacific, where wireless reception is particularly freaky.

OBSERVING the placid manner in which the average man accepts wireless telephony as one of the commonplace facts of life, one cannot but remark that the difficulties and fascination which wireless afforded the early experimenter have become eclipsed by the ease with which the modern valve enables long-distance reception to be effected.

In the early days of wireless not only were difficulties experienced in the amateur world, difficulties which to-day are easily overcome, but even the professional engineer and operator had more than he could wish for, in spite of the resources at his command. It will, however, be admitted by those to whom wireless is no new study that the ladder they have climbed has been made less steep by the fascination which lured them on.

One of the very earliest transmissions of music by wireless was carried out during the year 1910, the means of transmission being, not continuous waves, but the musical spark transmitter. It is, indeed, not unlikely that many who read these lines will remember with what doubts of their own hearing and sanity they first listened to strains of the "Marseillaise" coming among the buzzings of Morse. What is it? Can it be a dream? No; there it is again! In this way each one of us who heard accepted the mysterious music with wonderment.

Some few weeks after hearing this phantom musician I learned that the apparent music was merely the operator of the Prince of Monaco's private yacht *L'Hirondelle* altering the adjustments of his transmitter so as to vary the note of his spark in such a way that he was able to imitate a tune on a tin-whistle. Thus ended the mystery!

A general view of the waterway at Canton. The vessel in the centre of the picture is a type of junk in which whole families live, knowing no other home.

Some twelve months later another similarly uncanny experience was hearing a human voice from across the sea. It must be remembered that at that time the only sounds to be heard in a wireless receiver were dots and dashes of Morse code and, by way of a change, atmospherics. Incidentally both of these joyful sounds are still with us!

Listening one night at a very late hour to the various ships working outside New York, I was suddenly startled to no small extent by hearing in the telephones, "Hullo! Hullo!" and then silence. Thinking that some trick was being played, a careful search was made for local practical jokers, but without result. Hoping against hope, the telephones were replaced, when surely enough "Hullo! Hullo!" was again repeated. Subsequent enquiries elicited the information that engineers at one of the stations belonging to an American newspaper were experimenting in wireless telephony.

Thirty-Mile Transmission

A contribution in a recent issue of *Wireless Weekly* dealing with wireless recording recalls to mind an achievement which, although by present-day's standards an insignificant one, was at the time a source of pride. The coherer was being used as a detector and signals were recorded upon tape, the transmitter being a 10-inch spark coil connected between the aerial and

A view in the Botanical Gardens, Hong Kong.

An article which takes us back to the time when the word "wireless" was not synonymous with broadcasting.

Showing the manner in which the tall steel masts are built up section upon section.

earth. After many trials and with much patience we actually established two-way communication with Gibraltar at 30 miles!

It is not suggested that this distance was in any way a record, even at *that* time, but it appeared nevertheless a world-shaking achievement, and, looking back, its gain called for more patience, more adjusting, and more anxiety than did a transmission of one hundred times the distance some five years later.

A Lightning Story

During these last months we have both read and heard many stories about amateur stations being struck by lightning. In view of these, the following details of how a tropical thunderstorm treated a naval station may prove interesting reading. The incident in question took place in the Crown Colony of Hong Kong, which, as the Wembley visitor knows, is not far removed from the Tropics. The station referred to was one built for the Admiralty at a point called Cap D'Aguilar, on an open site free from trees or houses. It was, in fact, just one of those desolate spots far enough removed from civilisation to please even the most fastidious engineer who, after building the station, does not live there!

During an evening when there were few atmospherics there came a flash of lightning which made its way to earth *via* the aerial. Nothing preceded it; nothing gave warning; nothing but a loud explosion announced its arrival.

The point from whence the report seemed to emanate was the "safety spark-gap," and a subsequent inspection of this showed it to be completely burned out.

The station, which was put into darkness so far as the lighting system was concerned, conveyed the impression of being a giant Neon tube glowing with a ghostly pink-blue light. This, coupled with the fact that the report had rendered everyone temporarily stone-deaf, created an altogether uncomfortable atmosphere.

A daylight inspection revealed that the aerial had completely gone; the spreaders lay on the ground, split and broken, whilst attached to them were the smallest particles of insulator which could be recognised.

Though the masts appeared to have suffered no damage, being of steel, the station building was cracked across the roof, whilst a concrete footpath leading to the station, parallel and directly below the aerial position, showed a hole some inches deep and wide.

The receiving apparatus, strangely enough, was not seriously damaged, although the transmitting plant and land line communications were sadly in want of repair.

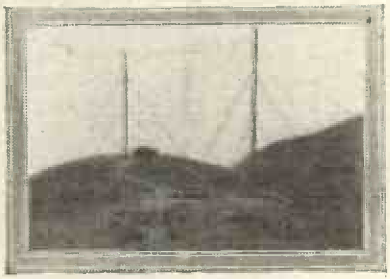
An Earthquake Experience

At this station, too, I had my first experience of an earthquake. At the time the air became oppressive and stifling, causing a pronounced giddiness in the head. Following this the earth shook beneath our feet. The station

The motor-generator and rotary spark gap for a Marconi 25 kw. transmitter. Such apparatus as this was used at the stations mentioned in this article.

building creaked, but stood the strain, while the land-line instruments within began tapping of their own accord.

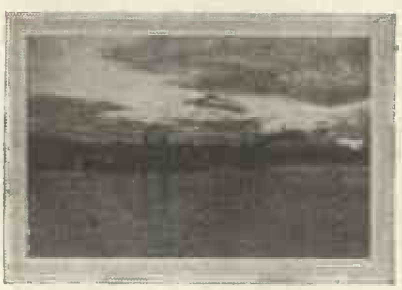
Outside the station were two large water tanks used for circulating water through the Gardner engines; on the tops of these tanks were thin sheet-tin lids to keep out



The Cap d'Aguilar station which was struck by lightning.

dust and insects. When the quake began the lids rattled in a way resembling stage thunder, when of a sudden they fell to the ground! The noise produced was responsible for an immediate realisation of the state of affairs.

Perhaps the most peculiar observation, during the quake, which lasted some few minutes only, was the extraordinary condition obtaining so far as wireless reception was concerned. Nothing resembling an atmospheric was audible, but stations well over a thousand miles away, which in normal times were inaudible, could be received at good strength and read without effort. Small-powered stations, such as those existing round the coast of Japan and the Federated Malay States, could be heard at good strength upon a carborundum crystal receiver, the apparatus in use at the time.



A pretty cloud effect at Gibraltar; the well-known rock lies to the left of this picture.

Pirates

Whilst dwelling upon things Chinese, there are many stories which, if space would permit, would provide the thrill of a book by Henty. Even in this modern age with navies policing the seas, the activities of pirates on the China coast and rivers are many. Compared with the stories of olden days, the work of these modern pirates lacks nothing in thrills and hair-raising adventure.

Some few years before the war, one of the vessels which ply between Hong-Kong and Canton left the latter port with passengers and cargo, just as she had done many times before. After some twenty miles had been covered a group of passengers rushed the bridge and the engine-room, holding up the ship's crew and other passengers by means of rifles, whilst others collected all the available money, bullion and jewellery that could be found. After satisfying their wants the pirates (such these passengers were) set fire to the vessel and jumped over the side into waiting sampans, making their escape.

With the pirates gone, the captain of the ship managed to run his vessel ashore, whereupon most of the passengers scrambled over the side and swam for the beach, the remainder either being killed in the panic or drowned. The vessel became a total wreck, the fire gutting her completely.

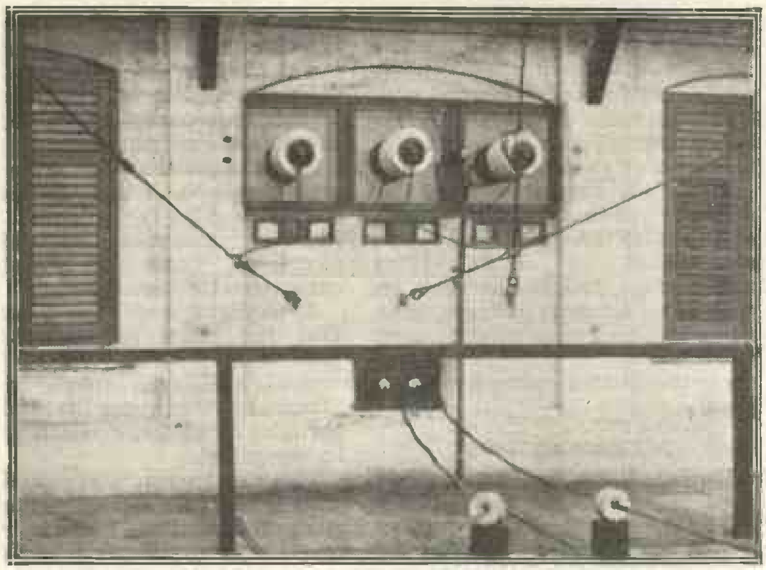
Ships making this and similar journeys to-day carry on their bridges, in addition to the navigators, two armed guards, but in spite of many precautions piracy in China and Chinese waters is just as prevalent, just as daring and just as cruel as it was many years ago.

It is interesting here to note that the very ceding of Hong-Kong to Britain was the result of Chinese disorder culminating in the death of several British residents at Shameen, Canton.

Screening Effects

Probably every reader of MODERN WIRELESS has some knowledge and experience of what has come to be known as screening. The broadcast listener, however, can scarcely realise the peculiar conditions prevailing on the River Amazon, Brazil, unless he has been there.

This river, as everyone knows, is some two to three thousand miles long, whilst both its swampy banks are very thickly bordered with trees, creepers and similar vegetation for several miles inland. The



The elaborate "leading-in" arrangements which form an essential part of every high-powered station.

river has also a course which twists and turns in every direction, many of the turns being full right-angles; the depth of water and width of this and the Rio Negro permitting ocean-going steamers to proceed as far inland as Iquitos.

On this river the wireless atmospheric conditions are beyond imagination; indeed, never have I heard anything with which to compare them. Apart from a continuous crackling and sizzling, there is for most of the time a sort of whistle similar to that which may be heard in the telephones during a heavy rainstorm, whilst the volume of the crackling noises is appalling.

When about 1,500 miles up the Amazon it was necessary on one occasion to communicate by wireless with a vessel some ten miles lower down, but after fruitless efforts to reach her, it was decided to slow down our vessel and so lessen the distance between us. After some hours of calling and listening without result, the vessel appeared in sight round a bend in the river, when visual signals informed us that she, too, was calling by wireless. Efforts were renewed by both of us, but neither could hear the other until the two vessels were actually in the same straight run of water!

Since both ships were using musical sparks, there is no possibility of the signals being lost in atmospherics, for though they may not have been readable, the fact that they were not even heard can only indicate that the neighbouring forestry was forming an impenetrable screen between the two stations.

A Contrast

Of less difficult country where wireless has proved useful, Egypt is perhaps the happiest.

Most readers will know of, and many may have heard, the big station at Abu Zabal, Cairo (SUC), for which reason the following may hold a touch of personal interest. The station we hear to-day is one built for the Post Office during the years 1920–1, but before that date the station was working under much the same conditions for the Admiralty. The apparatus at the original station was not so up-to-date as that at present in use, but nevertheless with an arc transmitter and a single-valve receiver such places as Seychelles, Aden, Colombo, Durban, Horsea, Mauritius, etc., could be communicated with whenever necessary. Indeed, a daily twenty-hour service was maintained with Horsea Island, Portsmouth, for several years.

Single-Valve Reception

The point of interest in these remarks lies in the fact that whereas such stations were then of relatively low power they were all received, and furthermore read, upon a single-valve apparatus without difficulty. Very rarely were atmospherics troublesome and very rarely were the nights "freaky" (*i.e.*, very rarely were signals rising and falling off in strength). The site of the station is perfectly flat and open, some few miles out in the desert.

Strangely enough, this part of the world (that is Egypt, Sudan and adjacent parts) is particularly favourable for wireless reception, and many cases are known of vessels in the Red Sea and Indian Ocean receiving the old veteran Poldhu upon magnetic detectors.

General Observations

In conclusion it may be understood that the best receiving conditions prevail south of the Equator, though the North Pacific round the Aleutian Islands also offers considerable opportunities for long-distance reception.

Atmospherics appear to be at their worst, excluding Egypt, in hot

The Pyramids at Mena, Cairo.

countries, Aden, India, Straits Settlements and similar warm spots rarely being free from interference.

The United States and Canada are also sometimes troubled with bad atmospheric conditions, but since there appears to be an unceasing muddle of jamming round the coasts of these countries, long distance reception is vary rarely possible on commercial wavelengths even during favourable weather conditions.

Early Amateurs

Prior to the sinking of the "Titanic" in 1912, the ether round the United States was about the busiest it has ever been my lot to hear. Everybody appeared to be working at the same time on a 600-metre wavelength, with an inexhaustible amount of matter for transmission. The majority of these stations were amateur transmitters using spark apparatus of any power up to about 5 kw. If replies were not forthcoming at once the procedure was to increase power until communication was established.

To-day the amateurs have increased in number, but their operations are mainly on wavelengths around 200 metres. Notwithstanding this fact the numbers of coast stations and ships carrying wireless have also greatly increased, and the 450 and 600 metres wavelengths are still too overcrowded for easy long distance work. The conditions of things prevailing in this country are already well known to readers, though perhaps they do not make the most of them.

Regular Programmes from Continental Broadcasting Stations

Times in British Summer Time

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

WEEK DAYS.

British Summer Time.	Name of Station.	Call Sign and Wave Length.	Locality where situated.	Nature of Transmission.	Closing-down time or approx. duration of Transmission.
a.m.					
7.40	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Weather Forecast	5 minutes.
8.00	Munich	—— 486 m. ..	Bavaria ..	Market Prices	10 minutes.
10.00	Voxhaus	——430 & 500 m.	Berlin ..	Stocks and Shares	3 minutes.
10.15	Voxhaus	——430 & 500 m.	Berlin ..	News	10 minutes.
10.23	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Time Signal in G.M.T. (Spark) ..	3 minutes.
10.30	Lyons	Y.N. 470 m. ..	Lyons ..	Concert	until 11.15 a.m.
10.40	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Cotton and Coffee quotations ..	5 minutes.
11.00	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Time Signal in Greenwich Sidereal Time (Spark).	5 minutes.
11.14	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Time Signal in French Summer Time (Spoken), followed by Weather Forecast.	5 minutes.
11.44	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Time Signal in G.M.T. (Spark) ..	3 minutes.
11.55	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Fish Market quotations (Mondays excepted).	5 minutes.
11.55	Frankfurt	—— 467 m. ..	Frankfurt	Time Signal (spoken) followed by news	10 minutes.
p.m.					
12.14	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Time Signal in French Summer Time (Spoken), followed by Weather Forecast.	5 minutes.
12.15	Voxhaus	——430 & 500 m.	Berlin ..	Stock Exchange News	5 minutes.
12.30	Radio-Paris	S.F.R. 1780 m. ..	Clichy ..	Items of News	15 minutes.
12.45	Radio-Paris	S.F.R. 1780 m. ..	Clichy ..	Concert (Light Orchestra), followed by Exchange Opening Prices.	1.45 p.m.
12.55	Voxhaus	——430 & 500 m.	Berlin ..	Time Signals (spoken) followed by News	10 minutes.
12.55	Breslau	——415 m. ..	Silesia ..	Time Signal (spoken) followed by Weather Report and Stock News	15 minutes.
12.57	Nauen	P.O.Z. 2800 m. ..	Berlin ..	Time Signal in G.M.T. (Spark) ..	3 minutes.
1.00	Haeren	B.A.V. 1100 m. ..	Brussels ..	Weather Forecast	3 minutes.
1.00	Leipzig	——452 m. ..	Leipzig ..	Stock Exchange nd General News	5 minutes.
1.15	Geneva	H.B.1 1100 m. ..	Switzerland	Weather Forecast, followed by Lecture.	One half-hour.
2.00	Haeren	B.A.V. 1100 m. ..	Brussels ..	Weather Forecast	5 minutes.
2.00	Munich	——486 m. ..	Bavaria ..	News and Weather Report ..	10 minutes.
2.15	Voxhaus	——430 & 500 m.	Berlin ..	Stock Exchange News	5 minutes.
3.40	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Stock Exchange Intelligence (Saturdays excepted).	8 minutes.
4.30	Radio-Paris	S.F.R. 1780 m. ..	Clichy ..	News, followed by Concert and late News	Until 5.45 p.m.
4.30	Stuttgart	——437 m. ..	Wurtemburg	Light Orchestra, followed by Weather Report	Until 6p.m.
4.30	Frankfurt	——467 m. ..	Frankfurt	Music by Station Orchestra ..	Until 6p.m.
4.30	Leipzig	——452 m. ..	Leipzig ..	Concert	Until 5.30
4.50	Haeren	B.A.V. 1100 m. ..	Brussels ..	Weather Forecast	3 minutes
5.00	Radio-Belgique ..	S.B.R. 262 m. ..	Brussels ..	Concert	6 p.m.
5.00	Geneva	H.B.1 1100 m. ..	Switzerland	Lecture	One hour.
5.30	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Stock Exchange, closing prices (Saturdays excepted).	8 minutes.
5.30	Voxhaus	——430 & 500 m.	Berlin ..	Light Orchestra, followed occasionally by Sporting News ..	Until 7.
5.50	Haeren	B.A.V. 1100 m. ..	Brussels ..	Weather Forecast	5 minutes.
6.15	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Concert, followed by News Bulletin	One hour.
6.30	Munich	——486 m. ..	Bavaria ..	Light Orchestra	Until 7.30
8.00	Voxhaus	——430 & 500 m.	Berlin ..	Lecture	45 minutes.

British Summer Time.	Name of Station.	Call Sign and Wave Length.	Locality where situated.	Nature of Transmission.	Closing-down time or approx. duration of Transmission
p.m. 8.00	Eiffel Tower	F.L. 2600 m.	Paris	General Weather Forecast	8 minutes.
8.00	Radio-Belgique	S.B.R. 262 m.	Brussels	Concert, followed by News Bulletin	Till 10.10 p.m.
8.15	Ecole. Sup. des Postes. et Telegraphes.	P.T.T. 385 m.	Paris	Lecture, followed by Concert. (Usually Outside Broadcast, sometimes begins at 8 or 8.30.)	Two to three hours.
8.15	Munich	——486 m.	Bavaria	Music and Speech, followed by News	10 o'clock.
8.15	Leipzig	——452 m.	Leipzig	Concert, followed by News	9.35.
8.15	Lausanne	H.B.2 800 m.	Switzerland	Concert (Thursdays excepted)	Until 9.30 p.m.
8.30	Ecole Sup. des Postes et Telegraphes	P.T.T. 385 m.	Paris	Lecture, followed by Concert (Usually Outside Broadcast, sometimes begins at 8.15 or 8.45 p.m.)	Two to three hours.
8.30	Radio-Paris	S.F.R. 1780 m.	Clichy	General News Bulletin	One half-hour.
8.30	Frankfurt	——467 m.	Frankfurt	Concert followed by News	Between 10 and 11 p.m.
8.30	Stuttgart	——437 m.	Wurtemburg	Concert followed by News	Until 9.30.
9.00	Voxhaus	——430 & 500 m.	Berlin	Concert followed by Weather Report	Until 10.15
9.00	Radio-Paris	S.F.R. 1780 m.	Clichy	Time Signal in French Summer Time, followed by Concert.	9.50 p.m.
9.45	Stuttgart	——437 m.	Wurtemburg	Repetition of Weather Reports, and Time Signal (spoken)	6 minutes.
10.30	Madrid	—— 408 m.	Spain	Concert	Until midnight.
11.00	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in Greenwich Sidereal Time (Spark).	5 minutes.
11.44	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in G.M.T. (Spark)	3 minutes.
a.m. 12.57	Nauen	P.O.Z. 2800 m.	Berlin	Time Signal in G.M.T. (Spark)	3 minutes.
			SUNDAYS.		
a.m. 10.23	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in G.M.T. (Spark)	3 minutes.
11.00	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in Greenwich Sidereal Time (Spark).	5 minutes.
11.44	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in G.M.T. (Spark)	3 minutes.
11.50	Konigswusterhauzen	L.P. 2800 m.	Berlin	Concert	Until 12.45 p.m.
11.55	Eiffel Tower	F.L. 2600 m.	Paris	Fish Market quotations	5 minutes.
p.m. 12.45	Radio-Paris	S.F.R. 1780 m.	Clichy	Concert	1.45 p.m.
12.57	Nauen	P.O.Z. 2800 m.	Berlin	Time Signal in G.M.T. (Spark)	3 minutes.
2.40	Ned. Radio Industrie	P.C.G.G. 1050 m.	The Hague	Concert	Until 5.40 p.m.
4.45	Radio-Paris	S.F.R. 1780 m.	Clichy	Concert, followed by News	5.45 p.m.
5.00	Radio-Belgique	S.B.R. 262 m.	Brussels	Concert	6 p.m.
6.15	Eiffel Tower	F.L. 2600 m.	Paris	Concert, followed by News Bulletin	One hour.
7.00	Voxhaus	——430 & 500 m.	Berlin	Children's Corner	30 minutes
8.00	Voxhaus	——430 & 500 m.	Berlin	Concert preceded by Religious or Patriotic Address	Until 10.15
8.00	Eiffel Tower	F.L. 2600 m.	Paris	General Weather Forecast	8 minutes.
8.00	Radio-Belgique	S.B.R. 262 m.	Brussels	Concert, followed by News Bulletin	Until 10 p.m
8.10	Ned. Seintoestellen Fabr.	N.S.F. 1050 m.	Hilversum	Concert	Until 10.10 p.m.
8.30	Radio-Paris	S.F.R. 1780 m.	Clichy	General News Bulletin	Until 9 p.m.
8.30	Ecole Sup. des Postes et Telegraphes.	P.T.T. 385 m.	Paris	Concert or Lecture. (May begin a quarter-hour earlier or later).	Ends between 10.30 and midnight.
9.00	Radio-Paris	S.F.R. 1780 m.	Clichy	Concert, followed from 10 p.m. until 10.45 p.m. by a dance lesson.	Until 10.45 p.m.
9.00	Eiffel Tower	F.L. 2600 m.	Paris	Concert	Two hours.
9.30	Petit Parisien	—— 340 m.	Paris	Concert (Items announced in English as well as French).	Until midnight.
10.30	Madrid	—— 408 m.	Spain	Concert	Until 12.30 a.m.
10.50	Konigswusterhausen	——680 m.	——	Concert	1 hour.

SPECIAL DAYS.

British Summer Time.	Name of Station.	Call Sign and Wave Length.	Locality where Situated.	Day of Week.	Nature of Transmission.	Closing-down time or approx. duration of Transmission
p.m. 3.00	Ecole Sup. des Postes et Telegraphes	P.T.T. 385 m. ..	Paris ..	Fridays ..	Concert or Lecture	Two hours.
5.00	Lausanne	H.B2 800 m. ..	Switzerland	Thursdays ..	Children's Stories ...	One hour
7.00	Voxhaux	——430 & 500 m.	Berlin ..	Wednesdays	Children's Corner ..	30 minutes.
7.40	Heussen Laboratory	P.C.U.U. 1050 m.	The Hague.	Tuesdays ..	Concert	Until 9.40 p.m.
7.40	Smith and Hooghoudt	P.A.5 1050 m. ..	Amsterdam	Wednesdays	Concert	Until 9.40 p.m.
8.10	Ned. Radio Industrie	P.C.G.G. 1050 m.	The Hague	Mondays ..	Concert	Until 10.10 p.m.
8.10	Ned. Vereenigen van Radio Telegraphie	P.C.G.G. 1050 m.	The Hague	Thursdays ..	Concert	Until 10.10 p.m.
8.10	Middlcraad	P.C.M.M. 1050 m.	Ymuiden ..	Saturdays ..	Concert	Until 9.40 p.m.
8.40	Ned. Seinteestellen Fabriek	N.S.F. 1050 m. ..	Hilversum	Fridays ..	Concert	Until 9.40 p.m.
9.00	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Wednesdays	Concert	Until 10.55 p.m.
9.30	Petit Parisien ..	—— 340 m. ..	Paris ..	Thursdays ..	Concert (Items announced in English as well as French).	Midnight.
10.00	Radio–Paris	S.F.R. 1780 m. ..	Clichy ..	Mondays Thursdays & Fridays	Dancing Music ..	Until 10.45 p.m.
10.15	Le Matin	S.F.R. 1780 m. ..	Paris ..	Every 2nd & 4th Saturday of the month	Special Gala Concert with leading Parisian artists.	Till 11.30 p.m.

AN INTERESTING EXPERIMENT.

5 AQ, Mr. D. Douet's station at Putney. Mr. Douet has used Myer's receiving valves succesfully for transmission with 300 volts on the plate and 6 volts on the filament. The aerial current was .29 ampere.

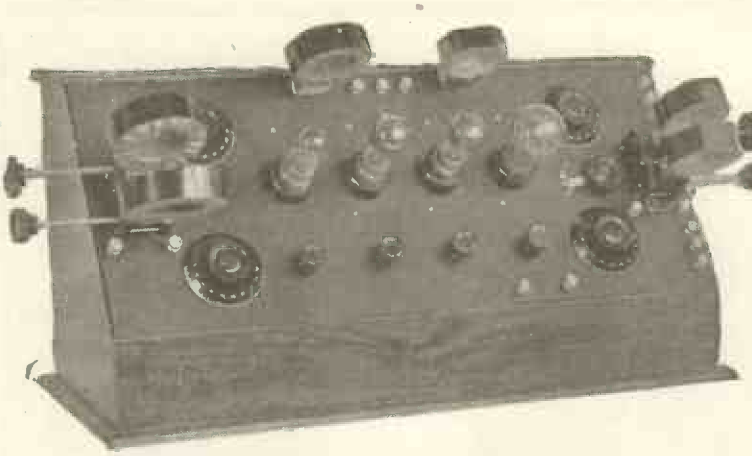


Fig. 1.—The completed receiver.

The Highlow Receiver

by *Walter Stevens.*

A useful receiver which will tune in the high and low broadcast wave-lengths, the change being effected by the throw of a switch.

MUCH enthusiasm regarding the high-power long-wave broadcasting station has been noticed by the writer among his wireless friends, and it is evident that many people wish to possess a receiver which will tune in both 5XX and the local station, with the minimum of knob-twisting.

The present receiver was, therefore, designed to fill the need of a really good broadcast receiver which could be operated by any member of the family, without trouble, and which would tune in both the short and long wave broadcasting.

The photograph, Fig. 1, shows the receiver complete with valves and plug-in coils, while Fig. 3 is another view with the valves and coils removed.

The coils and variable condensers on the right hand side of the receiver are those which effect the tuning on the shorter waves, while the longer wavelength stations are tuned in by means of the corresponding arrangements on the left of the set. The lever switch in the centre of the panel effects the change-over from high to low waves, while the two-point switch on the right serves to switch the set on or off by breaking the connection to the low-tension battery. It is thus possible for the experimenter to tune in the local short-wave station on one side, switch over and tune in, say 5XX, on the other, then switch the set off and know that it may be used by those at home during his absence.

The Circuit

As will be seen from the simplified circuit diagram, Fig. 5, four valves

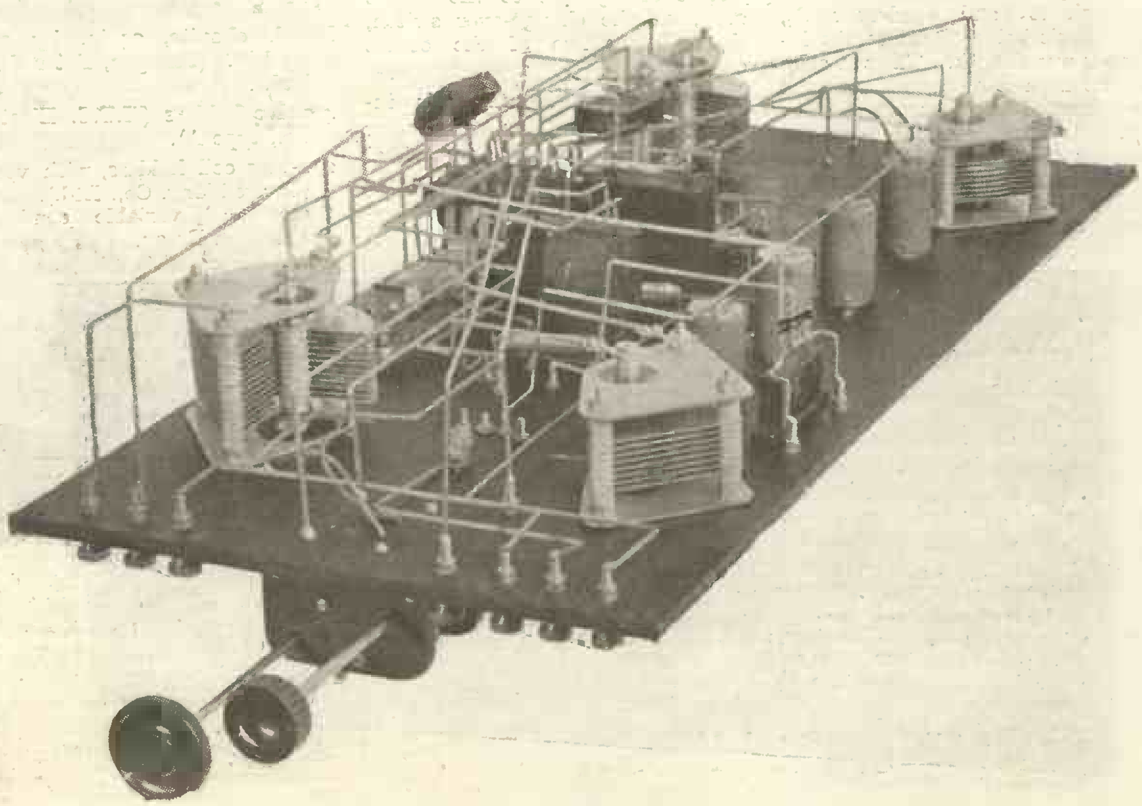


Fig. 2.—A view of the wiring

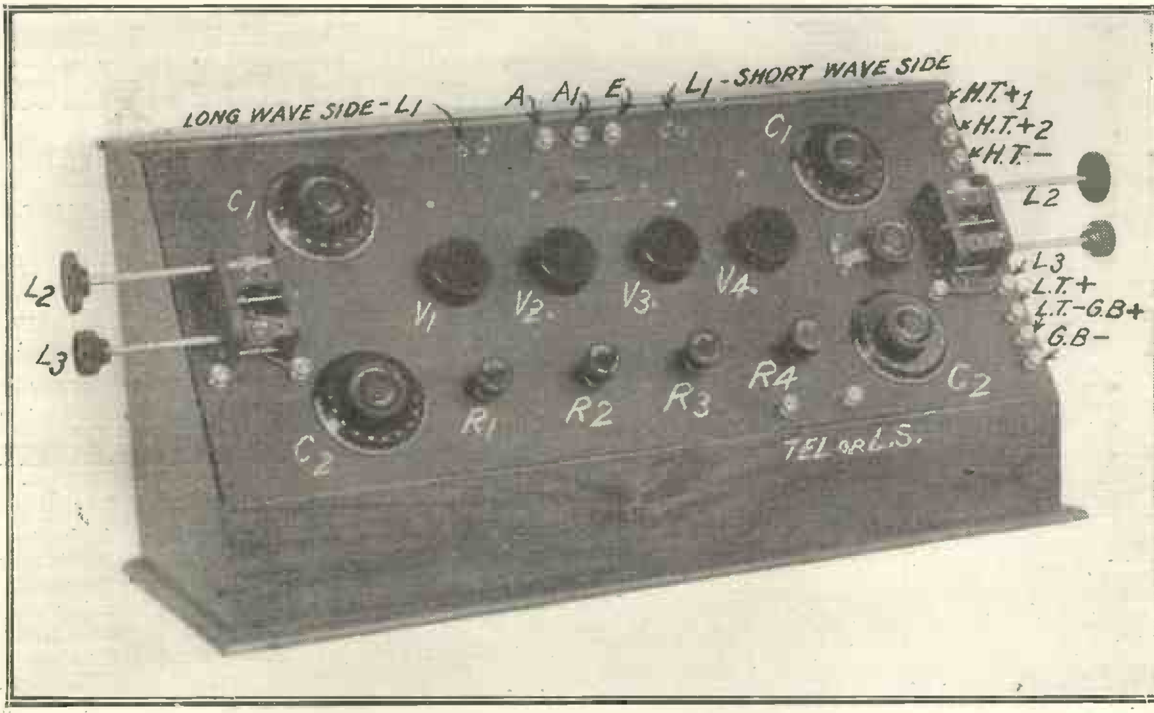


Fig. 3.—A view of the panel, with the various components labelled

are employed, the first being a high-frequency amplifier, the second a rectifier, followed by two stages of resistance-coupled note magnification. The high-frequency valve V_1 has in its anode circuit the coil L_2 and condenser C_2, this circuit being tuned to the incoming wavelength. The coil sizes for the high and low wavelengths are marked against the coils. Fig. 6 is another circuit diagram, showing the points at which contact is made to the switch, while Fig. 7 is a diagram of the switch itself, showing how the various coils and condensers are joined up to the switch. The numbers on these latter two circuits are arranged to correspond. For example, the points 2, 5, in the aerial circuit are joined to the points 2, 5, on the change-over switch, these being two of the centre contacts.

Constant aerial tuning is incorporated, for use on the shorter waves, and a terminal is provided whereby the 0.0001 μF condenser may be cut out, thus giving the simple form of parallel tuning.

Parts Required

To construct this receiver, the following pieces of apparatus will be necessary :—

Cabinet, with panel space 24 in. by 10 in.

Panel, ebonite, 24 in. by 10 in. by ¼ in. (Paragon, Peter Curtis, Ltd.).

4 valve holders (H.T.C. Electrical Co., type A).

2 2-way coil holders, with vernier (Goswell Eng. Co., Ltd.).

2 0.0005 μF variable condensers (Jackson Bros.).

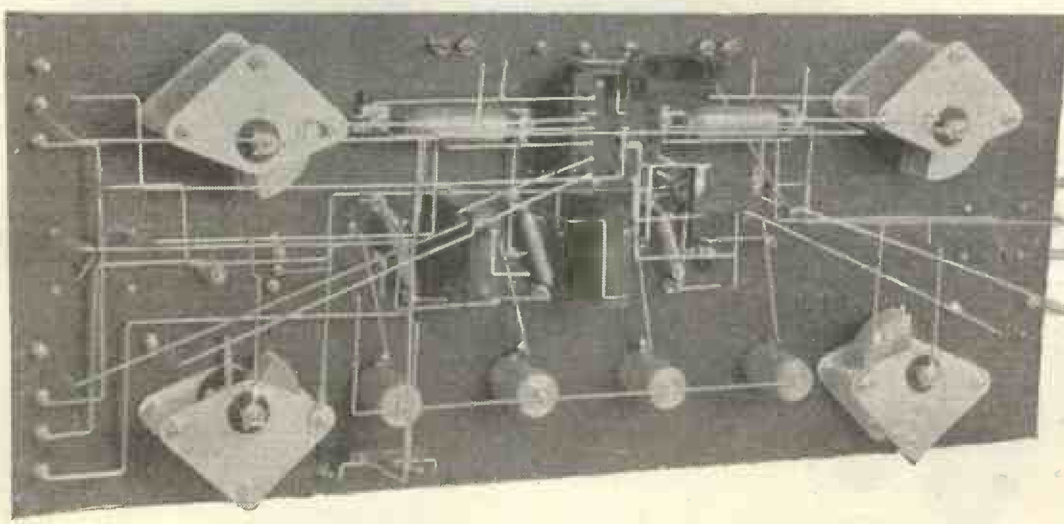


Fig. 4.—A further view of the wiring

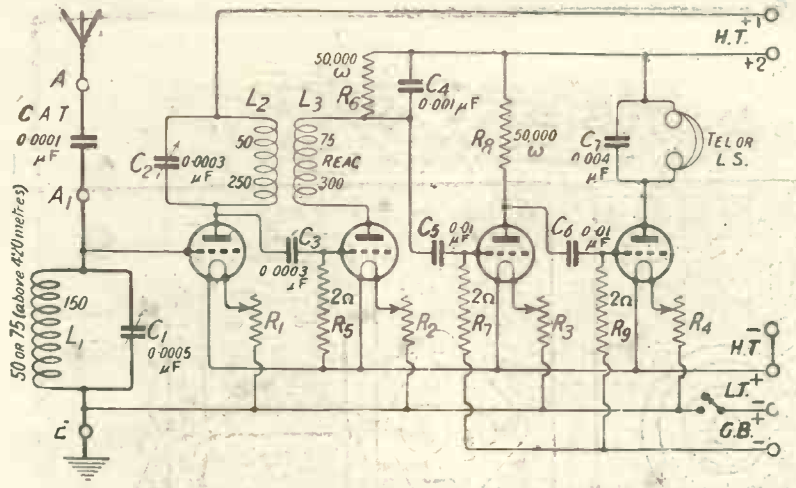


Fig. 5.—A simplified circuit diagram, showing values of coils for high and low wavelengths.

2 0.0003 μF variable condenser (Jackson Bros.).
4 Lissenstat filament resistances (Lissen, Ltd.).
2 50,000 ohm resistances (Dubilier, Ltd.).
3 2 megohm resistances (Dubilier, Ltd.).
Fixed condensers, one each 0.0001 μF, 0.0003 μF, 0.001 μF, 0.004 μF (Dubilier, Ltd.).
2 .01 μF condensers T.C.C.
1 6-point 2-way switch (Utility Lever type, Wilkins and Wright).
1 switch arm.
2 switch studs.
2 stops.
2 coil plugs for panel mounting.
15 terminals.
Square wire, rubber leads, screws.

It is not essential that the parts used should in all cases be of the make specified, but it is essential that they be of good quality.

Drilling the Panel

Fig. 8 shows the top of the panel with all the parts mounted up, and the necessary dimensions. It is advisable to have all the components at hand before the drilling is commenced, in order to ensure that the correct size of hole is made for each part. When marking out the panel, use a scriber, and not a pencil, and lightly scratch the lines on the reverse side of the panel. Many

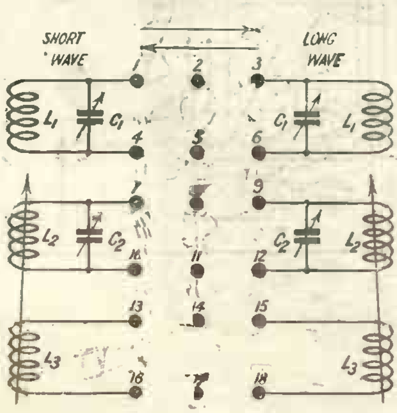


Fig. 7.—The contacts of the change-over switch.

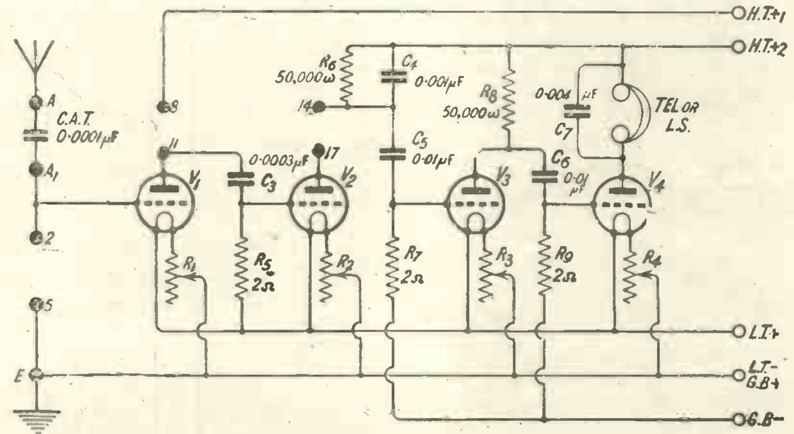


Fig. 6.—A diagram showing the points to be connected to the switch.

firms supply drilling templates with their component parts, thus greatly facilitating the constructor's work. The slot for the lever of the "Utility" switch may be cut with a fretsaw, or alternatively a series of holes, of a diameter equal to the width of the slot, may be drilled along the line of the slot, the remaining ebonite being removed with a small file.

The constructor may then proceed to mount up the various parts upon the panel, after which wiring may be commenced.

Wiring Up

The wiring of the receiver is carried out in square section tinned copper rod, and should present no difficulty if each piece is bent to fit correctly between the points which it has to join, before it is actually soldered in position. Figs. 2, 4, and 10, show the underside of the panel, and may help to clear up any difficult points which may be met with. Fig. 9 is a wiring diagram, and no difficulty should be experienced in following it.

The Cabinet

The cabinet in which the panel is mounted is of the sloping front type, with panel space of 24 in. by 10 in. Two dimensioned views are given in Fig. 11, and the constructor should have no trouble in making the box from these views. If desired, the cabinet may be purchased ready made from a firm specialising in this class of work. The panel is secured in position by means of wood screws, two in each of the shorter sides.

Coils and Valves

For the shorter wavelengths, using constant aerial tuning, the aerial coil L_1 on the right hand side should be a No. 50 for wavelengths up to 420 metres, above which a No. 75 may be used. The anode coil L_2 and reaction coil L_3, both on the right hand coil-holder, should be a No. 50 and No. 75 respectively.

For the longer wavelengths, such as those used by 5XX and Radio-Paris, the left hand aerial socket L_1 should contain a No. 150 plug-in coil, while L_2 and L_3 on the left hand coil-holder may be a No. 250 and a No. 300 respectively.

Almost any good make of valve may be used in this receiver with satisfactory results, but it is advised that the first valve should be one which is designed specially for

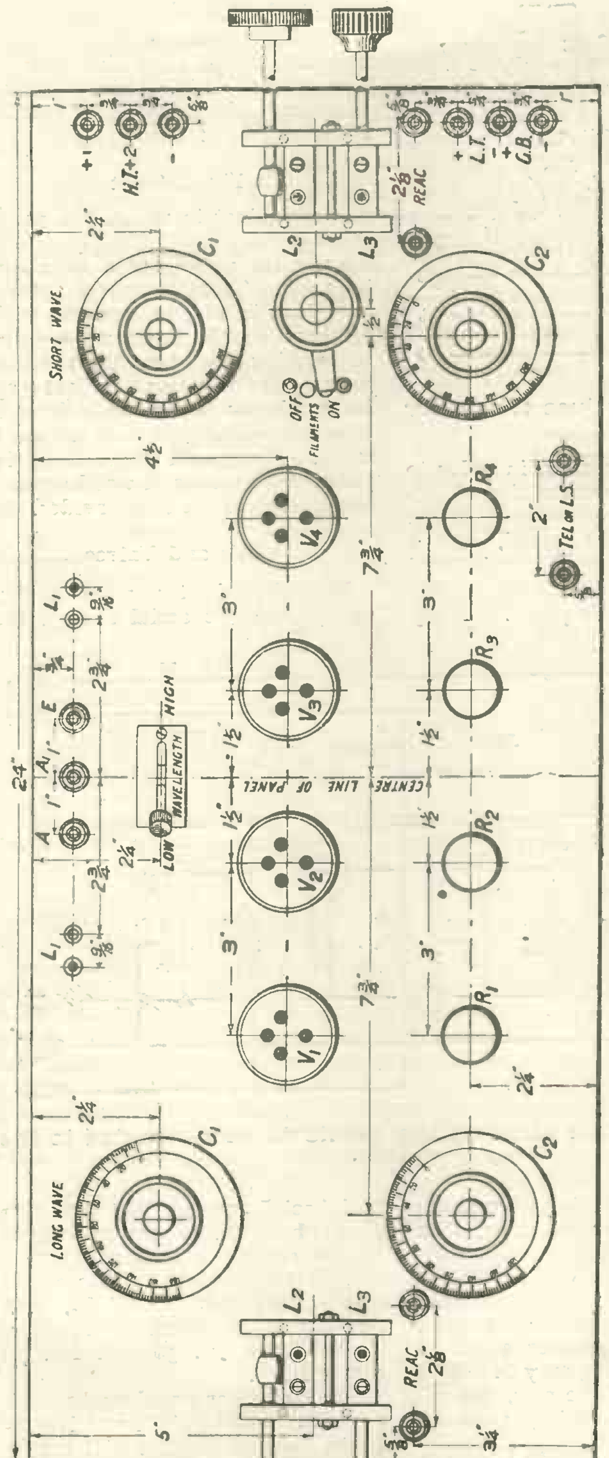


Fig. 8.—The panel layout and drilling figure. Blue Print No. 58a.

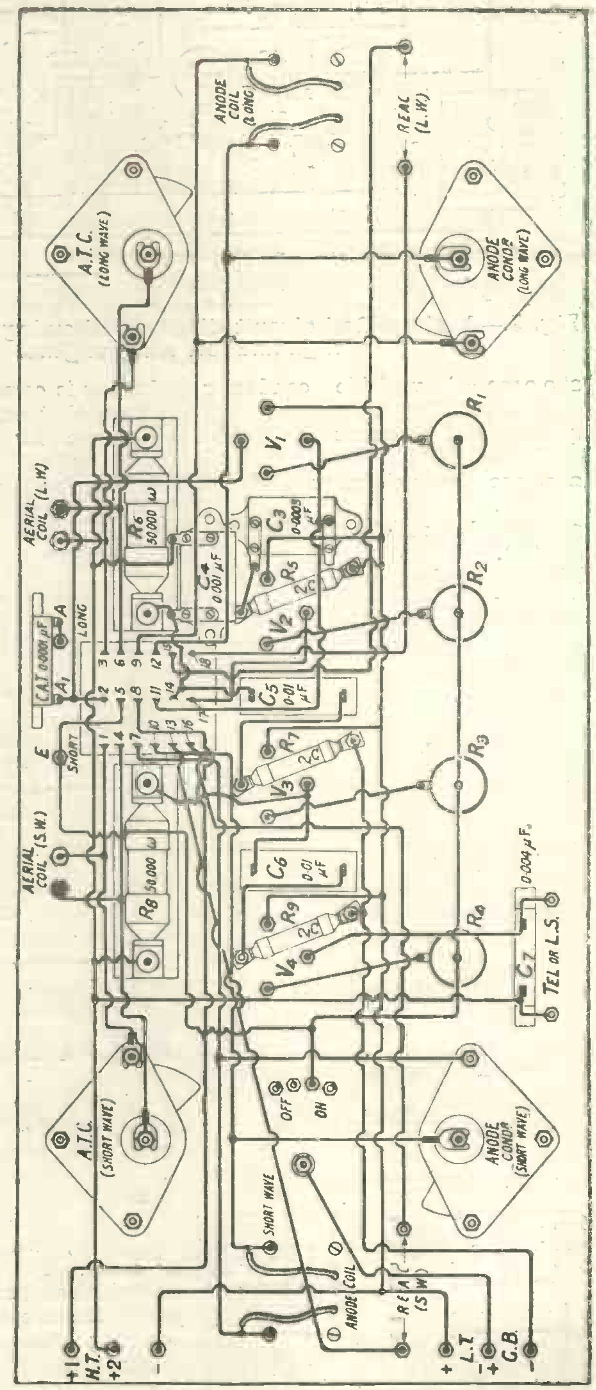


Fig. 9.—Wiring diagram of the receiver. The lettering corresponds to that in the circuit diagram. Blue Print No. 58b.

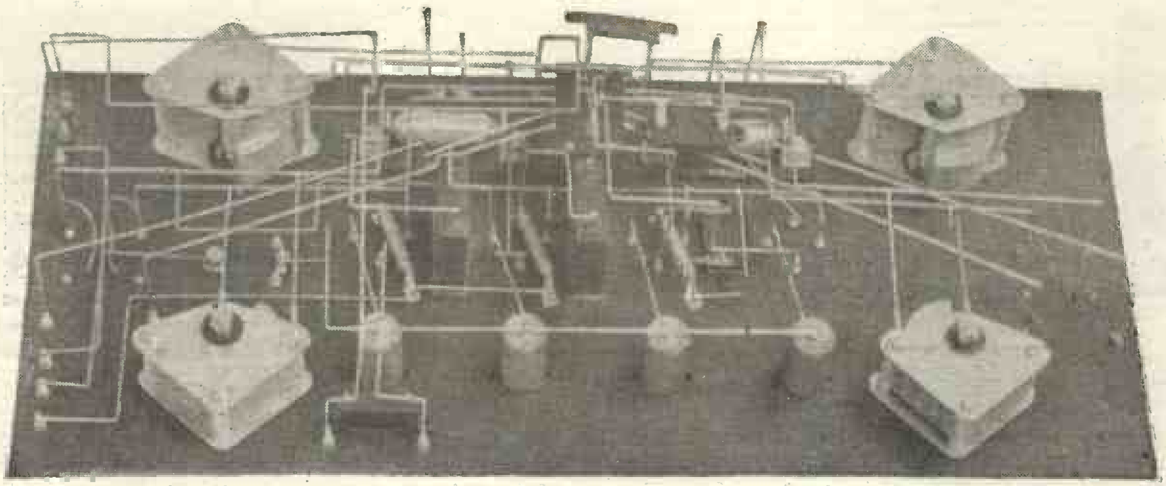


Fig. 10.—A view of the underside of the panel, showing the variable condensers and filament resistances

high-frequency amplification, while the last valve may with advantage be a small power valve.

A voltage of about 40-60 volts may be applied to the first high tension terminal (that marked HT + 1), and a higher voltage, say 100 volts or more, depending upon the type of valves employed, to the terminal marked HT + 2. The terminal HT – is a common negative terminal, and if separate high-tension batteries are used, their negative ends should be joined to this terminal.

Grid Bias

Terminals are provided, by means of which a negative bias may be applied to the grids of the two note-magnifying valves. If no extra grid bias is used, the terminal GB – must be joined to LT – GB + by a piece of wire. If 100 volts is used on the anodes of the last valves, say of the R type, then probably about 4 volts negative grid bias will be necessary.

Testing the Set

The set may readily be tested on the signals from the nearest broadcasting station by switching over to the short-wave side, and tuning on the aerial and anode condensers, keeping the coil L_3 sufficiently far away from L_2 that the set does not oscillate. When signals are heard, the coil L_3 may be brought nearer to L_2, the condenser C_2 (short wave) being readjusted. If this does not result in an increase in signal strength, the connections to L_3 should be reversed by changing over the leads to the terminals provided. A final touch should be given to the variable condensers in order to ensure that the best results are being obtained.

The Long-Wave Side

The receiver should also be tested on the longer wave transmissions either from 5XX, or Radio-Paris. Telephony from the Eiffel Tower should also be heard, when the correct sizes of coils are used. It will be necessary to change the aerial lead over to terminal A_1 when receiving the longer waves, in order to omit the constant aerial tuning condenser.

Test Report

The chief feature noticed in this instrument was the remarkable purity of reproduction, doubtless due to the resistance coupling. The change over from the local station to Chelmsford is effected simply by turning a knob and at nine miles there was obviously not the slightest interference between the two stations. For distant work the set compared favourably with previous M.W. sets using an H.F. stage, and all stations can be heard in the telephones after dark and when conditions are normal.

The volume on 2 LO was somewhat less than that obtained with a similar set using two stages of transformer L.F. coupling.

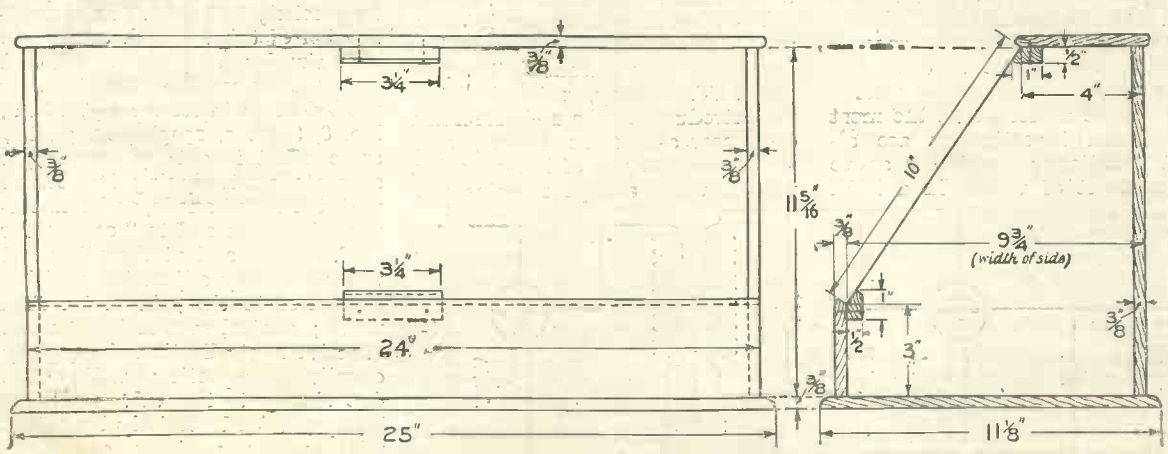
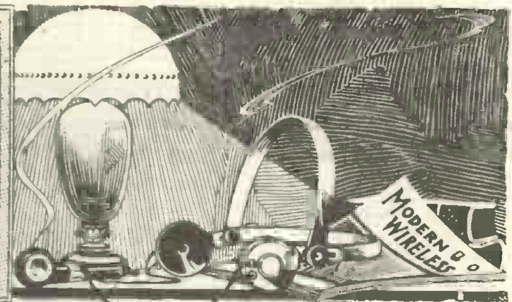


Fig. 11.—Two dimensioned views of the cabinet



Tuned-Anode-Cathode H.F. Coupling

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

Another ingenious contribution to the art from the pen of a prolific inventor

TO the experienced radio investigator it seems to be perpetrating a platitude to state that a tuned anode in a circuit tends to produce troublesome self-oscillation; yet judging from the popular literature, and from the common practice of advocating reaction on a tuned anode in circuits for broadcast reception, it would appear as if it were thrashing a dead horse to discuss at length methods of stabilising such circuits.

The fact is that heavily-damped and high-resistance aerial circuits, with excessively large tuning condensers arranged in parallel with fine wire coils are very widely used in which this instability (the bugbear of sensitive and selective receivers) is non-existent; and a terrific measure of brutal reaction is needed to get the circuits to oscillate at all.

An efficient, selective circuit, *i.e.*, one of low H.F. resistance, and but lightly coupled to the aerial by an extremely loose magnetic coupling or by a small series condenser (not over .0002 μF), will in general oscillate violently the moment an anode circuit of reasonably low resistance (say No. 22 wire with not over .00025 μF tuning condenser) even approaches resonance—and this although stray magnetic couplings are carefully avoided and the wiring is arranged carefully. Ample H.T. and a filament at a sufficiently high temperature to give reasonable emission are assumed, of course, and no positive bias on the grid.

It will be noticed that the most experienced investigators are almost fanatically particular as to arrangement of wiring in a H.F. circuit with tuned anodes or tuned transformers, etc.; even fractions of an inch in the length of the grid-connections being the subject of grave concern. Not nearly enough attention is generally given to these stray couplings, magnetic and capacitative, which are actually responsible for a great deal of the self-oscillation noticed in tuned high-frequency amplifiers. Thus, the subject of stray magnetic fields of tuning inductances, and possible means of reducing the same, has hardly been approached in practical radio work; the 55 or 60 degree neutralising angle introduced by Prof. Hazeltine in connection with the neutrodyne, and the new American D-coils, are perhaps the only prominent contributions of late in this direction.

Yet when all possible care is taken as to stray couplings, magnetic, capacitative, resistance (through the H.T. battery, minimised by the introduction of a 2 μF blocking condenser across the latter), and so on, and the use of low-capacity valves, there always remains the back-coupling through the grid-plate capacity of the valve itself; and, as indicated, this amply suffices to give rise to self-oscillation in a sensitive receiver.

From time to time several methods for neutralising this back-coupling effect have been proposed. The neutrodyne method of Prof. Hazeltine (Fig. 1) is familiar to all by this time: where by deliberately introducing a small back-coupling *in the opposite phase* from the outer end of the secondary of a tuned transformer by means of a tiny adjustable condenser, the back-coupling through the small condenser represented by the grid-plate capacity of the first valve (connecting the inner end of the primary of the same transformer with the grid) can be precisely balanced. In a modification of this method, applied to the simpler and more efficient tuned anode coupling, suggested by the writer (*Wireless Weekly*, Vol. 2, No. 8, Sept. 5, 1923) (Fig. 3), the same effect is got by coupling a separate neutrodyning inductance with the tuned anode, and connecting this at one end to "earth" for H.F. effects, and at the other end through a tiny adjustable variable condenser to the grid of the first valve; control over oscillation and effective neutralisation of any stray couplings (magnetic as well as that due simply to the valve-capacity) being obtained precisely by actual trial under working conditions through adjustment of this condenser, which corresponds to a

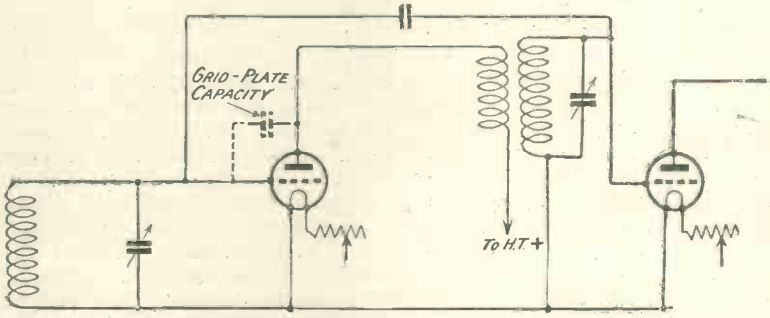


Fig. 1.—The neutrodyne method of neutralising the back-coupling effect are to plate-grid capacity.

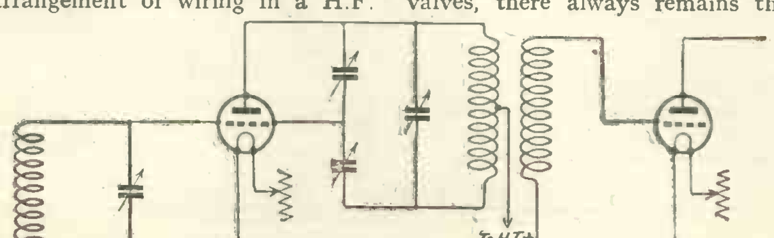


Fig. 2.—The "Bridge" method of stabilising a tuned high-frequency amplifier circuit.

" reaction - condenser " though actually negative in its effect.

A more complex method is the " bridge " method suggested by Mr. Scott-Taggart (*Wireless Weekly*, Vol. 1, No. 12, June 27, 1923), where by taking a centre tapping in the primary of a H.F. transformer for the H.T. connection (and H.F. " earth " connection therefore), and deliberately connecting *both* free ends of this primary (which is also tuned for resonance by a parallel condenser across the whole) by two fair-sized variable condensers to the grid of the first valve (Fig. 2). By proper adjustment of these two condensers the back coupling to the grid from the two ends of the inductance is made exactly equal, the small grid plate capacity being swamped, as it were, in the larger adjustable capacities. Then since the ends of the anode inductance are always in opposite phases, the grid is held precisely neutral at all times, as far as any back-coupling is concerned. The resemblance between this method and the tuned-anode-cathode method to be described here will become apparent later.

A kind of simplified version of this is that which has recently appeared in American magazines: in which a centre tap is taken as before from the transformer primary, but only one small neutrodying condenser is used, connecting the outer end of this primary to the grid. The balance is made then between this tiny condenser and the small grid-plate capacity, and the effect is identical to that already described. An obvious disadvantage of this method (apart from using the less efficient transformer coupling) is that the capacities involved are so small that it is hard to make steady and critically accurate adjustments. This criticism applies of course to any neutrodyning expedients. One version of this latter circuit was published by Mr. W. James on September 19, 1923.

The writer has recently applied this kind of neutralising effect to a tuned-anode coupling (Fig. 4). It is certainly effective there, but rather tricky in operation, hand-capacity effects being very noticeable. It appears to present no particular advantages over the simple neutrodyned tuned-anode, which has met with considerable success in the hands of different experimenters.

An entirely different line of attack is that of the " Tuned Cathode " (*Wireless Weekly*, Vol. 4, No. 9, p. 277, July 2, 1924), communicated some time previously (in April), and recently brought to the attention of the public by the experimenter responsible for the development of the method, Mr. J. F. Johnston. In this (Fig. 5), in place of positive electrostatic reaction through the grid-plate capacity of the first valve, *negative* reaction through the grid-*filament* capacity of the first valve is obtained by tuning an oscillating circuit interposed between the *filament* and earth; the plate being simply earthed (as far as H.F. is concerned). In the ordinary arrangement, a positive potential, *e.g.*, built up on the anode makes the grid more negative by ordinary electrostatic action. This by the valve action cuts off more of the electron stream to the anode and makes the latter more positive. And so the potential builds up until the " critical potential " of the anode for the particular degree of damping present in the whole circuit is exceeded, and self-oscillation sets in.

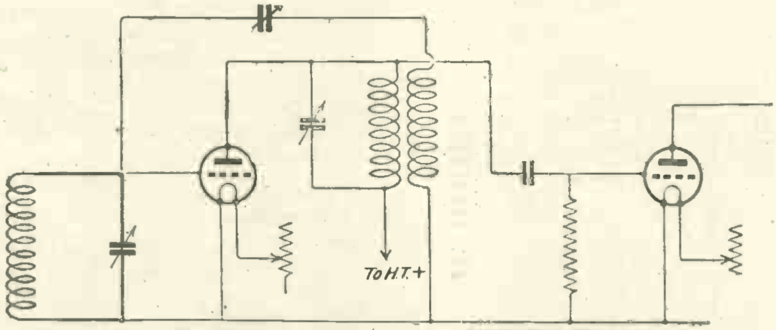


Fig. 3.—A modification of the neutrodyne, suggested by the author.

In the tuned cathode circuit, on the contrary, a positive potential on the filament, by making the grid more negative, will tend to make the other end of the oscillating circuit constituting the tuned cathode more positive; and hence to neutralise the original positive potential at the nearer end. Hence there is no tendency to build up or even maintain an oscillation as far as this small back-coupling is concerned: in fact, the reverse is the case, and considerable positive magnetic reaction has to be used with this circuit to produce and maintain self-oscillation. Mr. Johnston even suggests an arrangement of successive tuning inductances which gives a positive magnetic back-coupling between them, to help reaction.

The ideal arrangement would evidently be to balance the two back-couplings, positive and negative, given by tuned anode and tuned cathode respectively, by an arrangement similar to the "bridge" method discussed above. This the " tuned - anode - cathode " circuit suggested here attempts to do; and, experimentally, completely adequate stability is attainable by the method.

If a tuned cathode circuit be arranged as in Fig. 6, and an exactly similar inductance, coupled with the cathode inductance, be also included in the anode circuit, as shown, each being tuned by its own condenser, equal and opposite alternating potentials relative to the earth point, the centre of the coil, will be found on the filament and plate at all times, as the result of any H.F. oscillation set up in these two coils. The grid will remain at earth potential as far as any effect of these opposite charges on the opposite sides of it are concerned, provided that the grid-plate capacity is about the same as the grid-filament capacity, *i.e.*, that the grid is electrically in the exact centre between them. This is only approximately the case in an ordinary valve the grid-to-filament capacity being in general the greater. However, it will be sufficiently near the case for complete stability to be pro-

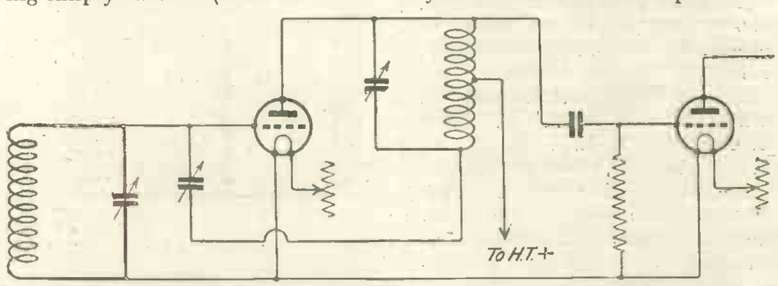


Fig. 4.—The application of the centre-tap method to a tuned anode.

duced in this simple manner. The close resemblance of this method to Mr. Scott-Taggart's bridge method will be evident.

An obvious simplification of this circuit can be effected by tuning right across the whole double inductance, as shown in Fig. 7, the centre earth-tapping being retained. A single tuning condenser now suffices; and the circuit is no more difficult to handle than an ordinary tuned-anode with resistance-damping beyond the minimum necessary for stability.

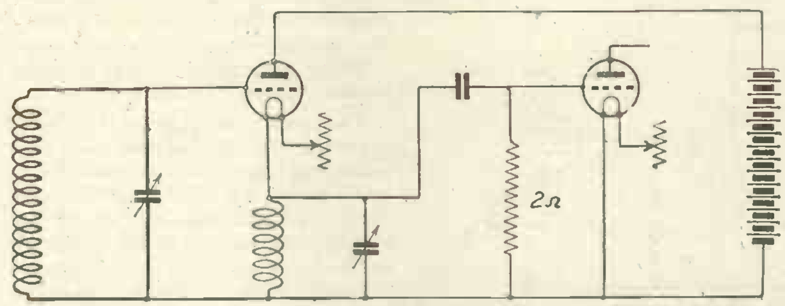


Fig. 5.—The "Tuned Cathode" arrangement due to Mr. J. F. Johnston.

In the figures the H.T. supply and filament-current supply have been omitted, for the sake of simplicity, only the oscillating circuits being shown. In order to obtain a practical circuit one can nowadays use, as Mr. Johnston suggests, for his tuned-cathode circuit the .06 dull-emitter type of valve, each with its own small L.T. battery well insulated (and isolated). Or double inductances can be used for the filament (cathode) oscillating circuit, the D.C. supply being led up one inductance and back down the other. A very simple way of solving the difficulty is that suggested here: merely winding the centre-tapped tuning inductance with double No. 26 wire, and using one as L.T. plus lead, the other as L.T. minus. At the centre tap the wires are separated and one goes to earth, the other to the opposite pole of the L.T. battery as shown. A single filament-resistance here can be used to control both valves; or individual resistances close to the actual filaments. The H.T. supply is easily accommodated by the familiar expedient of a H.F. radio-choke coil, with a large blocking condenser to bye-pass the H.F. component to the tuned circuit. The ordinary large coil specified for such purpose, say No. 250 of plug-in types, a solenoid or narrow slab-coil of 200-400 turns of almost any convenient size of wire, and any covering, suffice. The blocking condenser should be fairly large, say .002 μF.

For the broadcast belt, an inductance wound with doubled No. 26 S.W.G., d.c.c. wire, lightly twisted together for convenience in winding, of 60 turns (doubled) on a 4-in. diameter cardboard former, and tuned by a .0002-0003 μF. parallel tuning-condenser, gave good results. The type of light-coupled aerial circuit, with semi-aperiodic auto-transformer and aerial-tap at ten turns above the earth end, used by the writer in several recent circuits with very favourable results as regards selectivity, was adopted here; and the grid connection of the first valve was to the negative side of the L.T. battery. Complete stability was obtained, even with this lightly-damped grid circuit; and a moderate amount of direct magnetic reaction could be used, conveniently by means of a vario-coupler type of rotor swinging in the aerial-tuning inductance, a 2¾-in. diameter wooden ball wound full with No. 26 d.c.c. wire being found suitable. Reaction on the intervalve inductance did not appear to be favourable.

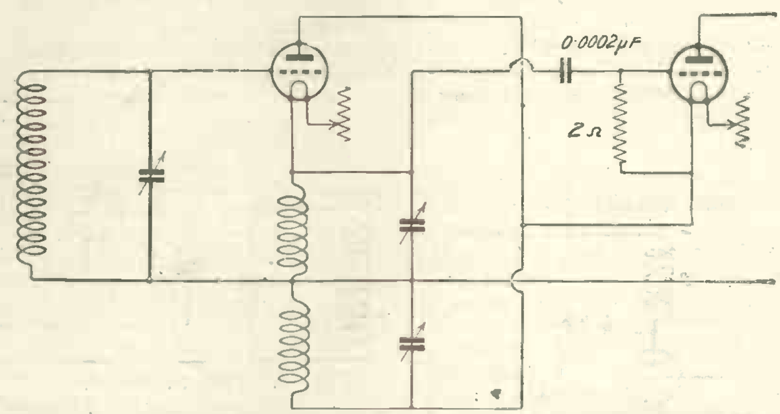


Fig. 6.—The oscillating circuits are here shown of the "Tuned Anode-Cathode" coupling. Batteries are omitted.

It will be noticed that the second detector valve must have, in this circuit, its filament "up in the air," as far as H.F. is concerned, since the H.F. oscillating potential difference we are applying to its grid is here relative to another point also at H.F. oscillating potential difference relative to earth; unless indeed we are content to halve it by using only one-half of the inductance in the inter-valve oscillating circuit across the grid and filament of the second valve. The grid of the second valve is connected by the usual small grid-condenser to the *filament* of the first valve, the second filament being already connected by the large blocking condenser to the anode of the first valve. Thus the whole of the oscillating P.D. built up in the intervalve oscillating circuit is available as signal voltage applied to the second valve. The connections are actually not so involved or complex on the receiver itself as they appear on a paper circuit-diagram. The coupling between the twin wires in the intervalve inductance is so close that they behave in every way as a single wire for H.F.

It was expected that on account of the intrinsic stability of this circuit, enabling the lightest possible resistance damping to be used, the selectivity and sharpness of tuning would be extraordinarily high; but on actual trial this proved not to be the case, although twin No. 26 should not offer a very serious H.F. resistance. The selectivity of the high-frequency stage was no more than with the ordinary tuned-anode with some resistance damping, so that the tuning was noticeably flat for a circuit of apparently favourable design. The same double-damping effect of the two valves, each acting as a Fleming two-electrode valve with uni-directional conductivity, but in opposite senses, which is characteristic of the author's series-tuned-anode H.F. coupling, is probably effective here, and gives actually fairly heavy damping in another wise low-resistance circuit, flattening the tuning considerably. For the same reason the actual amplification attained is not markedly different from that given by plain tuned-anode, when the latter is stabilised just below the

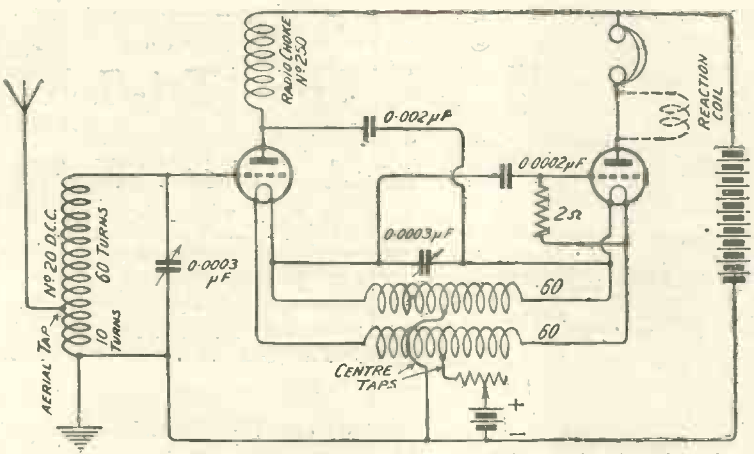


Fig 7.—A practical form of tuned anode-cathode circuit, the values of components being given.

point of self-oscillation, *i.e.*, by actual measurement from 1.5 to 1.7 times the signal strength of a single detector valve with critical reaction under otherwise identical circumstances. The point of this tuned-anode-cathode circuit is the stability reached without any fine adjustments, and without any additional apparatus other than a radio choke and a .002 blocking condenser together with the special double-wound inductance.

It is obvious that the same principle should be applied to a second H.F. stage, though the L.T. connections would become a little irksome here unless the expedient of D.E. valves, each with its own small L.T. battery, be adopted. Fig. 8 gives a suggestion of this type; it would be interesting to learn what results are obtained if any ambitious experimenter tackles this circuit. The writer is not of the opinion that abnormally high selectivity would be found, though there is no reason to expect instability troubles if the inductances are well spaced. A small amount of reaction directly on the first grid-circuit from an anode coil on the last valve would be in order.

Actual results obtained with the circuit in Fig. 7 were quite encouraging, although, as indicated, the selectivity was not abnormally high. Tuning was quite easy, and steady reaction could be obtained which made distant reception pleasurable. The local broadcast station came in at 13 miles at comfortable (not *very* loud) loud-speaker strength on a good outside aerial; and several other stations of the B.B.C. were read at good phone strength and undistorted on the two valves.

With the light aerial coupling indicated and full negative bias on the H.F. valve there was no tendency shown towards self-oscillation, even when the aerial was thrown off and both circuits tuned in unison. With a six-volt accumulator and ordinary R valves the extra resistance of the No. 26 wire in the L.T. leads did not give any difficulty; with D.E. valves this would be proportionately less noticeable.

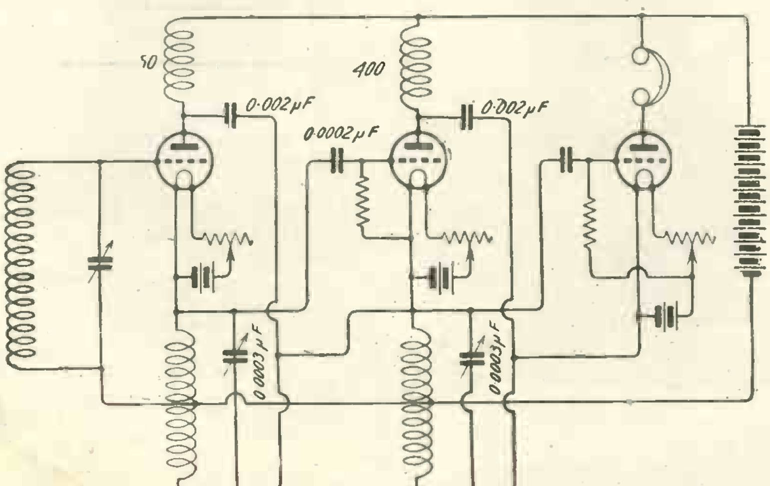


Fig. 8.—A suggested method of applying the principle to two stages of H.F. amplification.

A Belgian Appreciation

To the Editor of MODERN WIRELESS.

SIR,—About a month ago I made up your 4-valve family set, and am very satisfied with the results obtained.

Brussels is quite strong on the loud speaker, using only two valves. Using all four Radiola and Eiffel Tower come in well. Holland, Germany, Prague, P.T.T. Ecole Superieure and Bournmouth also may be heard on the loud speaker.

Bournemouth is by far the easiest English station to get, although England is, more or less, difficult, and everyone over here experiences the same difficulty. I cannot get England whilst Brussels is on. I included loose coupling, but was still unable to cut it out.

I use .06 valves, B.T.H. transformers, a .001μF variable condenser for the A.T.C. and a .0005μF with vernier for the T.A.T.C., Igranic potentiometer and honeycomb coils. My aerial is badly screened, but is of the two wire L type, having a length of 72 ft., and a down lead of 60 ft.

Yours truly,
A. E. LICENCE.
Brussels, Belgium.

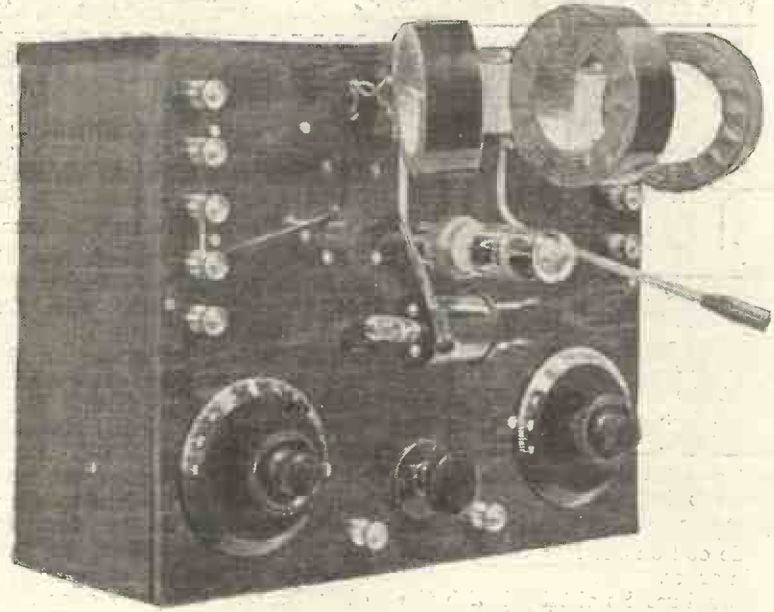
The Puriflex

To the Editor of MODERN WIRELESS.

SIR,—I was very pleased to see Mr. Harris' "Puriflex" receiver in your last issue, as I do not consider Mr. Voight's work has received the attention it deserves. I have used this type of circuit ever since you first published it in No. 1 of MODERN WIRELESS, and have obtained excellent results with it. I use a loose coupler to tune the aerial circuit, and in series with the secondary is a coil which I couple to the H.F. transformer to obtain reaction.

I do not know the exact size of this coil, as I wound it myself, but it must be large enough to make the set oscillate; a No. 75 should suffice.

Yours faithfully,
DUDLEY G. SAINSBURY.
East Finchley, N.2.



The appearance of the finished instrument.

The "Tri-Cell"

A Tri-coil Reflex for Dry Cells.

By

PERCY W. HARRIS.

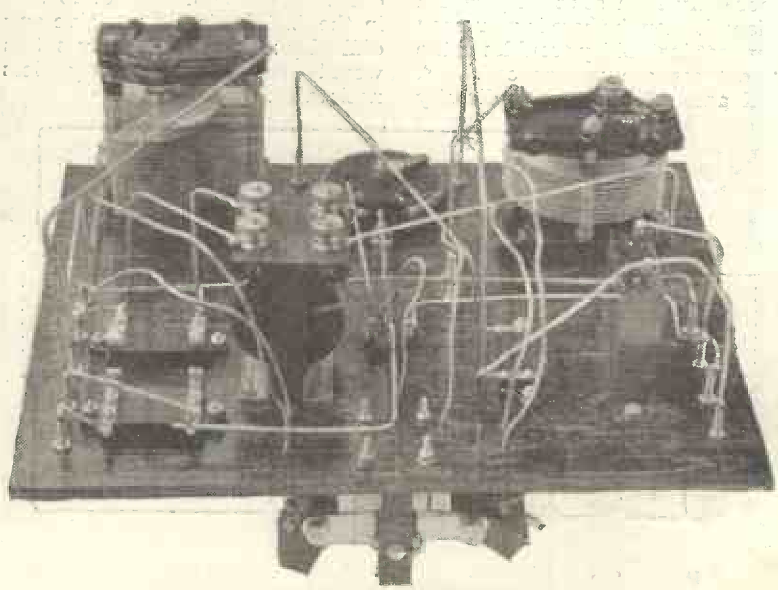
An essentially practical receiver, embodying the remarkable Tri-Coil method described by Mr. Scott-Taggart on another page.

THE simple reflex receiver about to be described utilises the loose-coupled transformer method with tuned secondary which I first described in the Spring Double Number, together with the special combination of coils in a three-coil holder, to which Mr. Scott-Taggart has given the name of "Tri-Coil Coupling." It is easily the most efficient and effective single-valve reflex receiver I have yet built, being much more selective than the usual arrangement. The simplicity of construction will appeal to many experimenters, for the material with which to make it can probably be found among existing apparatus, with the possible exception of the three-coil holder. As it works perfectly with the new .06 ampere valve no expensive accumulator is required, and satisfactory results can be obtained so far as the low-tension supply is concerned from two or three standard dry cells of the size used for ringing electric bells and the like.

The Circuit.

Fig. 1 shows the circuit used, which includes a modification of constant aerial tuning. There will be noted on the left five terminals marked respectively A_1, A_2, A_3, E_1, E_2. In most constant aerial tuning arrangements a fixed condenser of .0001 mfd. is placed in series with the aerial, thus reducing the aerial capacity to approximately .00007 mfd., or about a quarter of the normal. When, however, in a reflex receiver we place a feed-back transformer in series with the aerial and with a fixed condenser across this, we have three capacities in series: that of the aerial, the constant aerial tuning condenser, and the shunt condenser across the secondary of the transformer. This has the effect of reducing the aerial capacity still further. In my arrangement the value of the constant aerial tuning condenser is increased to .0003 μF, whilst that across the secondary is of the same value. If, now, we consider the aerial capacity to be .0003 μF or thereabouts, the three in series will give a total capacity of .0001, a figure I find by experiment to be quite good.

If the aerial is joined to A_2, the constant aerial tuning is eliminated. With the aerial on A_1, A_3 and E_1 joined by a link, the aerial tuning condenser is placed across the tuning coil for parallel working, while if the link is open and the aerial is joined to A_3 the aerial tuning condenser is now placed in series with the tuning coil, with the constant aerial tuning



Everything, including the coil holder, is carried on the panel.

THE "TRI-CELL."

THREE COILS

Giving High Efficiency, Selectivity and Fine Adjustment.

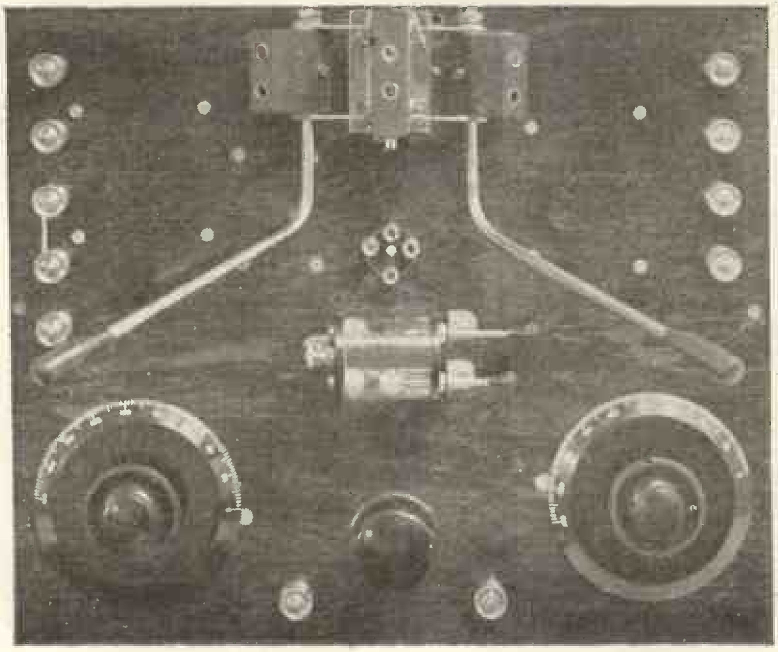
THREE FUNCTIONS

High Frequency Amplification, Detection, Low Frequency Amplification.

THREE DRY CELLS

In Place of an Expensive Accumulator.

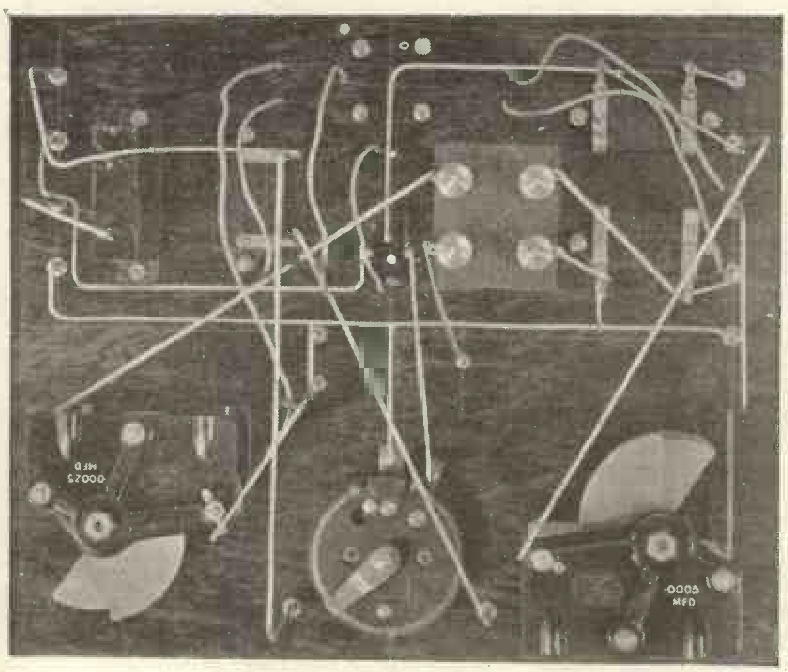
AN IDEAL SET FOR INDOOR AERIALS IN THE BROADCASTING CITIES.



By using a fairly large panel a good layout is secured.

condenser, of course, cut out. This arrangement may suit some aerials. Normally the earth will be connected to E_2, which places the feed-back transformer in series with the aerial, but, if desired, it can be connected to E_1, whereupon the transformer is removed from the aerial circuit. In practically all cases it would be found convenient to leave the aerial connected to A_1, and earth to E_2, with the link closed, so that the aerial tuning condenser is in parallel with the tuning coil.

The valve, which may be either a bright or a dull emitter, is joined as shown across the tuning coil and the earth connection, whilst in the plate circuit is connected a coil which for the ordinary broadcast wavelengths may be 100 turns, the circuit being completed through the telephones and the high-tension battery. Across this latter is placed a 1 mfd. capacity to smooth out the high-tension supply when the battery tends to be irregular, which will often be the case after some months of use. The telephones have, of course, a .001 mfd. condenser across them.



A plan view of the rear of panel. The variable condenser values are stamped on each.

Loosely coupled to the plate coil is a third coil which, for British broadcast wavelengths, other than Chelmsford, may be a 50 or 75, across which is connected a variable condenser of .00025 or .0003 mfd. As plug-in coils are used there will be no advantage in making this condenser larger, as the capacity is ample to bridge the gaps between the various coils of the commercial series. Shunted across the tuning condenser is a crystal detector in series with the primary of the feed-back transformer, the secondary of which, as previously mentioned, is in the aerial circuit. Simply explained, the functioning of the circuit is as follows :

Incoming oscillations set up differences of potential across the aerial tuning coil, and these differences of potential are impressed upon the grid and filament of the valve, setting up fluctuations of plate current from the high-tension battery. These fluctuations cause a varying magnetic field in the plate coil, and this in turn induces current in the third coil shunted by the tuning condenser. When this last coil is in resonance with the aerial frequency, considerable differences of potential will be set up across the terminals of the tuning condenser and, by the aid of the crystal detector, rectified current will be fed through the primary of the intervalve transformer, setting up differences of potential across the secondary. These are impressed upon the grid of the valve once more, magnified fluctuations of low-frequency current passing through the telephones and making themselves audible as signals we desire. We thus have in the plate circuit of the valve two fluctuating currents, one of high-frequency and the other of low-frequency. These do not interfere with one another in any way, one set of ripples flowing over another, just as we may see two different sets of waves in a seaside pool.

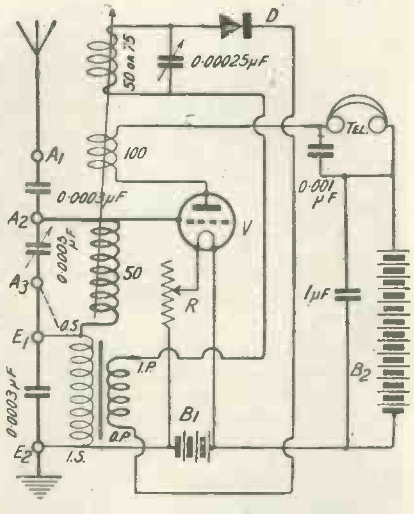


Fig. 1.—The theoretical diagram.

Coupling between the plate coil and the coil across which the crystal detector is shunted is necessary, but coupling between the plate coil and the aerial is not essential. These two coils may be so arranged as to be at right angles, but any coupling between them will give additional magnification through reaction. This coupling effect is very valuable, and the whole arrangement of three coils in one holder is most efficient and useful.

Components Required.

To make up the set the following are the components required. In accordance with the usual practice of this magazine the names of the actual components used are given, but it should be understood that any good equivalent makes can be substituted.

One ebonite panel (Radion Mahoganite) 12 by 10 by $\frac{3}{16}$ in. (or $\frac{1}{4}$ in.)

One box or cabinet for same, 5 in. deep.

Eleven terminals.

One three-coil holder (Magnum).

One valve socket or set of valve legs.

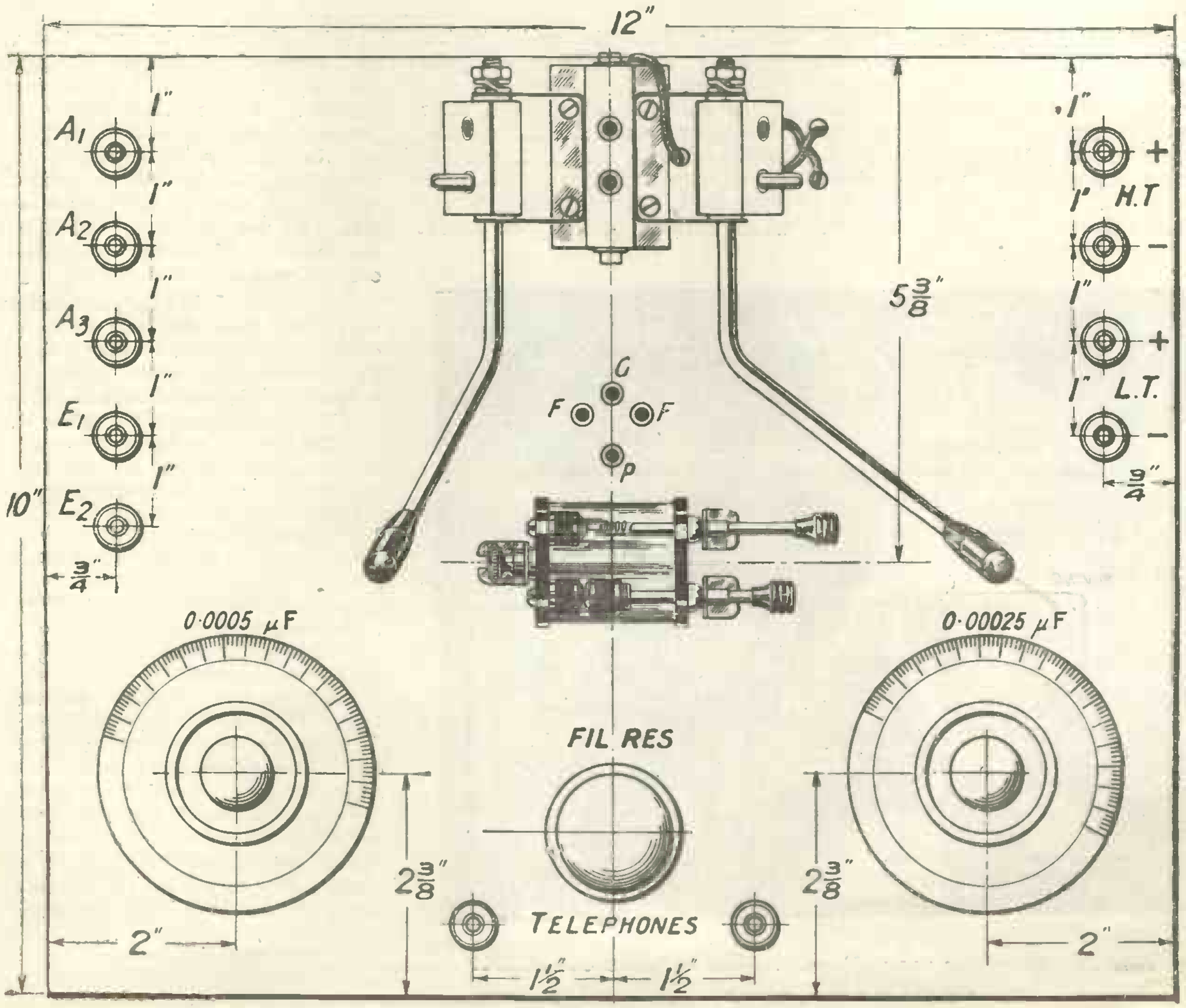


Fig. 2.—Front of panel drilling diagram and engraving key.

One square law condenser with vernier (.0005 mfd.), Sterling Condenser.

One square law condenser with vernier (.00025 mfd.) Sterling Condenser.

A vernier fitting to the aerial tuning condenser (.0005 μF) is essential if the best is to be obtained from the set.

One filament resistance (Burndept Dual). If dull emitter valves are used care should be taken to obtain a resistance suitable for the valve.

Two fixed condensers, .0003 mfd.

One fixed condenser, .001 mfd.

One fixed condenser, 1 mfd.

One intervalve transformer (McMichael). This firm now sells an improved model fitted with clips for a fixed condenser. The fixed condenser supplied with this transformer can be substituted for the .001 μF above specified.

One crystal detector (that shown is of a double pattern so that zincite-bornite or treated galena with cat's-whisker can be used. Any good make of glass-enclosed crystal detector will do. I forget where that shown was purchased).

Square section wi e for wiring-up.

One 60-volt high-tension unit.

Three large dry cells (if dull emitt rs are used of the .06 ampere type).

One 20 or 30 ampere-hours accumulator (6-volt, if a bright emitter is to be used).

Constructional Work.

The first step in making the set is to see that your panel is suitably finished. The Radion panels are highly polished and at the same time are guaranteed free from surface leakage. They can therefore be used just as they are, and can be bought cut to this size. The Paragon panels and those sold by the Bowyer-Lowe Company are both guaranteed free from surface leakage. Most other ebonite sold needs to have the surface skin removed with emery, otherwise there will be considerable leaking and the set will certainly not work satisfactorily. I am sorry to have to emphasise this point once again, but Mr. Kendall tells me that many sets submitted to the Radio Press Service Department, for an explanation as to why they do not work, have untreated ebonite panels which leak badly.

The square law condensers are supplied with drilling templates, which greatly facilitate the marking out of the panel. If you use a Sterling condenser be sure to allow ample room for plate clearance when marking out the panel, as owing to the peculiar formation of the moving plates these stick out at one side when the spindle is rotated. No explanation is needed regarding the lay-out of the panel, for a full-size blue print can be obtained for 1s. 6d. on application. The blue print is No. 62 and the number should be given when ordering.

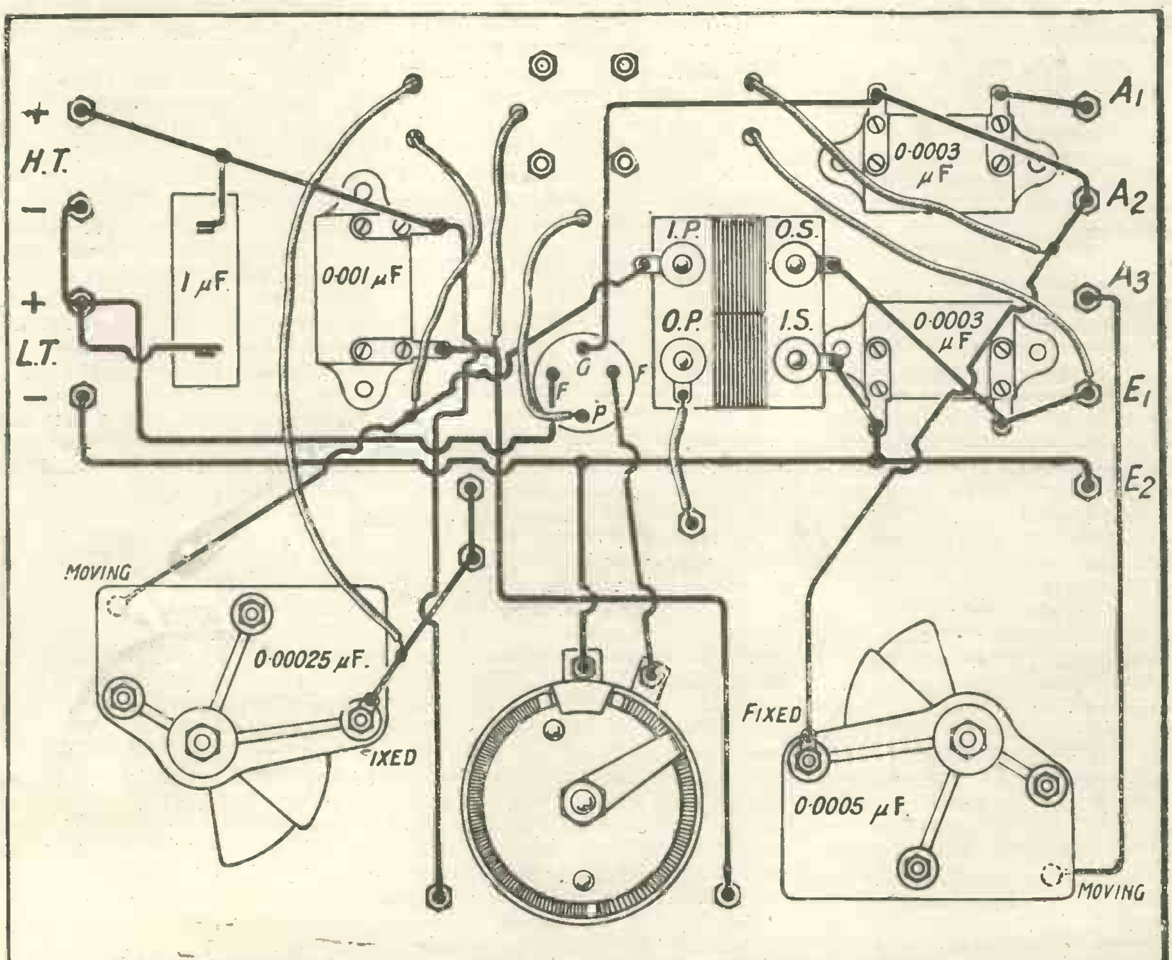


Fig. 3.—Back of panel wiring key. Blueprint No. 62.

Wiring Up

Wiring is best when done with the square section wire, and the disposition of wires should follow closely that given in the illustrations if good results are to be obtained. The six leads from the moving coil holder are flexible wires obtained by undoing electric lighting flex and stripping off the silk covering. This leaves a rubber-covered wire, which is very suitable for the purpose. Keep all wires well clear of one another. You will have no difficulty in doing this if you follow the lay-out given.

Testing

As soon as wiring up is finished mount the panel on its box, connect the aerial to A_1, and join A_3 and E_1 by a piece of wire. Connect earth to E_2. A pair of telephones should be connected to the terminals on the front of panel, and high tension and low tension batteries joined up to terminals on the right, as marked. If your local station is one of the lower wavelengths, plug in a 50 coil in the aerial socket, a 100 coil in the central socket, and a 50 or 75 in the right-hand socket. Move the aerial coil flat against the panel and bring up the right-hand moving coil (secondary) close against the central coil. Place the cat's-whisker on the crystal, or, if you are using the zincite-bornite combination, bring the two crystals in contact, set the right-hand tuning condenser at about half its full value and move the left-hand condenser until you hear the local station. Now readjust the right-hand condenser, make a final adjustment on the aerial tuning condenser until you hear the local station quite well. You will probably find the tuning of the aerial circuit extraordinarily sharp and you might quite easily miss the station on first trial. When you have obtained signals at good strength move the aerial coil slightly towards the central coil and see if signal strength is improved thereby. If it is, all is well, and you may adjust reaction until you come near the oscillating point. However, if you are a considerate listener, as I believe you to be, you will keep well away from the oscillating point. If moving the aerial coil towards the fixed coil reduces signal strength, reverse the connections to this coil. When you have become used to handling the set in this way try varying the coupling between the secondary and the central anode coil.

Test Report

I have no hesitation in saying this is the most efficient single valve reflex set I have yet made or described, and although to get the best results a little patience is required, the average experimenter who has already handled one or two sets acquires the necessary skill very quickly. The selectivity is very high compared with an ordinary reflex receiver, and on an indoor aerial at Wimbledon I have had no difficulty in getting loud signals from Radiola without any interference whatever from Chelmsford. At seven miles from 2LO a good indoor aerial will work a loud speaker for a small room, whilst on an outdoor aerial several other stations, and, in good conditions, all of the B.B.C. stations, can be heard in the telephones.

In accordance with my usual practice, on completion the set was tested with several makes of tuning coils and with many different makes of valves. The set worked admirably with three dry cells as a low-tension battery, using a D.E.3, a B.5, or an A.R.06. It should work just as well with the Mullard D.F. Ora Valve. Of the bright emitters, those valves which have proved satisfactory for high-frequency amplification were suitable here, although all the usual general purpose valves worked well.

The set can be worked with the panel either horizontal or vertical, although the vertical position is best, as many three-coil holders tend to open out of their own accord when used on horizontal panels. For longer wavelengths the aerial may be connected to A_2, thus cutting out the constant aerial tuning condenser; whilst for very short waves the aerial can be connected to A_3, with the link opened up, whereupon the aerial tuning condenser is in series with the coil.

Too tight a reaction adjustment will bring about a noisy buzzing in the telephones or loud-speaker.

If a different transformer from that used by me in the present set is adopted it will be well to try reversing IS and OS. In the transformer arrangement described the OS is connected as shown in the diagram.

As usual, reports from readers on the working of this set will be welcomed. It is not generally realised how helpful these reports can be to other readers. A subscriber in a country town, for example, may have doubts as to whether the particular set will serve for reception of a particular station in his locality. A letter from a reader near by, using the same set, will give him much valuable information.

From Spain

To the Editor of MODERN WIRELESS.

SIR,—It may interest you to know about some of the excellent results which I have obtained with several home-made sets which I have constructed under the directions published by you in MODERN WIRELESS.

The first set which I constructed was the S.T. 100, giving me excellent results; with this set I could hear from Madrid, all the London and Bournemouth concerts, the particular feature of the set being its clearness in reception. I could hear also Aberdeen (bagpipes on the inaugural day of the B.B.C. station), Manchester and others. With a similar set constructed by the President of the Radio Club of Spain we were able to hear last February an American station on L.S. standing at a distance of 4 metres. We could, of course, under favourable circumstances hear English stations in the L.S. nearly every day.

Lately I have constructed your 3 valve dual set with which I have also obtained first-rate results. In Madrid in spite of the heat (70 degrees C. in the shade in day-time) with single aerial wire of 30 metres we received five English stations, and one in the loud-speaker (London with remarkable volume). Madrid at distance of 7 kilometres is heard on L.S. without either aerial or earth.

From this sea-side resort situated about 400 kilometres as the crow flies from Madrid, I have been able to hear this station (800 watts) using the earth on the aerial terminal (without earth) in the L.S. with good volume and excellent quality. By this means I can hear better than with aerial, because thus I eliminate the effects of the alternating current which we have in this village. The set works likewise using the aerial without the earth terminal, of course, without eliminating the sound caused by the alternating current.

I am planning the construction of the "Transatlantic V." hoping to obtain good results.

Congratulating you on the excellent results which Spanish amateurs have obtained with your sets and on the high esteem with which these are held amongst us.—Yours truly,

SALVADOR ALONSO,
Vigo Bayona.

The Gentle Art of Tuning

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

A welcome article of great help to the beginner.

THERE is a great deal more in tuning a wireless set than most people think. Some men are artists at the business, whilst to others it means little or nothing more than a rather haphazard moving of knobs and handles until the desired signal is somehow obtained. Even expert knowledge does not always bring the power of handling a receiving set to the best advantage. I have known quite a number of enthusiasts who, though excellent as regards the construction and design of sets and though possessing an extensive knowledge of the theory of wireless, were yet unable to get the best out of any instrument that they were handling. We may find a parallel which is almost exact in horsemanship. With one rider a horse will be thoroughly well mannered, will move well and jump freely, whilst with another he may be a perfect fiend, refusing to do anything as it should be done and fidgeting all the while as though he were thoroughly uncomfortable. The first rider has sympathy with his mount and is also blessed with " hands," the second is probably lacking in one or both of these desirable attributes. In just the same way a given wireless set may appear unstable, not very selective and far from sensitive when handled by one man, whilst when another takes charge it will behave as though it were an absolutely different set, bringing in distant signals with good strength and showing no tendency to self-oscillation. The secret of getting the best out of a set lies in the possession of a full knowledge of what you are doing when you make any adjustment, and the ability to make the very small movements of the controls that are called for.

When we speak of tuning we are really using a comprehensive term to cover a good many processes. Before we can obtain, for example, perfect reproduction of a broadcast item by means of headphones or loud-speaker we must—

1. Pick up the desired signal.
2. Tune *in* this signal to good strength.
3. Tune *out* other signals on neighbouring wave lengths.
4. Avoid distortion by seeing that the set is neither in oscillation nor working too close to the oscillating point.

The process then divides itself into four parts, which may be summed up as searching, obtaining resonance, obtaining selectivity and avoiding distortion. Let us deal with these matters in the order in which they have been mentioned.

Searching wrongly performed is responsible, I believe, for the majority of the interference by radiation which so frequently ruins the reception of broadcast items. The trouble is that there are thousands of folk who operate wireless sets without the slightest knowledge of what they are doing. To them the simplest way of searching for a transmission seems to be to bring the set into oscillation by coupling the reaction coil tightly to the aerial tuning inductance and then to vary the capacity of the aerial tuning condenser until a carrier wave is found by the process of heterodyning. This done, the aerial condenser and the reaction coil coupling are adjusted in an endeavour to find the " silent point," which is not always a very easy process, since the set, being in oscillation, calls for very critical adjustment, and the effects of any hand capacity make themselves felt. Thus an unskilful person searching in this way may take several minutes to obtain the required adjustment, during the whole of which time he is treating the surrounding neighbourhood to a varied selection of those wails and howls which we know only too well. Now this is emphatically not the way in which searching for telephony should be done, at any rate upon broadcast wavelengths. The process of trying round for a carrier wave is absolutely unjustifiable, except possibly when one is striving outside broadcasting hours to pick up some very weak and distant signal which cannot be obtained in any other way. Even then it should be very sparingly used, owing to the interference which it is bound to cause. When a continuous wave transmission is being

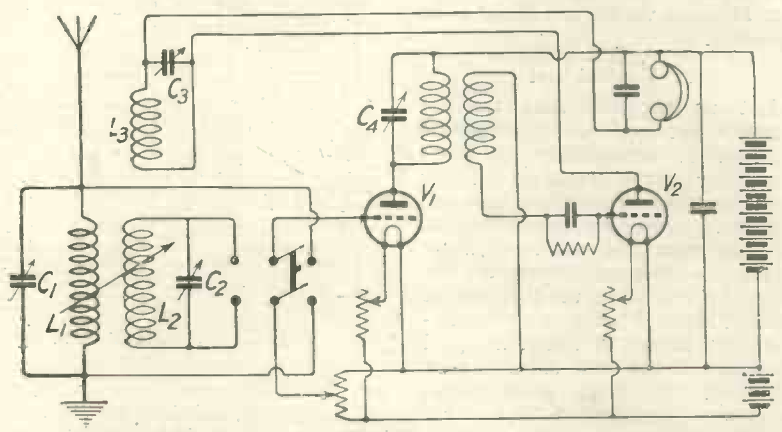


Fig. 1.—A typical receiver which is difficult to tune.

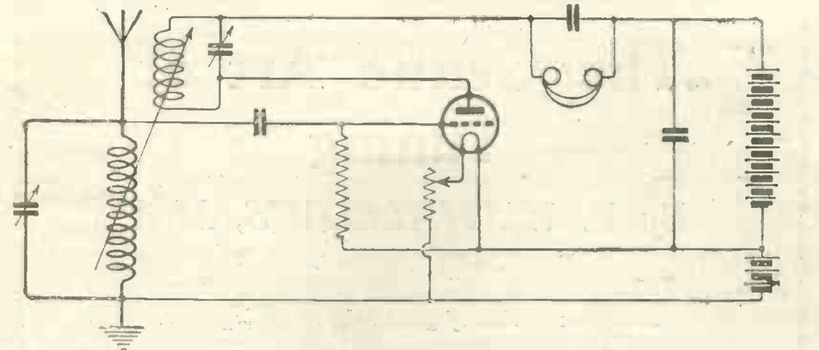


Fig. 2.—A fairly simple circuit to adjust.

sought for the case is of course quite different, for then if one has not access to a separate heterodyne, it is essential that the receiving set should be oscillating in order to heterodyne the signal. Quite apart from the question of interference, oscillation is most undesirable when telephony is being received owing to the distortion which it must cause. The proper way of searching for a spark or telephonic transmission is first of all to adjust the set well off the oscillation point. One then tries round, hearing a number of signals, and then separates the one desired from the rest by tuning it in as well as possible and then making the set selective before accomplishing the final adjustment. The closely coupled reaction coil makes for selectivity. It should therefore not be used whilst searching is in progress.

A Typical Set

Let us suppose that we are using a set such as that shown in Fig. 1, containing one high frequency stage and a rectifier with transformer coupling between the two. The tuner is loose coupled and is provided with a tune-standby switch which enables the closed circuit to be used or not at will. There is also a potentiometer by means of which the grid potential of the first valve can be adjusted. To bring such a set into an unselective condition we first of all throw the tune-standby switch over to the right, so as to cut out the closed circuit L_2 C_2. Secondly, we adjust the potentiometer so that the potential on the grid of V_1 is one or two volts positive. We thus introduce damping, which besides making for stability also renders the set unselective. The reaction coil L_3 we place so that it is loosely coupled to L_1 and we apply the usual test of touching the aerial terminal with a wet finger to see that the set is not in oscillation. We can move up the reaction coil a little, but not too much. Searching can now be done by means of two controls only, the condensers C_1 and C_4. With the help of these we can try over the whole band of wavelengths covered by the aerial tuning inductance L_1 and the high frequency transformer. If this band is between, say, 350 and 500 metres, we shall find that as the controls are moved a number of transmissions from both British and European broadcasting stations may be heard. Some will be quite strong, others very weak.

The best way of conducting searching, supposing that we have

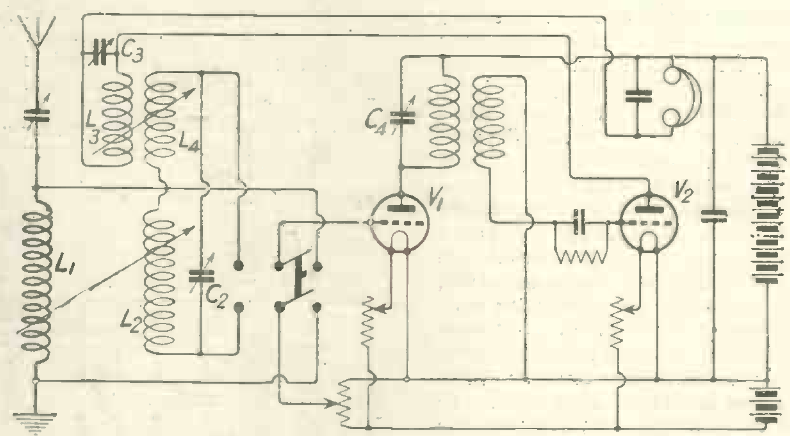


Fig. 3.—A better arrangement of the Fig. 1 circuit.

not the slightest idea of the capacity required in C_1 or C_4 to bring in the desired transmission, is as follows: Set C_1 at 20 degrees—unless it is a Square Law condenser the portion of its scale below 20 degrees will not be of very much use in any case. Then turn C_4 very slowly from 0 to 180, listening carefully for any signal. If this produces no result, set C_1 at 25 degrees and repeat the process with C_4. Continue advancing C_1 5 degrees at a time until some transmission of known wavelength is picked up. Supposing, for example, that the signal we want has a wavelength of 390 metres, and that we eventually succeed in picking up Birmingham with C_1 at 120 degrees, we know that the set is now tuned roughly to 475 metres, which is considerably above the required wavelength. We therefore work backwards from this point, reducing the setting of C_1 by two or three degrees at a time until another station whose wavelength can be identified is found. If this is above 390 metres we know that we must continue downwards, but if it is below, then the wanted station has been "bracketed" and the setting of C_1 which will bring it in must lie somewhere between the two which have been found. The process sounds a little laborious when it is written down on paper, but actually it takes only a very short time, and perfection comes with practice. When we know that we must be quite close to the desired wavelength we search very carefully, and supposing that we hear no sign of the signal we want we tighten the coupling of the reaction coil, though still keeping it short of the point which will produce oscillation. We may also move the potentiometer a little over towards the negative end. As soon as the required signal has been found the first process, that of searching, is at an end and the second, that of tuning proper, begins.

It is not, of course, every set which is arranged on the lines shown in Fig. 1. But of whatever type the set may be the general principles of searching remain the same, and the golden rule is to render the set as unselective as may be before starting and also to stabilise it as far as is possible without undue loss of sensitiveness. Let us take the case of a very simple circuit such as that which appears in Fig. 2. Here the set is by its very nature not selective.

When a single-circuit tuner is in use considerable damping due to the aerial itself is present in the grid circuit, and there is also the fact that the aerial tuning condenser is in parallel with the inductance. Further, the finer the wire with which this inductance is wound the greater will be its high-frequency resistance and therefore the flatter the tuning. With such a circuit there will be no need to produce decreased selectivity: it exists already to a sufficiently marked degree. Selectivity can be obtained in this circuit only by means of reaction, and we must do our searching with the reaction coil not too closely coupled. This is precisely what happened before, but in the former case we were able deliberately to decrease the natural selectivity of the circuit by various adjustments.

Resonance

We come now to the important question of tuning the circuits of the receiving set to resonance with the frequency of the incoming transmission. Here the requirements are precisely the opposite of those which existed when we were searching. We wish to be able to tune in the desired signal as sharply as possible, to obtain the greatest strength and to exclude all other signals. Except in so far as it is necessary to produce stability, damping is no longer desirable, for a damped circuit will always be unselective, that is to say, it will respond not to one frequency but to frequencies covering a fairly wide band, the width of the band depending upon the amount of damping that is present. If we are using a double-circuit tuner we now throw the switch over so that the closed circuit is brought in. We take steps towards obtaining resonance by manipulating the closed circuit condenser, working first of all with a fairly tight coupling between the aerial tuning inductance and the closed circuit inductance. The introduction of the secondary circuit may make it necessary to alter slightly the adjustments of the condensers in other circuits. These adjustments should be made very gradually until the best strength is obtained.

Reaction

It is now time to make use of the reaction coil to increase our signal strength. The circuit which is shown in Fig. 1, though it has its good points, has one very great drawback. It can be made up only by mounting the three coils, primary, secondary and the reaction upon a triple coil stand. This system has the grave disadvantage that strong cross coupling between all three inductances cannot be avoided, in fact I do not know of any more difficult tuning arrangement in the hands of a beginner than that which consists of three coils, one fixed and two moving mounted upon the same stand. A far better arrangement of the Fig. 1 circuit is shown in Fig. 3.

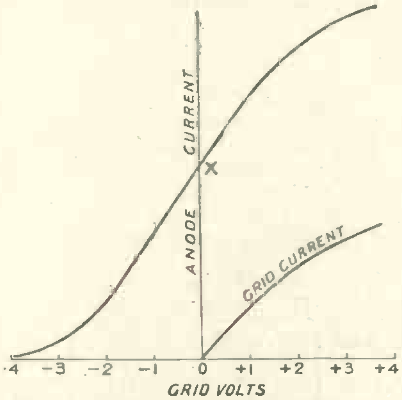


Fig. 4.—Explaining grid current.

Here the secondary has been "split," part of it being coupled to the A.T.I. and part to the reaction coil. This calls for the use of two double coil stands, the A.T.I. and part of the C.C.I. being mounted upon one, whilst the other part of the C.C.I. and the reaction coil are upon the other. The two stands should be kept well apart so that no cross coupling occurs between their inductances.

However this coupling is arranged the reaction coil should be brought very gradually up, a careful watch being kept meantime for signs of oscillation. It is surprising to find how many people are quite unable to recognise the presence of oscillation, though they may talk glibly about it. Briefly the signs are these. As the reaction coil is brought closer a rushing or rustling noise will be heard in the receivers, and if the high-tension battery is at all noisy sounds which so many call "atmospherics" will become very evident. Touching the aerial terminal with a wet finger will now produce a distinct "plock" in the receivers, and if the grid-leg of the first valve is touched in the same way the "plock" will also be heard. If speech has been tuned in it will become louder and louder as the distance between the coils is decreased, but at the same time its distinctness will be mutilated; music loses its tone, becoming wooden, with considerable harshness upon loud passages. If we continue to bring up the reaction coil the set will howl. Anybody can of course recognise a howl, but there are many who do not realise that the set may be in oscillation long before the actual howl is heard. In tuning we should be careful not to reduce the distance between the reaction coil and the secondary so much that we are just upon the oscillating point. As we shall see later, distortion is bound to occur if the set is in oscillation or close to the oscillating point.

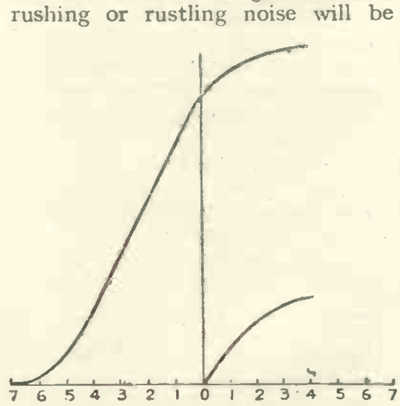


Fig 5.—Use of higher potential to displace curve to left.

Fine Work

In making adjustments to obtain resonance it must be realised that fine work is called for, especially when signals are weak and distant. In a circuit such as those shown in Fig. 1 and Fig. 3, the adjustment of the aerial tuning condenser when the secondary circuit is in play will not as a rule be very critical. It can usually be left for the time being at its original setting, whilst C_2 and C_4 are manipulated. The adjustments required in C_2 may be very fine indeed if signals are weak. For some reason it was at one time almost a standard practice to use as the A.T.C. a condenser with a maximum capacity of .001 μF, the capacity of C_2 being .0005 μF, and that of C_3 .00025 or .0003 μF. It is now realised that .0005 μF is quite big enough for the primary, and that .0003 is on the big side for the secondary. For tuning either high-frequency transformers or tuned anode circuits I employ condensers with a maximum capacity of .0002 μF, or possibly .00025 μF. Better results are obtained with these and one's task is easier, since such fine adjustments are not required as with larger condensers. Should you be unable to make satisfactorily the small adjustments required for C_2 and C_4 the work will be greatly simplified by fitting a "vernier" condenser in parallel with C_2 and by using a device such as the Fynetune or the Friction Pencil for adjusting C_4.

Two Stages Completed

We have now accomplished the first two stages: the desired signal has been picked up and it has been tuned in with good strength. If it is on a fairly crowded waveband we shall probably find that it is not coming in quite alone. It will be louder than other signals, though they will provide an undercurrent of sound which is not pleasant. Whether we can get rid of them altogether depends very largely upon the design and construction of the set. If its coils are wound with thin wire and if the wiring is done so that stray capacities between leads at different potentials render it naturally unstable, great selectivity will not be obtained, since we shall be unable to reduce the amount of damping to small proportions. The first step towards obtaining selectivity is to loosen the coupling as much as possible between L_1 and L_2. If the set is at all unstable it will be found that when the coupling is very loose it shows a strong tendency to oscillate, since there is now very little damping in the secondary circuit. Should this be the case do not try to get rid of oscillation by throwing the potentiometer over to its positive end, for by doing so you will introduce very heavy damping and may nullify the effect of the loose coupling. Work rather with a reasonably loose coupling and with only a small positive potential upon the grid of the high-frequency valve. A little practice will enable you to strike a balance which gives the best results and yet leaves the set quite stable. The reaction coil, too, if properly used, is a very great aid to selectivity, but it must never be so closely coupled that the set is all the time trembling upon the brink of oscillation.

Nearby Transmissions

Even in the most skilful hands the best set can seldom be made selective enough to tune out a powerful transmission from a near-by station so completely that a weaker signal upon a neighbouring wave can be brought in absolutely without interference. Those who are unfortunate enough to be situated in places where interference from spark stations or from other broadcasting stations is very bad must have recourse to some form of wave trap. It is not always realised that selectivity in a set can be overdone, for the reception of telephony at any rate. A telephonic transmission consists not of a single frequency but of a fairly wide band of frequencies lying upon either side of the carrier wave. If the set is ultra-selective distortion may arise through the straining out of a portion of the modulation.

It must never be forgotten when obtaining either resonance or selectivity that it is of the utmost importance that the valves should be worked upon the correct portion of their curves. The set may be unstable and unsatisfactory altogether simply because the anode voltage of the high frequency valves and rectifier is too great, or because the filament voltage is either excessive or too small, or again, because the gridleak of the rectifier is not of the right value. Each of these adjustments demands attention in order to obtain the best results.

Distortion

We come lastly to the question of obtaining good signal strength without distortion. It is a common experience of those who start with small sets and afterwards increase their power by adding to them either high-frequency stages or note-magnifying valves that reception which was perfectly good with headphones is far from pleasing with the extra power and a loud-speaker. The loud-speaker is usually blamed, but as often as not it is almost entirely guiltless. Distortion, provided that the telephones or loud-speaker are all that they should be, may arise from several causes. A very frequent one, though it is seldom recognised, comes from the use of excessive damping by means of the potentiometer in the high-frequency circuits. If in order to control the set the grid of any high-frequency valve must be given a strong positive bias, mutilation of the wave forms takes place before they reach the rectifier owing to the heavy flow of grid current which is set up by positive half-cycles. It should therefore be the aim of every user of a multi-valve set to use the potentiometer as little as possible and to get its slider as near the negative end as may be, controlling any tendency to oscillation rather by adjusting the coupling between primary and secondary coils, by reducing stray capacities on the high frequency side of the set to a minimum, and by varying the plate and filament potentials until a correct adjustment of each is found.

The same distorting effect of grid current often occurs on the low-frequency side of the set where the same anode potential is supplied to all valves, no matter what their functions may be, and where the note magnifiers are worked with their grids at zero potential.

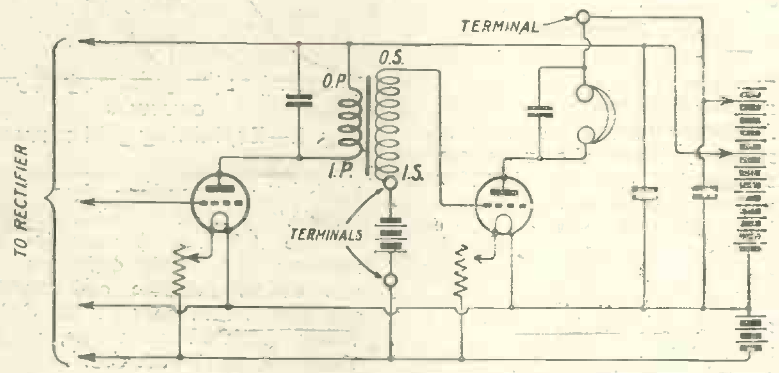


Fig. 6.—Two improvements of value.

An examination of Fig. 4 will show that if the working point of the valve is at X a positive half-cycle will lead to a large flow of grid current, which will be cut down to zero by a negative half-cycle. Mutilation of the upper half of our wave will therefore take place. By applying a high potential to the anode the whole curve of the valve can be moved bodily to the left as seen in Fig. 5. Obviously we cannot now work at zero grid volts, for if we do so the upper half of each wave would run into the upper bend and the almost flat portion of the curve. But by applying a negative grid bias with a value of about 3 volts we bring the working point to X in the curve. An impulse with a value of plus or minus 2 volts will thus not take the working point of the valve off the straight portion of its curve, nor will it cause any appreciable flow of grid current. The result will be pure and undistorted low-frequency amplification. If any reader has a set with one or more stages of low-frequency amplification which is not provided with a grid battery he should fit one without delay. This can usually be done quite easily even with boxed-in sets. All that is necessary is to disconnect the lead running from LT to IS of the transformer. Two terminals are then mounted upon the panel, one being connected to IS and the other to LT. A suitable number of flashlamp cells can then be inserted in series between these terminals as shown in Fig. 6, the negative being connected to the terminal which corresponds to IS. Besides improving the quality of the reception this battery will also effect great economies in the high-tension output and therefore increase the life of the plate battery. A further improvement that can be made to almost any set is also shown in Fig. 6. This consists in disconnecting the telephones from the high-tension busbar and joining them instead to an extra terminal provided upon the panel. A second wander plug connected to this terminal will enable extra positive potential to be applied to the anode of the last note-magnifying valve.

To sum up, the whole art of tuning resolves itself into a thorough understanding of what one is doing and the paying of careful attention to points of detail. Do not search for carrier waves; be sparing in your use of reaction; keep the slider of the potentiometer as near its negative end as possible; always use a loose-coupled tuner if you can; see to the adjustments of your valves, and, finally, make purity and not mere volume of sound your standard.

INTERESTING EXPERIENCES WITH THE THREE-VALVE DUAL.

To the Editor of MODERN WIRELESS.

SIR,—I am enclosing herewith two photographs of the "3-valve dual," as described in your April issue. You will observe the panel is mounted into a cabinet that is entirely self-containing, the only wires seen externally are the aerial, earth, and loud-speaker leads. The cabinet is capable of holding all accessories, such as 'phones, coils, and a spare accumulator. As regards the disposition of components, I have kept strictly to your design. I used "R.I." L.F. transformers and a McMichael H.F. (tapped) transformer. The "low range" model, which covers up to 1,000 metres, is efficient, and works perfectly. There are also three extra switches in the negative leads of the L.T., H.T., and G.B. batteries, which enable the set to be switched on as left, tuned to a station. I was unable to obtain a Watmel grid lead when constructing this set, but have fitted one since, as without it the set was unworkable. I constructed this set for a certain purpose, which is not of interest here, and have used it daily for a couple of months now, so perhaps some fellow readers will be pleased to compare it on test. It will receive all the principle B.B.C. stations on the loud-speaker, which you will observe is not a baby. Glasgow comes in with

The Set Described.

wonderful volume, Cardiff, however, is for some reason hard to tune in. It gives by far the best reception of 5XX that I have heard, the reaction in this case is shorted. I have received many Continental stations that I am unable to identify, but as an instance of what can be done with this set the following may be of interest. On Sunday night, 3/8/24, after all B.B.C. stations had closed down, I noticed by reference to your table of Continental programmes that Madrid should be transmitting. This station was easily tuned in. A little adjustment was then made to the H.T. voltage, and loud-speaker reception of really good tone and sufficient volume to be heard quite easily four rooms distant was obtained. A selection from "The Merry Widow" was exceptionally fine. There was also "A Talk" (goodness knows what about) and some good soprano singing. I suppose Madrid cannot be less than 700 miles "as wireless flies." I found much depended on a proper combination of valves. Those in the photograph make an excellent combination, they are—No. 1, B.T.-H. B4; Nos. 2 and 3 are Marconi R.5 V. I have discovered since that the new Marconi D.E.5 in the No. 3 socket gives a vast increase in tone and volume. The leads to the batteries, etc., are taken through a small hole drilled by the side of the terminals, this has the advantage of keeping all the connections on top and in view. A great advantage in this set is that only one L.T. and H.T. service is required. As a complete outfit, that is, with all accessories, Amplion, etc., it easily surpasses any other set, and by way of comparison does this at a quarter of the cost. It can be guaranteed to give loud-speaker reception on an 18-in. amplion of good tone and volume at 200 miles any time, in quite inexperienced hands, and certainly is, in my opinion, an excellent standard set. Another great advantage is that with the "high range" McMichael H.F. transformer (tapped) and a few extra coils it will give reception up to 6,000

Complete with Loud-speaker.

metres. I should mention that my reception conditions here are ideal, and I have also a perfect aerial and earth system.—Yours truly,

J. D. S.

TO NEW READERS.
Place a standing order for "Modern Wireless" with your newsagent and save disappointment.

An Amplifier for Bright or Dull-Emitter Valves.

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

A useful low-frequency amplifier for either crystal or valve receivers, constructed so as to permit duplication if more than one is required.

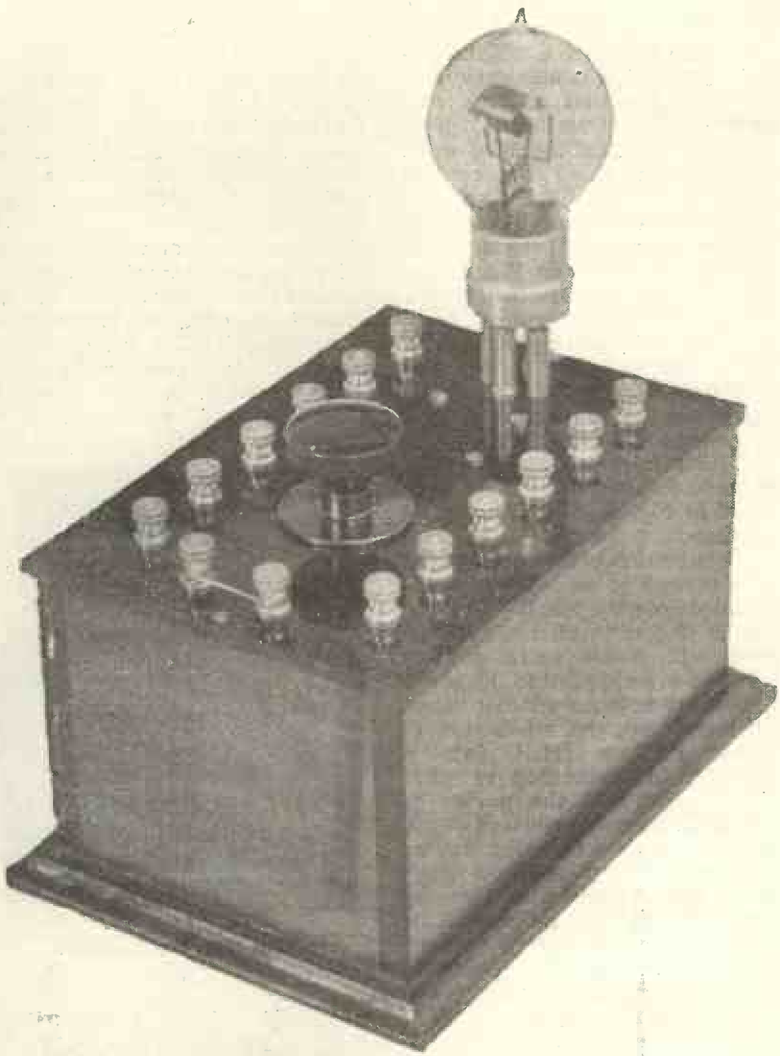


Fig. 1.—A simple amplifier which will appeal to the beginner in constructional work.

THE instrument to be described is not in itself a radio receiver, but an apparatus employing one valve, which, when connected across the telephone-terminals of the ordinary broadcast receiver, permits the received speech, music or Morse signals to be heard with greater volume.

The amplification given by this instrument is what is known as "low-frequency," or sometimes as "audio-frequency," which means that the amplification takes place *after* the signals have been rectified by the crystal or valve detector, as the case may be.

Though this form of amplification gives a considerable increase in signal strength, it must not be assumed that the addition of this unit, to, say, a crystal or valve receiver will give an increase in range; the purpose of this or any other low-frequency amplifier is to make louder those signals already audible in the receiver.

As the "output" of the amplifier is a considerably magnified repetition of the "input," the speech or music should be perfectly free from distortion before being applied to this unit, otherwise all such distortion will be proportionately increased. Another point to be borne in mind is that the transformer used should be of good manufacture, the subsequent results depending very considerably upon the merits of this useful component.

Features of Design

The compact appearance of the unit will be observed from the first photograph, which shows the instrument ready for connecting to any receiver which does not incorporate a low-frequency stage, or to a receiver which does not already employ more than a single stage.

The reason for this latter remark is that in no circumstances is it recommended that more than two stages of low-frequency amplification be used, in view of the fact that distortion is likely to result, and in those cases where two low-frequency stages do not give the required volume, then a *high-frequency* stage is advocated, thereby increasing the range of the receiver. The unit under description is capable of duplication and may be used with practically any type of receiver, the only exceptions being valve sets which have the internal L.T. negative connected to the H.T. negative, instead of the more usual practice of L.T. positive to H.T. negative.

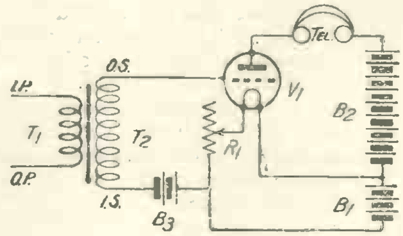


Fig. 2.—The theoretical circuit arrangement.

The arrangement of the terminals seen in the photograph are on the left-hand side, reading from the top, the two "input" terminals for connecting to the telephone terminals of the receiver; the H.T. positive and H.T. negative, the L.T. positive and L.T, negative. On the right-hand side, reading from the top, are the two "output" terminals for telephone connections or the "input" of a similar unit, the H.T. positive and H.T. negative, the L.T. positive and L.T. negative. The two terminals seen at the bottom end of the panel are for grid cells when required, the left-hand terminal being connected to the positive of the battery and the right-hand terminal to the negative.

in the instrument. The choice of components is, of course, a matter for the reader to decide himself, but in cases w ere makes other than those stated are chosen, then

1 Low-frequency Transformer (Max-Amp, by Peto Scott, Ltd.)
1 Filament resistance suitable for either bright or dull emitter valves (Burndept, Ltd.)

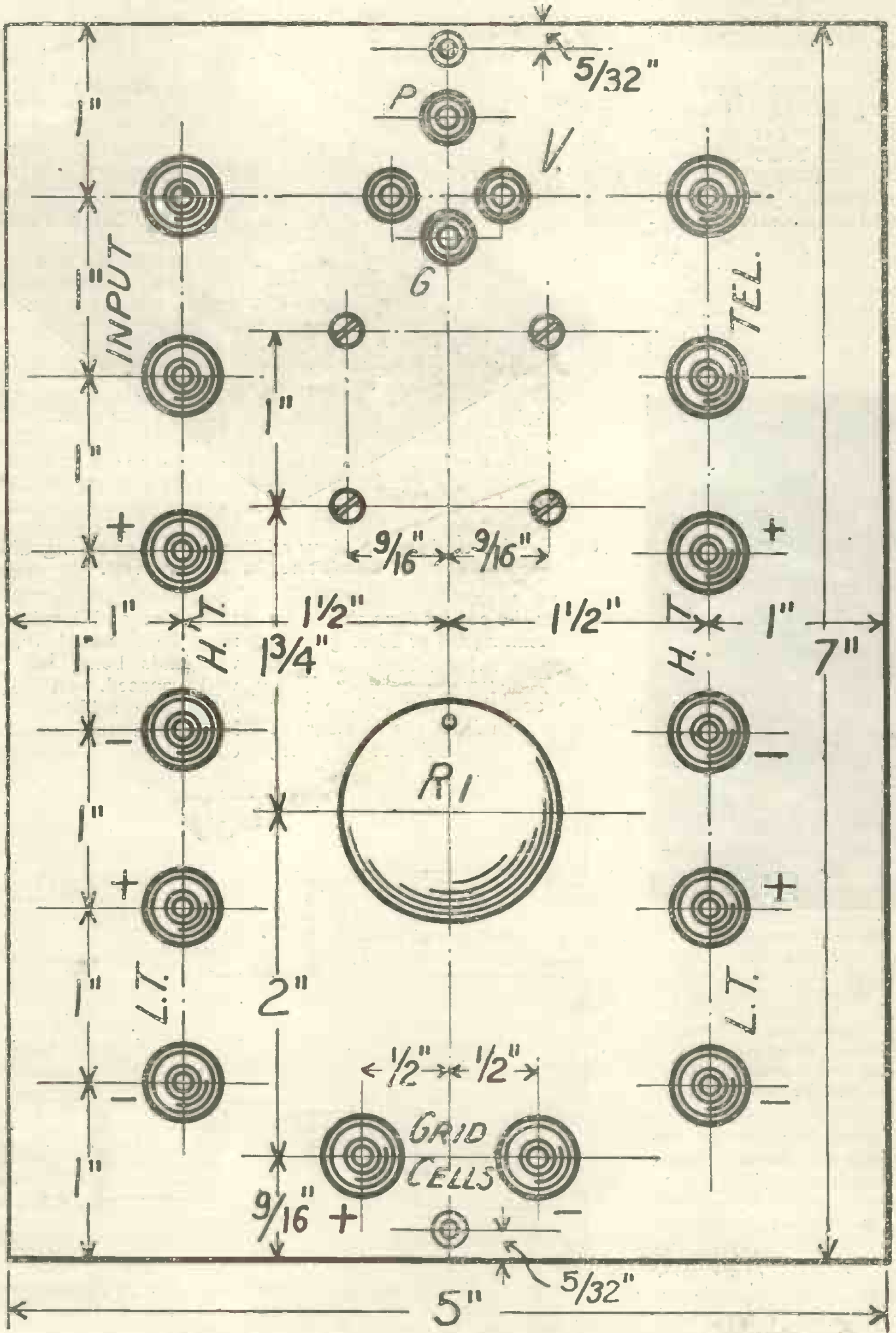


Fig. 3.—The lay-out of the panel drawn full size.

Materials and Components

For the assistance of those readers whose intention it is to construct this unit, the names of manufacturers are given, in addition to the components embodied their origin should be known and the material worthy of inclusion in a good wireless instrument :—

1 Ebonite panel measuring 7 in. by 5 in. by $\frac{3}{16}$ in.
1 Valve holder or alternatively four sockets.
14 Brass terminals.
Quantity of stiff wire for connecting purposes.
1 Box to take panel and of a

depth to take the transformer chosen.

The Panel

The material used for the panel of the unit is what is advertised as "Radion Mahoganite," which, besides having the attraction of a glossy finish, is guaranteed to be free from surface leakage.

Where ebonite other than this is purchased, readers should assure themselves whether or not the material supplied bears a similar guarantee.

In those instances where specially prepared ebonite is not obtained, then the panel must be subjected, after the drill holes have been made, to a thorough rubbing on both sides with fine emery cloth, in order to remove any impurities which may be adhering

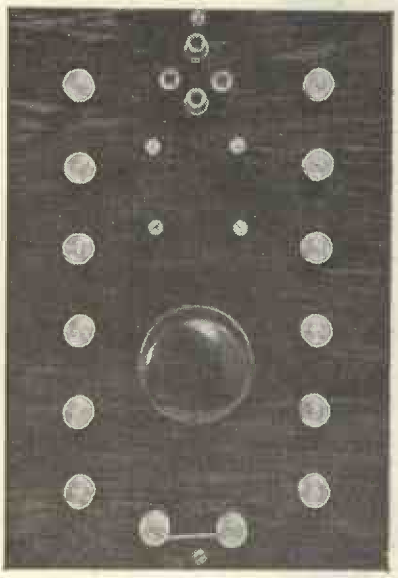


Fig. 4.—Plan photograph of the panel. Note that the grid battery terminals are shorted. When this battery is used, however, the shorting wire should be removed and the positive of battery connected on left and negative on right.

to the surface as a result of tinfoil treatment it may have received during its manufacture.

The Circuit

The circuit arrangement of the unit is given in Fig. 2 wherein it will be seen that the connections are those of the usual kind, with the addition of grid cells.

The connections to the transformer are given in both this figure and that of the wiring diagram as being the best with the transformer used, but in cases where a make other than that mentioned is chosen, then these connections may vary; it is advocated therefor that before making the final connections, the practice of changing over the connections should be tried, meaning OS or IS to grid.

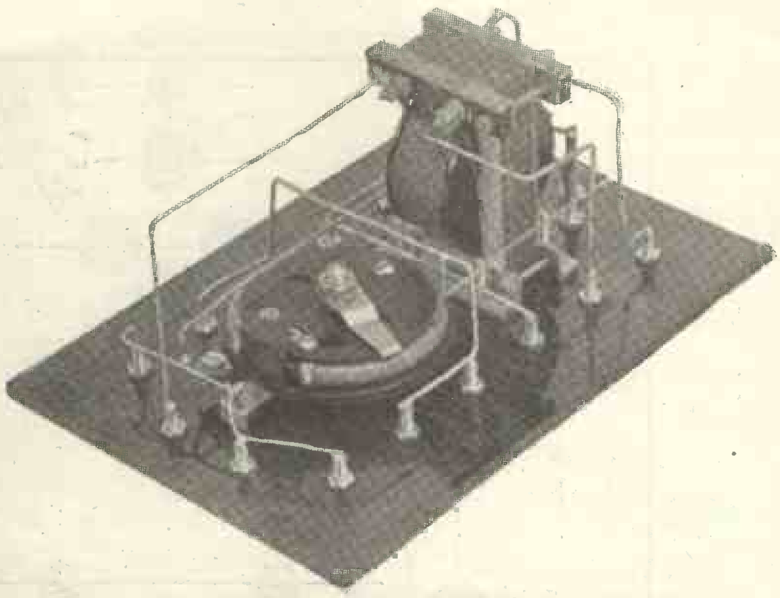


Fig. 5.—An underside view of the panel, showing disposition of components and wiring.

Wiring Up

The actual wiring of the unit may be seen from the photograph showing the underside of the panel, whilst a practical drawing of the same work is given in Fig. 7. It will be noticed that in the instrument illustrated the stiff wire method is employed, but in those cases where readers anticipate difficulty in wiring up, then the somewhat easier task of utilising thin wire and insulating sleeving may be reverted to, subject to the leads being kept short and well spaced. All connections should be soldered, rather than locked between nuts, as one bad connection in the instrument will cause hissing or crackling sounds to be heard in the telephones, especially if more than one stage of low-frequency amplification is used,

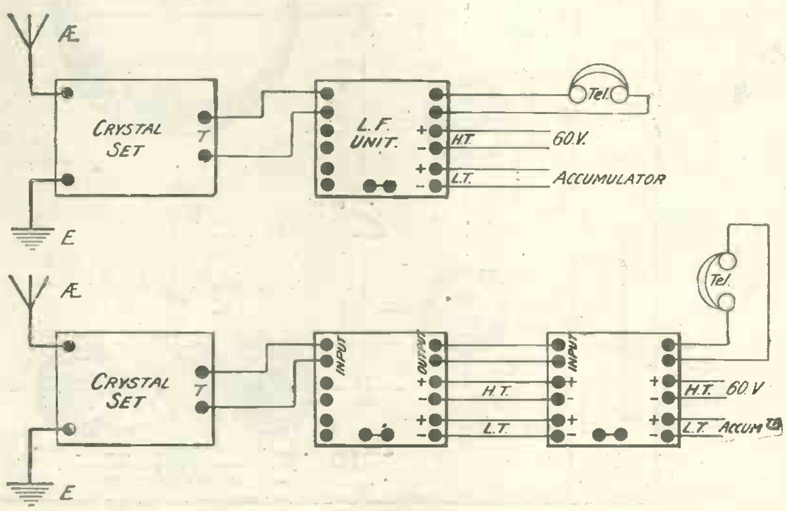


Fig. 6.—Illustrating the method of connecting one or two units to a crystal set. If more than 40 volts H.T. is used with dull-emitter valves, grid cells should be connected across the terminals provided.

the reason for this being that not only will the reception be amplified very considerably but any extraneous noises due to faulty connections must of necessity be similarly amplified.

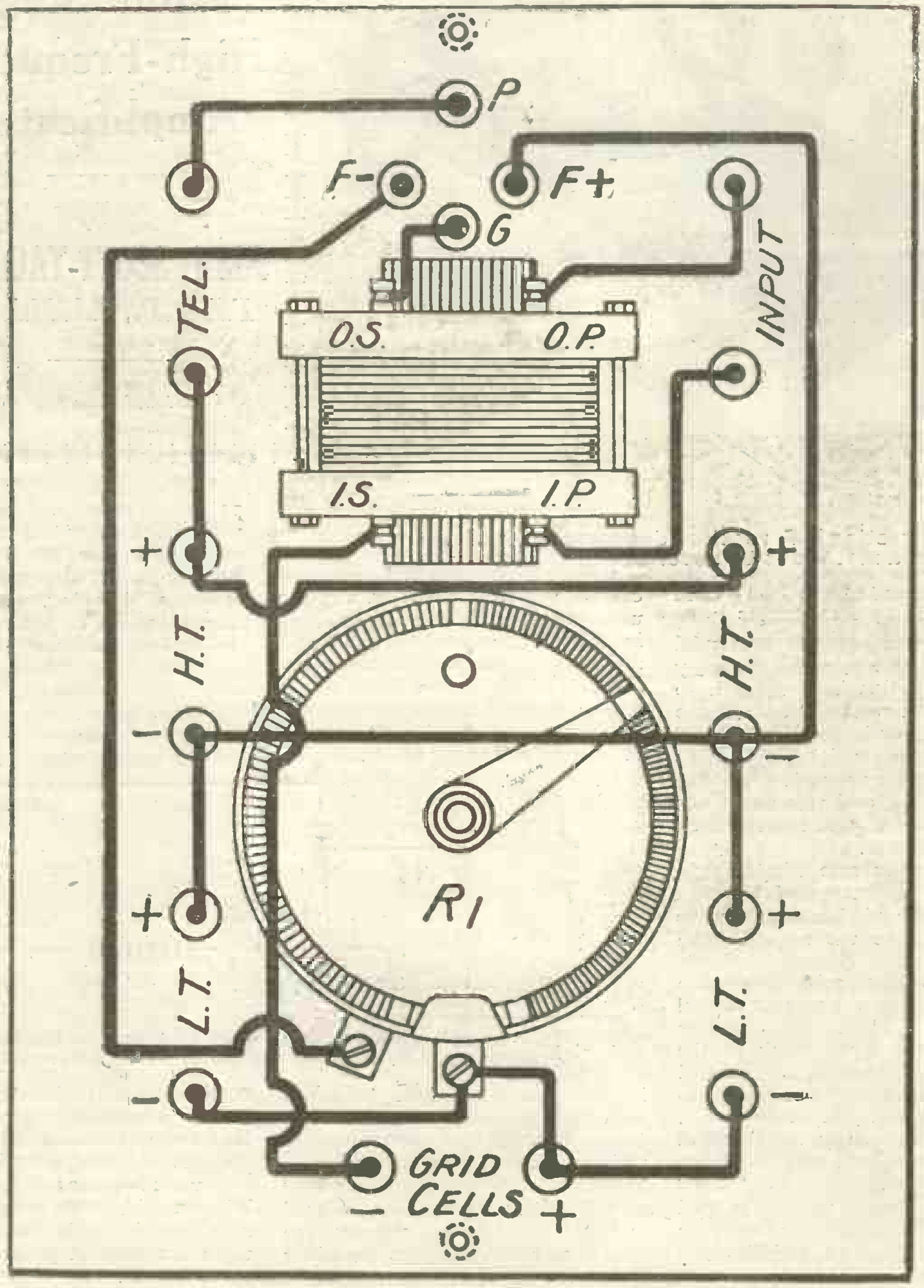


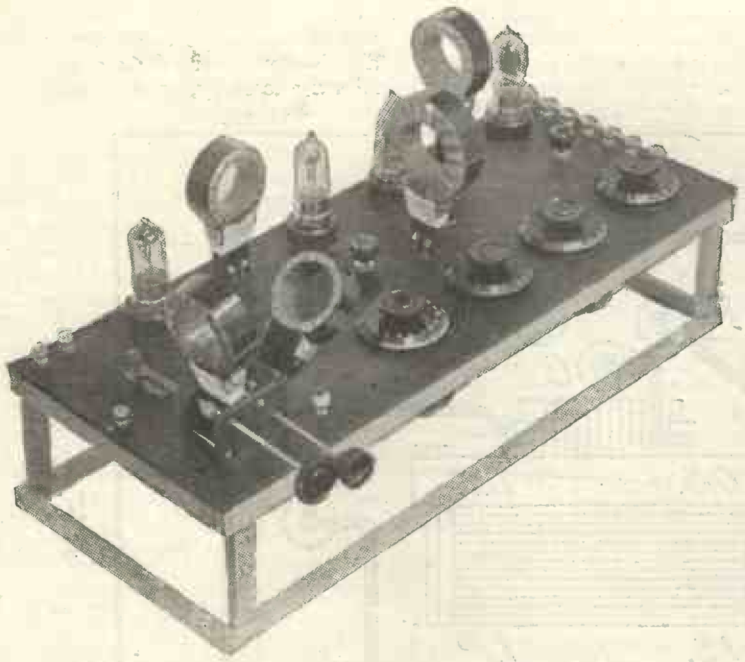
Fig. 7.—Practical wiring diagram (full size).

Fixed Condensers

It will be observed from the circuit diagram that the usual condenser across the H.T. battery is omitted, and the reason for this is that where the unit is connected to a valve receiver, the condenser will in most cases be connected across the H.T. terminals of the receiver itself. Where, however, the unit is to be used in conjunction with a crystal receiver, a fixed condenser of 0.05 μF may be connected externally across the H.T. battery if desired, though in most cases, unless the battery is old and noisy, its inclusion or omission will make very little difference if any at all.

It will be further noticed that there is no condenser connected across the primary of the transformer, the reason being that where the unit is to be used with a crystal receiver such a condenser is not necessary, whilst assuming the unit is to be used in conjunction with a valve receiver, it will be found in most cases that the receiver is fitted with a telephone condenser which virtually becomes connected across the primary when the receiver and unit are connected together. Should there be no telephone condenser, however,

(Continued on Page 460.)



An interesting H.F. receiver designed by the author on a method to be described next month.

Multi-Stage High-Frequency Amplification

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

(Continued from page 232.)

Adding Damping to the Grid Circuit by Resistances

A very common and successful method of reducing the tendency of self-oscillation in a valve is to connect a resistance across the grid circuit, or in the grid circuit. Sometimes this resistance consists of an actual resistance of the ordinary kind, and sometimes the grid to filament path itself is used as the resistance.

In the latter case what we do is to take advantage of the fact that when the grid becomes positive with respect to the negative end of the flament, electrons are attracted to the grid from the filament; these electrons travel round the g i l circuit, through the grid inductance, back to the filament. This setting up of a grid current introduces damping into the grid circuit. In other words, some of the energy in the grid circuit is consumed and losses are incurred by making the oscillations in the grid circuit produce a grid current. This loss may be made sufficiently great to stabilise the circuit and prevent the valve oscillating. To set up a steady grid current is a simple matter, and the usual method is that illustrated in Fig. 15, where the slider S moves along a potentiometer resistance of about 400 ohms resistance connected across the filament battery B_1. A fixed condenser C_3 of 0.002 μF may be connected in the position shown to avoid making the high-frequency currents travel through the potentiometer resistance itself. This condenser C_3 may frequently be omitted without any ill-effects. When the slider S is to the extreme left position, the grid is at zero volts; as the slider is moved further to the right the grid will be given a varying potential, which will become + 6 volts if the slider S is moved to the right-hand side of R_2 and the battery B_1 given 6 volts. Any degree of damping, within limits, may therefore be introduced into the grid circuit, and the slider S will usually be adjusted to such a point that the valve is just off the oscillation point.

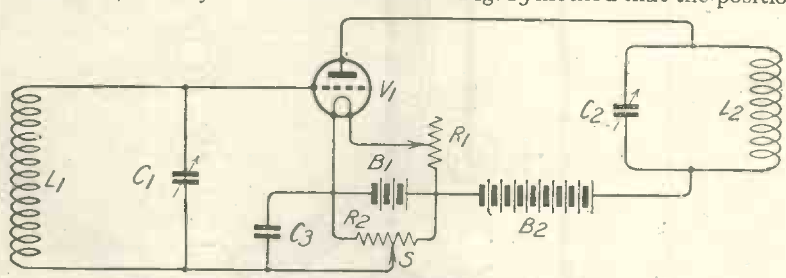


Fig. 15.—Circuit showing how grid current is obtained to stabilise a H.F. valve by means of a potentiometer.

It is rather important to note in the Fig. 15 method that the position of the rheostat R_1 is of importance. If it is connected in the negative lead to the filament it will not be possible to give the grid the full + 6 volts because when S is at the left-hand side of R_2 the grid will be at a negative potential depending upon the drop in potential across the rheostat. As S is moved to the right a point will be reached where the grid has a potential of zero volts, and a further movement of S to the right will commence to give the grid a positive potential. If the drop in potential across the rheostat is normally 2 volts, it would only be possible to give the grid a maximum potential of + 4 volts, which, however, in most cases, would be all that is necessary. Where, however, it is desired to be

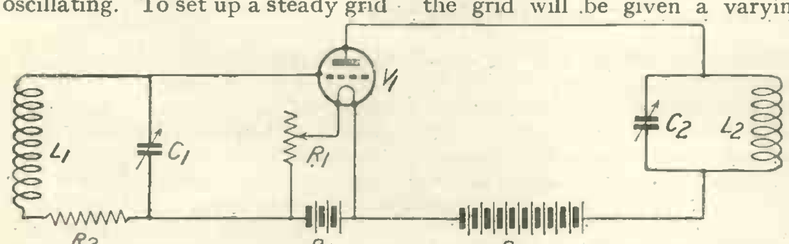


Fig. 16.—Damping added direct to grid circuit by means of a resistance.

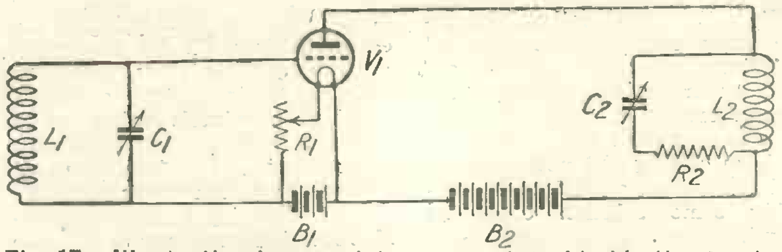


Fig. 17.—Illustrating how resistance may be added in the anode circuit to prevent self-oscillation.

able to give the grid any positive voltage from zero to + 6, it is desirable to connect the rheostat in the *positive* lead.

Fig. 16 shows the connection of a resistance R_2 actually in the grid oscillatory circuit. This resistance may have a value of from 20 to 50 ohms, according to various factors, such as the amplification factor of the valve and the constants of the oscillating circuits and the natural coupling between grid and anode circuits. The correct value of the resistance R_2 is best found by experiment, and if the resistance is variable, so much the better.

Fig 17 shows the resistance R_2 included in the anode oscillatory circuits. This is an alternative arrangement and self-oscillation may be prevented, by introducing damping into the grid or the anode oscillatory circuits. In some cases the damping is introduced into both circuits by any of the methods specified.

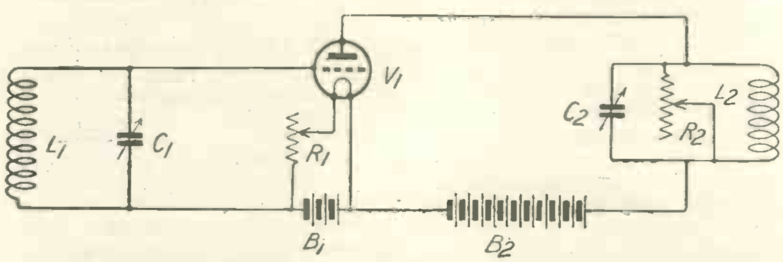


Fig. 19.—The method of Figure 18 applied to the anode circuit.

Fig. 18 shows the use of a resistance R_2 in parallel with the oscillatory circuit L_1 C_1. This method has been advocated by the author on several occasions, because it does not involve the production of direct currents in the grid circuit which are liable to cause distortion. The resistance R_2 now has a value of the order of 100,000 ohms, and a variable resistance having this maximum value will be found very convenient.

Fig. 19 is the same arrangement as Fig. 18, but this time the resistance R_2 has been connected across the anode oscillatory circuit to introduce damping into it.

Fig. 20 shows the use of a resistance R_2 in the grid circuit of the valve, but in rather a different position to that shown in Fig. 16. The effect, however, is very similar, and the value of R_2 is usually of the same order as the resistance R_2

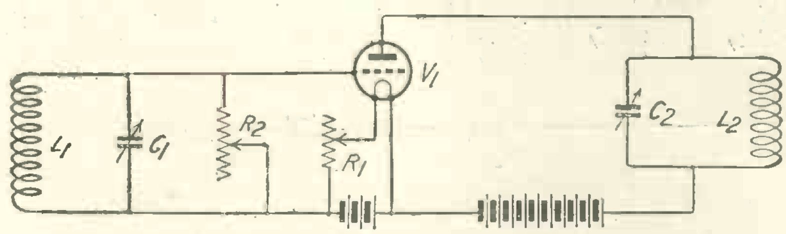


Fig. 18.—A method of introducing damping advocated by the author.

described in connection with Fig. 16. It is desirable to make all the resistances used in these various cases devoid of self-capacity.

Obtaining Stability by Reducing Amplification

A rather obvious method of increasing the stability of a high-frequency amplifying circuit is to reduce the amount of amplification given by the valve. We can do this, either by a valve having a poorer amplification factor or by reducing the amplification given by the valve in use. This may be done by dimming the filaments, a very common expedient, and by reducing the high-tension voltage. Dulling the filaments is usually a very effective method of stabilising a high-frequency amplifier, but at the same time any beginner will appreciate that reducing the efficiency of the apparatus in this way is wrong, and that the necessity for doing this is merely due to lack of proper design elsewhere.

Anode Impedance Method

An interesting and useful method of stabilising a high-frequency amplifier is that illustrated in Fig. 21. We here have an impedance Z shunted by a variable condenser C_3. The impedance Z, which may be a choke coil with or without an iron-core inductance, has in parallel with it the small variable condenser C_3, and the choking effect on the high-frequency oscillations in the anode circuit may be controlled by means of a condenser C_3. The smaller the value of C_3 the less tendency will the valve have to generate oscillations, while the greater the capacity of C_3 the more readily will the valve oscillate.

Use of Reverse Reaction

Reverse reaction, which consists in feeding back energy into the grid circuit in a direction opposite to that which produced a build-up effect, may be employed for stabilising a high-frequency amplifier.

Fig. 22 shows how the inductance L_2 is connected in a reverse direction to produce a reverse reaction effect which will tend to

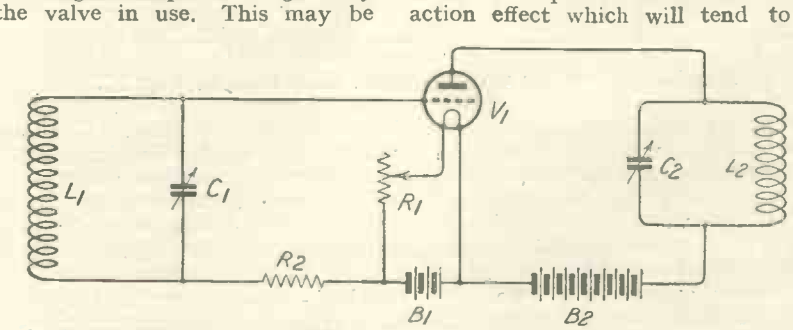


Fig. 20.—A somewhat similar arrangement to Figure 16 circuit

oppose the natural reception effect due to capacity coupling, etc.

In the Fig. 22 arrangement the reverse reaction effect may be obtained when the coils L_1 and L_2 are fairly loosely coupled in a reverse direction. If L_2 is brought too close up to L_1, the reverse inductive effect is swamped by the increased capacity coupling between L_2 and L_1, and this produces a greater tendency to self-oscillation.

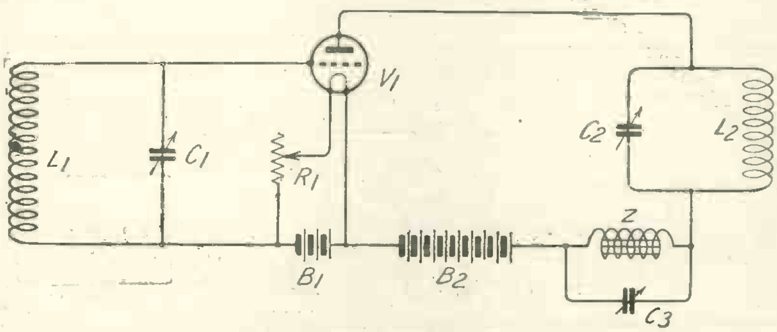


Fig. 21.—Circuit showing anode impedance method of introducing damping.

A coupling of two tuned circuits to produce a reverse reaction effect is therefore not a very practicable arrangement, although when the anode circuit is not tuned reverse reaction may be quite useful in stabilising a receiver.

Fig. 23 shows a modified arrangement in which the reaction coil L_3 is now not part of the main tuned anode circuit but is connected in series with it. This circuit will in general be found better than Fig. 22, although the coil L_3 should be kept small.

Eliminating the Causes of Self-Oscillation

The method we have described above may be regarded as general

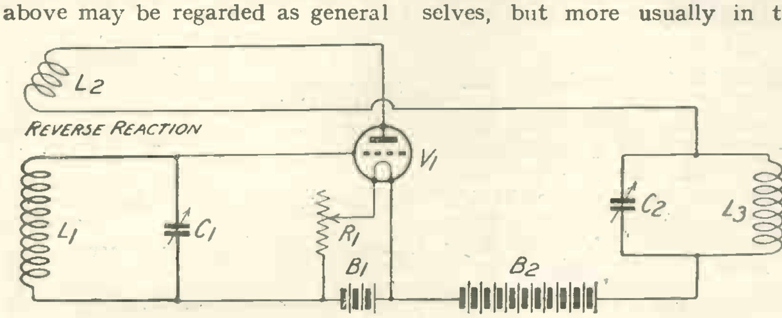


Fig. 23.—A better arrangement than that of Fig. 22.

means of counteracting the ill-effects of faulty design. The design of the receiving apparatus should be such that palliatives should not be necessary, but while it is a simple matter to make theoretical comments on the problem of high-frequency amplification, the fact remains that there is to-day no really satisfactory method of high-frequency amplification. If all experimenters who at present are working in directions where great success has already been achieved were to turn their attention to the problem of long distance reception and multi-stage amplification, probably some solution could be found.

It is the purpose of this article to explain the difficulties and to indicate what has already been done to overcome the troubles experienced in multi-stage high-frequency amplification. A method of the author's own is also given.

The elimination of self-oscillation is a practical impossibility, but much can be done to eliminate the actual causes and much more can be done to balance them out with a minimum of energy loss.

In the first place, since the grid to anode capacity of the valve is one of the chief troubles, much can be done by lessening this capacity. Sometimes the capacity is between the electrodes themselves, but more usually in the leads to these electrodes. The B_4 valve, for example, which is a low-frequency amplifier of great utility, has the disadvantage that the grid to anode capacity is substantial. The Myers valve and the V_{24} are, however, admirable for high-frequency work, because the capacities between the electrodes, and the leads going to the electrodes, is small.

Much can be done, however, with the ordinary type of valve, provided a suitable valve holder is used. Quite apart from the other merits, the widely-spaced contacts on certain types of special valve holders are particularly suitable for high-frequency work. The ordinary arrangement where the socket pins are very close together, the nuts and washers being frequently only a matter of 1-16th inch apart, are entirely unsuitable for high-frequency, or, in fact, for any other work.

All leads, of course, should be kept as short as possible and as far apart as can be arranged. Bare square wire connections are probably the best for wiring a set with several stages of high-frequency amplification.

Overcoming Inductive Coupling

The overcoming of inductive coupling has received very little attention, probably because capa-

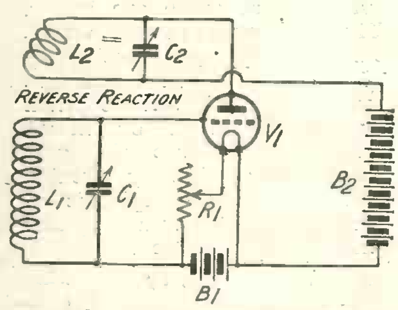


Fig. 22.—An arrangement which gives reverse reaction only when loosely coupled.

city coupling is much more insidious and dangerous.

Inductive coupling may be made very small by arranging that the fields of coils in the grid and anode circuits do not interact. The coils should be kept well apart, so as not to influence each other, and they may conveniently be arranged at right angles. To keep the inductive fields as small as possible, the coils may be wound on small diameter tubes with fine wire, but this may lead to a certain amount of inefficiency. It is, however, a direction in which experiments may be made. The smaller the coil the less will be the inductive effect of it on another coil.

A method of reducing the magnetic effect of one coil on another is illustrated in Fig. 24, which shows both coils L_1 and L_2 enclosed in metal boxes, having only small openings to allow the connecting wires to pass through. The metal casings should be of

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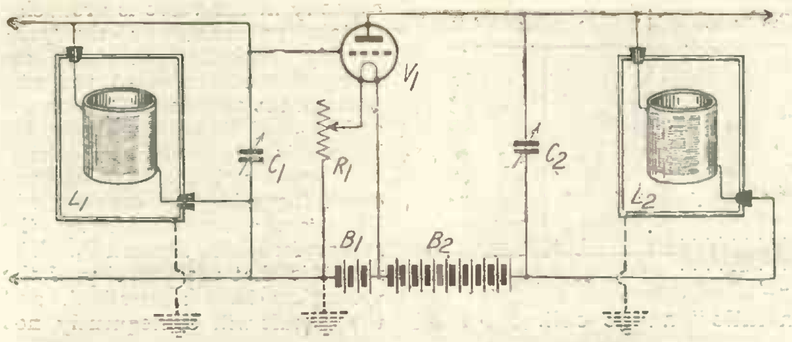


Fig. 24.—Showing the introduction of metal shields to eliminate magnetic interaction.

fairly substantial size, and the coils arranged clear of the sides. Sometimes it may be desirable to earth the shields.

Fig. 25 shows the inductances L_1 and L_2 wound on tubes which are staggered in relation to each other. This arrangement has been used by Prof. Hazeltine in his neutrodyne receiver, which involves the use of high-frequency transformers. The same arrangement, however, could be used for tuned anode circuits. The fields of the two coils are shown in dotted lines, and it will be seen that by arranging the coils in a suitable manner it is possible to avoid any appreciable inductive coupling between the inductances.

An interesting arrangement which has been tried by Mr. G. P. Kendall and the author is that illustrated in Fig. 26. Here the inductance coils L_1 and L_2 are in the form of toroids. The inductances are shaped like a curtain ring. If we obtained a wooden curtain ring and completely wound it with insulated wire, the ends, however, being separated by a fraction of an inch and leads taken from the ends, we would have a toroidal coil. The same effect would be obtained by taking a long cylindrical coil and bending it round so that the ends met. In the case of such a coil the magnetic field is entirely enclosed, and while the coil possesses all the properties of an inductance, there is no external field which could influence another coil. In Fig. 26 both grid and anode coils are shown of toroidal shape. A practical coil may be made by taking, say, a 3 in. length of ebonite tubing 3 or 4 in. in diameter and cutting a slit in the tube. A toroidal coil can then be wound on the tube. Fig. 27 shows a circuit using two tuned anode circuits employing toroidal coils. In this arrangement there will be no inductive effect between the coils, but this does not mean that there will be no capacity coupling, which is the most trouble in multi-stage high-frequency amplifiers. The fact that toroidal coils are used does not mean that the coils can be put close together, because we then get a substantial capacity coupling between the coils, even though there is no inductive coupling, and the capacity coupling is generally the most troublesome. The Fig. 27 arrangement must therefore not be taken as a solution of the problem of multi-stage high-frequency amplification ; it is, however, a very interesting suggestion for overcoming one of the coupling effects likely to cause instability.

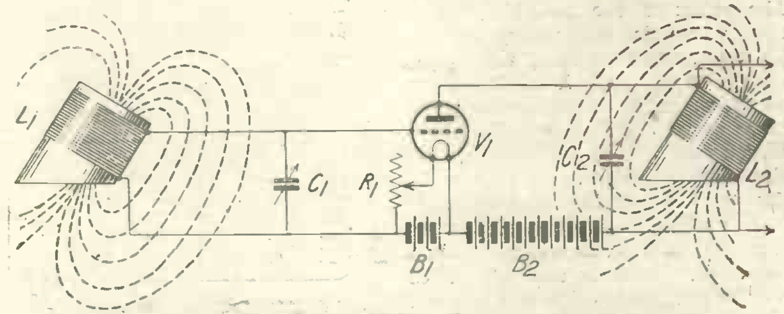


Fig. 25.—A similar arrangement of inductances to that used in the Hazeltine neutrodyne receiver.

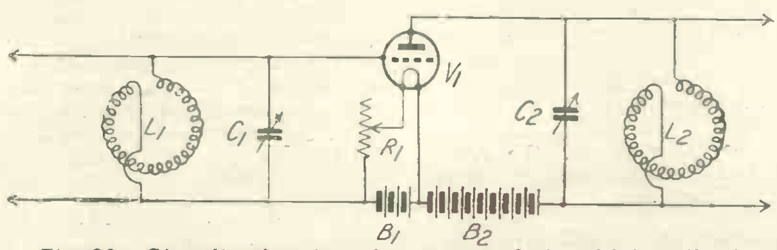


Fig. 26.—Circuit showing the use of toroidal coils to minimise inductive effects.

The "Astatic" Anode Coil

An interesting suggestion for eliminating inductive coupling from the anode circuit of a valve to the grid circuit is that illustrated in Fig. 28. We here have two anode coils L_2 and L_3 wound in opposite directions. The idea is that the inductive effect of L_2 on L_1 would be neutralised by the opposite inductive effect of the coil L_3 on L_1.

The coupling between L_2 and L_3 should not be sufficiently great as to materially reduce the total inductance of the two coils in series. It would seem that the positioning of the combined coil L_2 L_3 should be symmetrical with respect to the coil L_1 in any set built using such a coil.

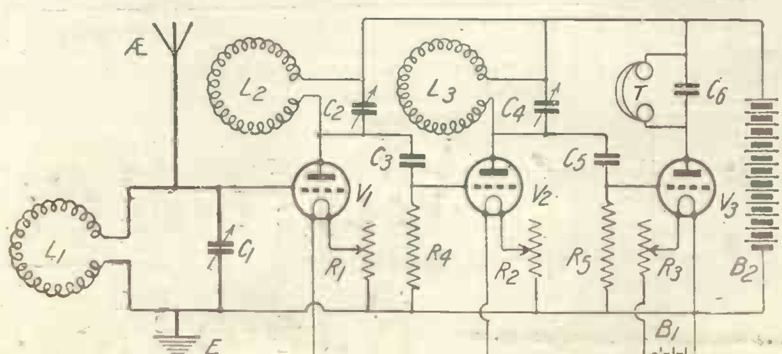


Fig. 27.—A two-tuned circuit using torodial anode coils.

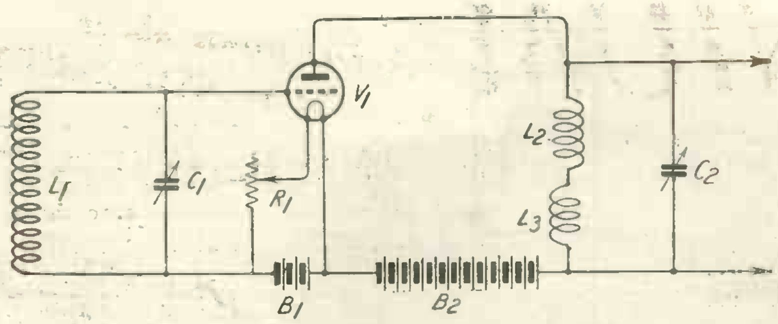


Fig. 28.—The suggested "astatic" anode coil.

Balancing out the Capacity Effect in a Valve

Since the coupling inside the valve is effected by means of a capacity, it is natural we should turn to a capacity for the purpose of neutralising this coupling. The effect of the coupling inside the valve is for potentials to be communicated from the anode circuit to the grid circuit in such a direction as to increase the tendency to self-oscillation. To counteract this capacity effect, we therefore require to introduce to the grid potentials of opposite but similar magnitude. If the capacity of the valve is more than balanced, a reverse reaction effect will be obtained which will weaken signals. It is therefore desirable that the balance should be an exact one. It is, of course, no use connecting a condenser from the anode to the grid, because th's condenser would merely assist the existing capacity. It is necessary to obtain a reversal of phase and this reversal may be obtained by tapping either the grid or anode inductance or by the use of transformer coupling. These methods will now be described.

Fig. 29 shows a simple valve amplifier in which, however, the direct current anode circuit contains only a portion of the oscillatory circuit. In this figure it will be seen that a tapping S is taken from about half-way along the inductance L_2 and therefore the direct anode current only flows from the top of the inductance L_2 to the middle tapping. It is, of course, sufficient to pass a varying anode current through a part of the oscillatory circuit to set up oscillations in that circuit, but it will be found in practice that usually the maximum amplification

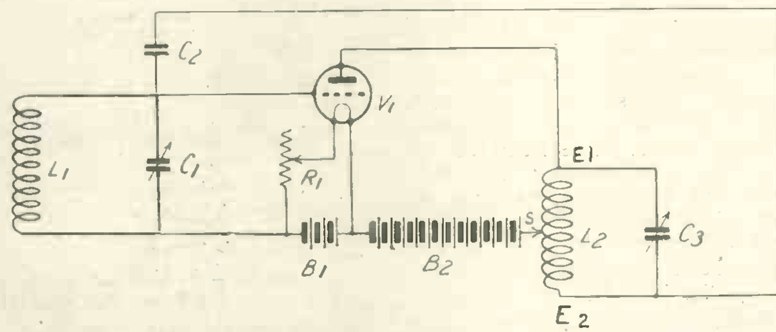


Fig. 29.—A circuit with midpoint tapping on the coil L2.

is obtained when the whole of the inductance in the anode circuit is included in the direct current anode circuit. In Fig. 29, when the end E_1 is negative, the end E_2 will be positive with respect to the tapping S, and therefore with respect to the filament of the valve, the end E_1 being connected to the grid of the valve through the grid to anode capacity and these potentials will be opposite at any given moment to those at the end E_2. We now connect the end E_2 through a very small condenser C_3 to the grid of the valve, and it will be seen that, whereas the capacity in the valve is producing certain potentials on the grid, exactly opposite potentials are being communicated to the grid through the condenser C_2 from the end E_2 of the inductance L_2. By making C_2 of the correct size, the reaction impulses communicated the grid-plate capacity will be exactly neutralised by the reverse feed-back through C_2. The result is that the capacity of the valve has been neutralised, and the circuit will consequently not oscillate.

The condenser C_4 may also be used to balance out the capacity coupling between the coils L_1 and L_2. In order to enable a more correct balance to be obtained I have suggested connecting an actual condenser in the position shown as C_3 in Fig. 30. This condenser will actually increase the tendency to oscillate, but by making C_4 larger it is possible to balance C_3 and C_4 accurately, whereas when we are relying upon capacity between grid and anode of the valve, we are dealing with a very small capacity and one which is liable to fluctuation, a change of valves might easily upset the balance.

Having got the amplified oscillations in the circuit L_2C_2, we have to find some method of using them, and we can couple an inductance to L_2, this inductance being connected in the grid circuit of another valve. Another arrangement would be to connect the point E_1 through a grid condenser to a second valve, but in this case we would only be obtaining about half the potentials developed across the inductance L_2. We can, however, overcome this difficulty by seeing that the tapping S is not in the middle but nearer to the end E_2. In order to obtain a balance we then have to make the condenser C_4 very much larger, and if the distance S and E_2 is, say, one tenth of the distance between E_1 and E_2, then the capacity C_3 will have to be ten times the capacity between the grid and anode of the valve (and,

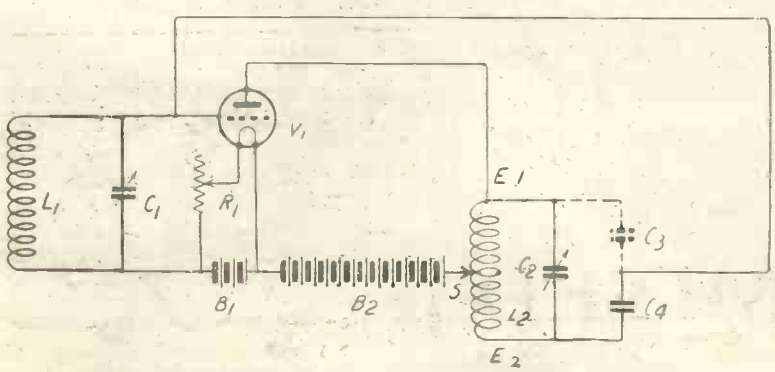
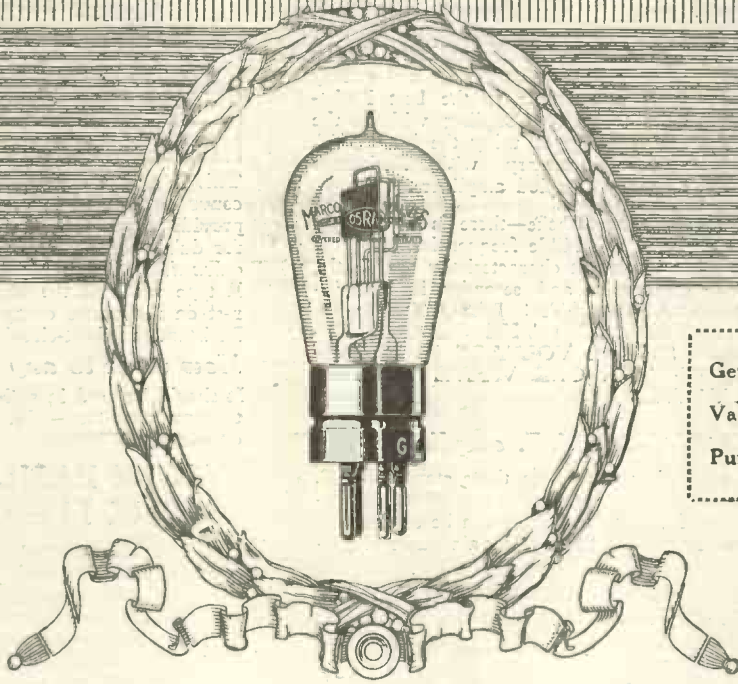


Fig. 30.—Fig. 29 re-drawn for explanatory purposes.



of course, the other undesirable coupling capacities).

In Fig. 30 we have reproduced the arrangement of Fig. 29 in a manner which may be a little clearer to some. We have now shown the grid to anode capacity of the valve by the condenser C_3, while C_4 represents the neutralising or balancing capacity which actually consists of a real condenser. In this circuit it will be seen that the midpoint between C_3 and C_4 will, as far as any amplified currents in the anode circuit of a valve are concerned, always have the same potential as the point S and therefore the same potential as the filament of the valve. By connecting the middle point between C_3 and C_4 to the grid of the valve we ensure that oscillations in the anode circuit of a valve will not in any way affect the potential of the grid, the potentials on which will now be simply those due to the oscillations in the circuit L_1 C_1.

The arrangements of Figs. 29 and 30 may be reversed so that the anode circuit remains normal, but the grid circuit has a middle tapping to enable the neutralising electromotive forces from the anode circuit to compensate for the grid to anode capacity of the valve.

(To be continued.)

From Our Readers

Interesting Experiences with "M.W." Sets

To the Editor of MODERN WIRELESS.

SIR,—With reference to your "Two-Valve Cabinet Receiver" in the June number of MODERN WIRELESS, by Stanley G. Rattee, I altered my existing set to this, and am exceedingly pleased with same. I have a fairly good aerial and can get Birmingham, London and Manchester quite clear, also Glasgow comes in satisfactorily, and I am confident of getting the other stations, but as I have not much spare time I have not been able to find this out as yet. I use ordinary valves instead of Myers. The new station, 5XX, comes in splendidly with 150 coil in aerial socket and 200 in reaction. I am able to get Radio-Paris with these coils and at times the music and speech is quite clear.

With every good wish to your magazines MODERN WIRELESS and *Wireless Weekly*.—Yours truly,

A. C. PARSONS.

Hinckley.

To the Editor of MODERN WIRELESS.

SIR,—With regard to your article on "The Crystal Menace," and the letter signed by Mr. W. T. Bartholomew in your August issue of MODERN WIRELESS, I have experienced the following, which may be of interest :—

Using a double "L" aerial, spaced 4ft. with separate down leads and separate earths, connected to two crystal sets both tuned to 2LO, the strength of the signals were considerably weaker in each than when listening on either of the sets alone connected to either of the down leads. When the cats-whisker was lifted off one, the signals in the other increased in volume. The alteration in strength of the signals, though considerable, varied with different sets and different crystals, results being louder on sets wound with heavy gauge wire.

When a single-valve reflex set and a crystal set were connected and tuned to 2LO the strength of the signals from the valve set remained the same, but the strength from the crystal set was greater than usual. So long as the crystal set was tuned to 2 LO it was impossible to get another station on the valve set, London coming in loudly over the whole of the tuning scale. On lifting the cats-whisker on the crystal set it was possible to tune 5NO and 5IT quite easily, and by adjusting the crystal set suitably to also hear these stations on the crystal set.

One or two evenings during intervals in the programmes, while 2LO's carrier wave was still on, I plainly heard conversations which evidently proceeded from a neighbouring "receiving set" this has occurred both while using the valve and crystal set.

On another occasion another transmission which was not 2LO or 5XX, but was too weak to identify, was heard on the crystal set ; evidently a case of re-radiation.

The Reflex set is an experimental one on which I have been following your article, "Reflex receivers in theory and practice," with much benefit, but I have now altered it and have started experimenting with the Reinartz circuit, so ably detailed by Messrs. Harris and Chapman, and so far have had very fine results, the ease and control over oscillation being a revelation after using reflex circuits.—Yours truly,

JAS. H. SLATTER.

East Sheen.

To the Editor of MODERN WIRELESS.

SIR,—Just a few lines to tell you what a big difference the adding of the other H.F. valve has made to the S.T. 100. I am using Igranic coils L_1 50, L_2 100, L_3 and L_4 75. A.T.C. .001, L_3 is tuned with a .0005 and L_4 with a .0003, with .0001 for C.A.T. Though there is a big A.C. power station within three hundred yards there is little A.C. hum. 2ZY, 2LO, 5IT, 6BM, are received on the loud-speaker ; 5WA, 2BD, and 5SC are very loud on the phones ; tuning is very sharp, though no trouble is given in tuning these stations.

I am only 22 miles from our local station, 2ZY, and about 9 miles from the new relay station 6LV, but can almost tune 2ZY right out when getting 2LO, 6BM and 5WA, which normally is very difficult.

At thirty yards from the set music and speech can be heard quite plainly, by placing the ear pieces in a small basin.

I am using Marconi valves, 6-volts on the filament and 96 volts H.T.

Wishing MODERN WIRELESS every success.—Yours truly,

R. DAINTITH.

Widnes.

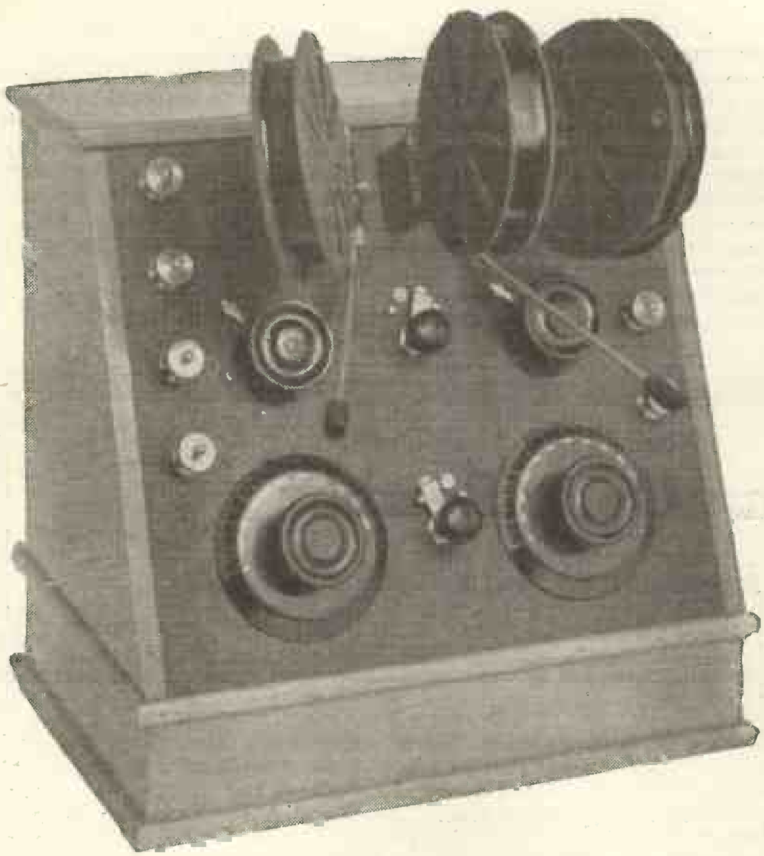


Fig. 1.—The loose-coupled circuit (Fig. 7) in use. Note the setting of the switches.

An Experimenter's Tuner.

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

An instrument of particular interest to the more advanced reader. It enables all the more standard tuning circuits to be employed, and also a new and ultra-selective one. This latter somewhat resembles the Cockaday circuit, but functions in a different manner.

It has always seemed to me a somewhat illogical proceeding upon the part of the experimenter to build a completely new set every time it is desired to try, say, a new type of high-frequency inter-valve coupling. I myself have built many sets in the course of the last eighteen months, all of which were self-contained receivers, in the sense that the tuning arrangement, high-frequency amplifying circuits and detector circuits were all mounted upon the same panel or board, and in the great majority of these, perfectly conventional tuning arrangements were incorporated, the only exceptions being one or two special sets where the aperiodic aerial method was adopted. Anyone who cares to make a special analysis will find that in the vast majority of receivers in common use the tuning arrangement can be reduced to a relatively small number of standard circuits which will suit practically every case. Upon consideration it becomes at once apparent that a well-designed tuning unit with some simple arrangement of switches and terminals to enable one to obtain the various conventional arrangements of circuits is a most valuable possession for the experimenter, since it will enable him to carry out his work with much greater ease than by the making up of complete sets, by the simple addition of the appropriate amplifying and detecting circuits to his standard tuner.

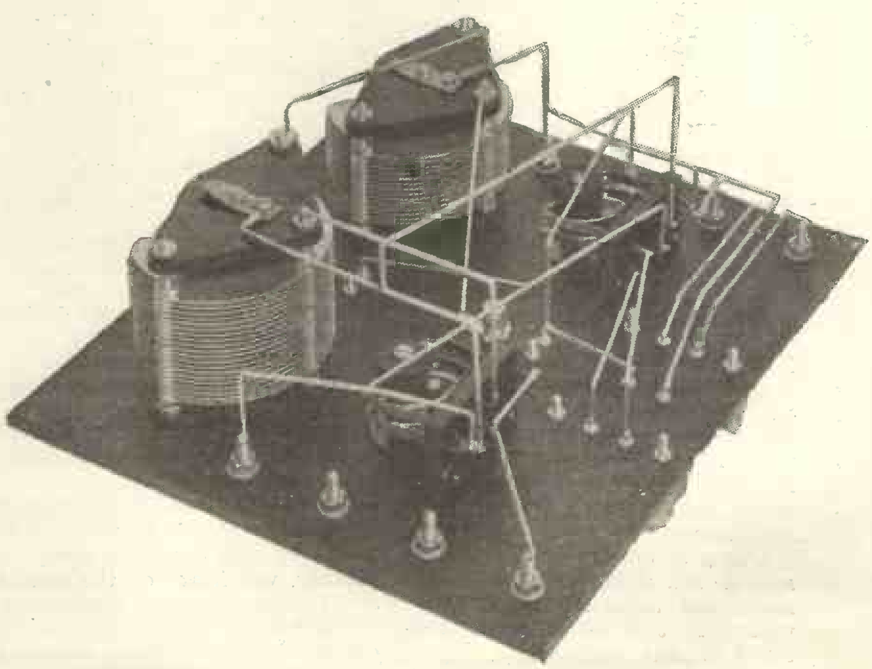


Fig. 2.—Although the wiring looks complicated the important leads are quite short.

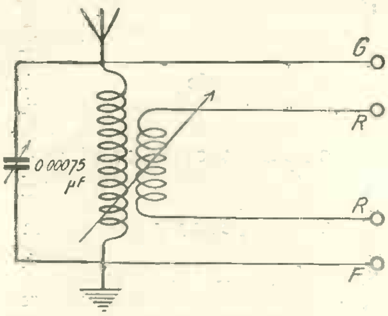


Fig. 3.—The simplest circuit.

Tuner Requirements

It will be observed that the requirements in a tuning unit are comparatively simple. In the first place it may be assumed that the first essential is flexibility—that is to say, it must be possible to use any of the well-known tuning circuits, changing from one to another with ease, and without the use of complicated switching systems, or the changing of many wires from one terminal to another. The latter, in particular, is exceedingly tiresome if one is carrying out comparative tests. It must be possible to use any desired arrangement of series or parallel tuning condensers, loose or direct-

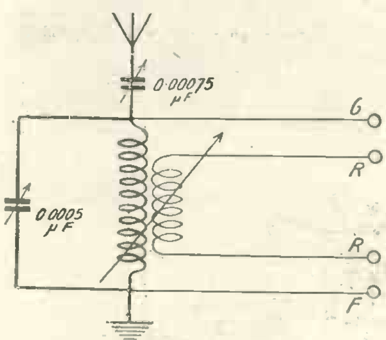


Fig. 6.—A useful arrangement of condensers.

coupled circuits, direct or reversed reaction, aperiodic or tuned aerial circuit, and so forth.

Secondly, the tuner must be easy to handle if it is to form a valued part of one's regular receiving equipment. The arrangement for mounting the various coils employed should be provided with some sort of extension handle, so that fairly fine adjustments can be obtained, or some arrangement with a slow motion can be adopted, many coil holders of this description being available at the present time. In the interests of flexibility, of course, plug-in coils should be adopted as a standard, and it is well to note when choosing a coil holder that it is really possible to get the primary and secondary coil fairly well separated so as to be able to weaken the coupling between the aerial and secondary circuits to such an extent as to obtain a real increase in selectivity when using loose-coupled circuits. Ease of handling also demands that the parts be laid out with considerable care upon the panel to obviate, or at any rate to reduce, hand capacity effects, and this demands that the condensers used for tuning should be placed in such positions that when the hands are placed upon their knobs when tuning neither the wrists of the operator nor his hands shall approach near to any

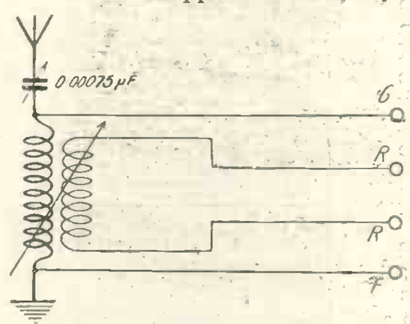


Fig. 5.—Useful for short waves.

of the other components included in the high-frequency circuits, and at any difference of high-frequency potential to earth.

Thirdly, but by no means as an after-thought, we have the requirement of simplicity of wiring, a very important factor in determining the efficiency of the finished instrument. "Shortness of Wiring" may be interpreted with discretion, since certain parts of the circuit are not critical to length of wiring, such as the parts which are connected to earth, while the critical ones are those on the aerial or grid side of the various tuned circuits, with which great care should be taken. The wiring of these should not merely be short, but it should also be well spaced

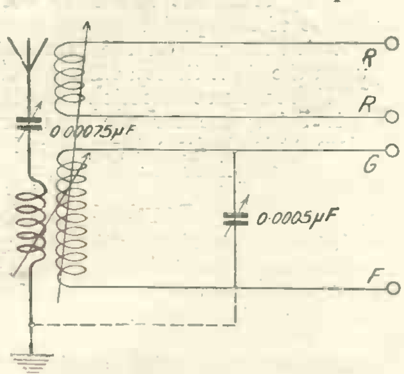


Fig. 8.—With a large aerial try this circuit.

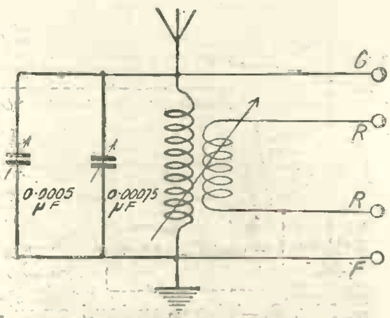


Fig. 4.—Both condensers may be used for long-wave work.

out from any other wires, and also, needless to say, the highest possible insulation should be sought throughout. It may perhaps be thought by the more advanced reader that I am somewhat unnecessarily stressing some very obvious points here, but it must be remembered that this instrument includes within itself all the most critical of the circuits in the receiving set, where the energy is lowest and yet where losses are exceedingly liable to occur, and where due care is well repaid. Closely bound up with the question of the simplification of the wiring is the problem of the switching of the instrument, since naturally the use of a large number of switches of a complicated nature

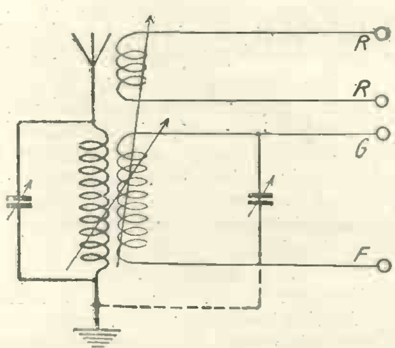


Fig. 7.—The standard circuit for selectivity.

makes good wiring quite impossible, and it is somewhat difficult to decide just how much switching to indulge in. A fair amount is undoubtedly necessary to comply with the requirements of flexibility and general convenience in working, and it is a great temptation to use far too many switches. I think it will be found that the instrument under discussion possesses a sufficient number of circuit-changing devices to make it convenient when in use, that the wiring is relatively simple, and the results which I have obtained with it are quite promising as to its efficiency.

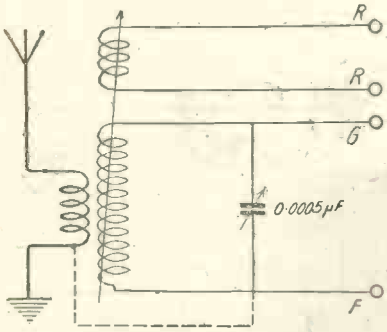


Fig. 9.—The standard aperiodic aerial circuit.

General Arrangement

The instrument is mounted in one of the sloping front type cabinets, for the simple reason that I commonly employ boxes of this nature, but of course the experimenter will fit it in any convenient cabinet which is uniform with the other apparatus which he may intend to employ. The panel is 10 in. by 9 in. and a ¼ in. thick, and was obtained already "skinned." As usual, great attention should be directed to this point, since these are the circuits in which leakages are particularly fatal. At the top of the panel is mounted the three-coil holder, which, it will be observed, is of the type with extension handles. Immediately beneath this is a small single-pole two-way switch, which serves as an "on-and-off" switch in one of the arrangements of the condensers, which we will discuss presently. At either side upon the same level are two "Utility" switches, of which the left-hand one is the series-parallel switch, and that upon the right is the one which serves to change over from a direct-coupled circuit to the loose-coupled type. At the bottom of the panel are the two variable condensers, of which the left-hand one is the aerial circuit condenser of .00075 μF. capacity, and that upon the right is the secondary circuit condenser of .0005 μF. capacity. Between them is another small "on and off" switch which connects the filament circuit to earth when working with a loose-coupled circuit. I have found that some sets appear to work better with this connection, while others are better without it, more particularly in situations where a loose-coupled circuit is employed to eliminate interference from A.C. mains. The four terminals upon the left are for the connections for aerial and earth leads, the one at the top being for the aerial and that at the bottom for the earth, the two in between being dummy terminals which are used in one of the special circuits to be detailed later. Of the terminals upon the right those at the top are for the reaction connections, and the pair below are for the grid and filament leads from the first valve of the amplifier or detector.

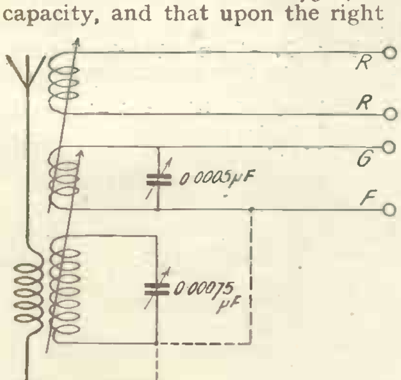


Fig. 10.—A new and ultra selective circuit.

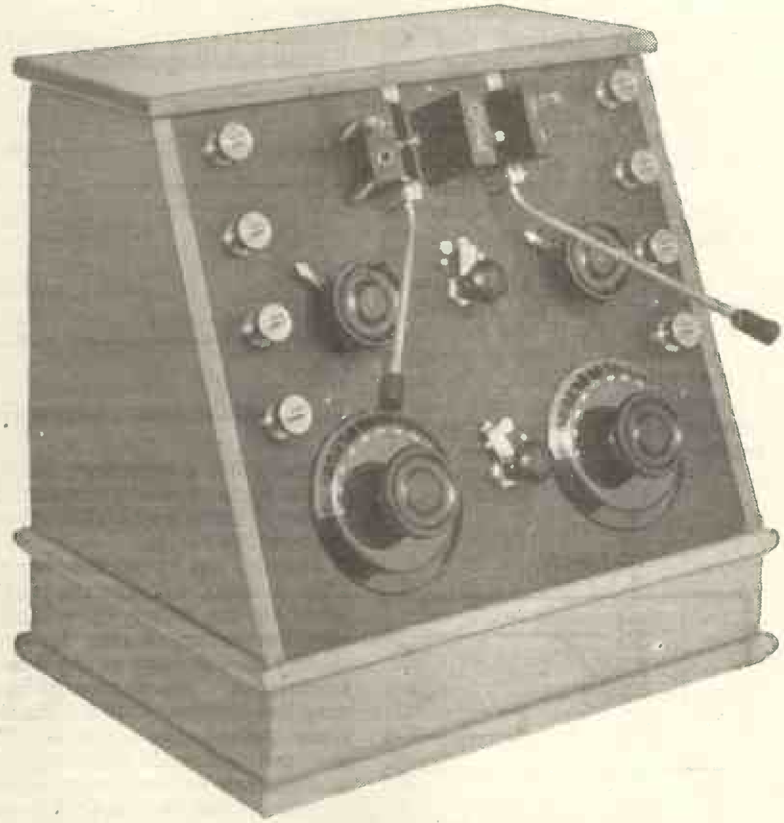


Fig. 11.—Details are seen more clearly when the coils are removed.

Parts Required

To duplicate exactly the original instrument the following parts and materials will be needed, but of course any good components can be used.

1 cabinet (Scientific Appliances).
1 ebonite panel, 9 in. by 10 in. by ¼ in. thick with the surface matted.
1 three-coil holder (Bowyer-Lowe, Ltd.).
2 single-pole two-way switches for panel mounting (Bowyer-Lowe, Ltd.).
2 Utility switches, two-pole change-over type (Wilkins and Wright).
1 variable condenser, square law pattern, .00075 μF. (Bowyer-Lowe, Ltd.).
1 variable condenser, square law pattern, .0005 μF. (Bowyer-Lowe, Ltd.).
8 brass terminals.
Small quantity of square-tinned copper wire.

Construction

The actual construction of the instrument is fairly simple, and little guidance will be needed. The drilling of the panel will be accomplished with little difficulty with the aid of the panel lay-out diagram given in this article, and the templates supplied with the components mentioned, and the rest of the work is merely a matter of attaching the parts by means of the screws and nuts provided with them. The two multi-way switches, of course, are of the single-hole fixing type. The wiring must be done with due care to produce a really sound job, since a few poor joints in these circuits may be disastrous in their results. Square wire is advised, carefully bent to shape, copying as exactly as possible the original arrangements depicted in the photographs, and very carefully soldered into position, using a really hot iron, cleaning the parts to be joined with great care, and using as little Fluxite or other soldering paste as possible. Any residue should be wiped away with a piece of clean rag when each joint has been made.

The particular advantage of this arrangement which led me to adopt it is concerned with the reaction arrangements, and it will be seen that the reaction coil is always coupled to the centre coil, whichever circuit is in use. Thus, switching over the circuit from the standby to the tune side leaves the valve connected across the centre socket, transfers the aerial and earth to the left-hand coil-holder, and automatically transfers the reaction from the aerial circuit to the secondary circuit. In other words what was the aerial coil now becomes the secondary-circuit coil, and the third coil comes into use for the aerial coil. The only obvious drawback to this arrangement is the fact that when changing from the direct-coupled circuit to the loose-coupled one it is necessary to withdraw the coil from the centre socket and insert it in the left-hand moving socket. A suitable coil is then inserted in the middle socket.

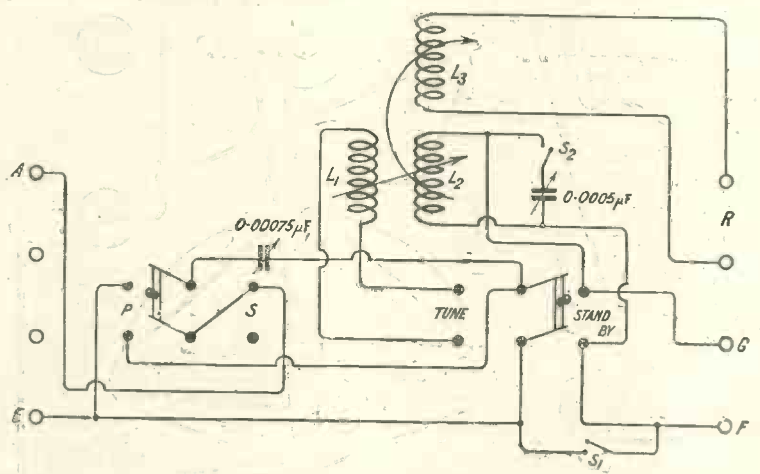


Fig. 12.—The Complete Circuit.

Switching Arrangements

A complete circuit of the tuner is given in Fig. 12, which should be consulted in reading the following description of the switching arrangements. The left-hand Utility switch (looking at the panel from the front) is for the purpose of placing the aerial tuning condenser (the one of .00075 μF capacity) in series or parallel, the parallel position being with the pointer turned to the left. The right-hand switch enables one to change from the arrangement commonly known as the "tune" circuit to the "standby" circuit, —in other words, from the loose-coupled arrangement to the direct-coupled circuit. The actual connections employed to do this are somewhat unconventional and have some slight advantages. Instead of transferring the leads from the grid and filament of the first valve of the set from the middle socket of the coil-holder to the left-hand one, as in the conventional arrangement, the switching in my instrument transfers the aerial and earth leads from the middle coil to the left-hand socket when changing from the direct-coupled circuit to the loose-coupled one.

The smaller variable condenser is, of course, permanently connected across the middle socket, while the larger (aerial) condenser is so connected to the series parallel switch that it can be placed in series or in parallel with whichever coil is switched into the aerial circuit. Thus, when working on the direct-coupled circuit, with only the centre coil in use, the aerial condenser can be switched in series or in parallel with this coil, which already has the smaller condenser in parallel with it. It will thus be seen that, when working with the aerial condenser in the parallel position, there are really two condensers in parallel with this coil, and upon the shorter waves this may be somewhat undesirable. A small "on-and-off" switch is therefore provided, which will cut off the secondary condenser from the coil when not required, and this is the switch which is seen just beneath the coilholder.

The Simplest Circuit

Fig. 3 shows the simplest circuit available with this tuner, consisting of the conventional coil and condenser in parallel, across which the grid and filament of the valve are connected, the reaction coil being coupled to the aerial inductance. If reaction is not desired, a shorting plug should be inserted in the reaction socket.

Upon the longest waves in common use, say those above 15,000 metres and up to 30,000 metres, a parallel condenser of quite large size is desirable, since the ordinary commercial coils of the largest size employed by the amateur—namely, a 1,000 or a 1,500—are not large enough to reach these waves with the ordinary size of tuning condenser. It is here that the particular arrangements of switching which I adopted are particularly convenient, since both the variable condensers can be switched into the parallel position across the aerial coil, when the direct coupled circuit is employed, and since their total capacity is then .00125 μF, the desired wavelengths are quite easily attained. This is shown in Fig. 4.

For short-wave work below the fundamental wavelength of the aerial a series condenser is necessary and this is shown in Fig. 5, this circuit being obtained by turning the series-parallel switch pointer to the right. This, of course, has the effect of reducing the effective capacity of the aerial circuit, and enables one to get down to shorter wavelengths, and also to use a larger value of inductance upon the normal wavelengths, which is sometimes found to be an advantage.

Constant Aerial Tuning

Although no fixed constant aerial tuning condenser is provided in the tuner, yet the same effects can be obtained with the direct-coupled circuit by using the arrangement shown in Fig. 6, where the larger condenser is placed in the series position and the smaller one in parallel. To do this, turn the series-parallel switch pointer to the right, and turn the blade of the small "on-and-off" switch immediately on the right of the series-parallel switch also to the right. This brings the secondary-circuit condenser across the aerial tuning coil. Both condensers are thus in circuit, and the larger one (in the series position) can be set to some arbitrary small reading upon the dial, say 15 degrees, which can be adhered to as a standard. If the readings of

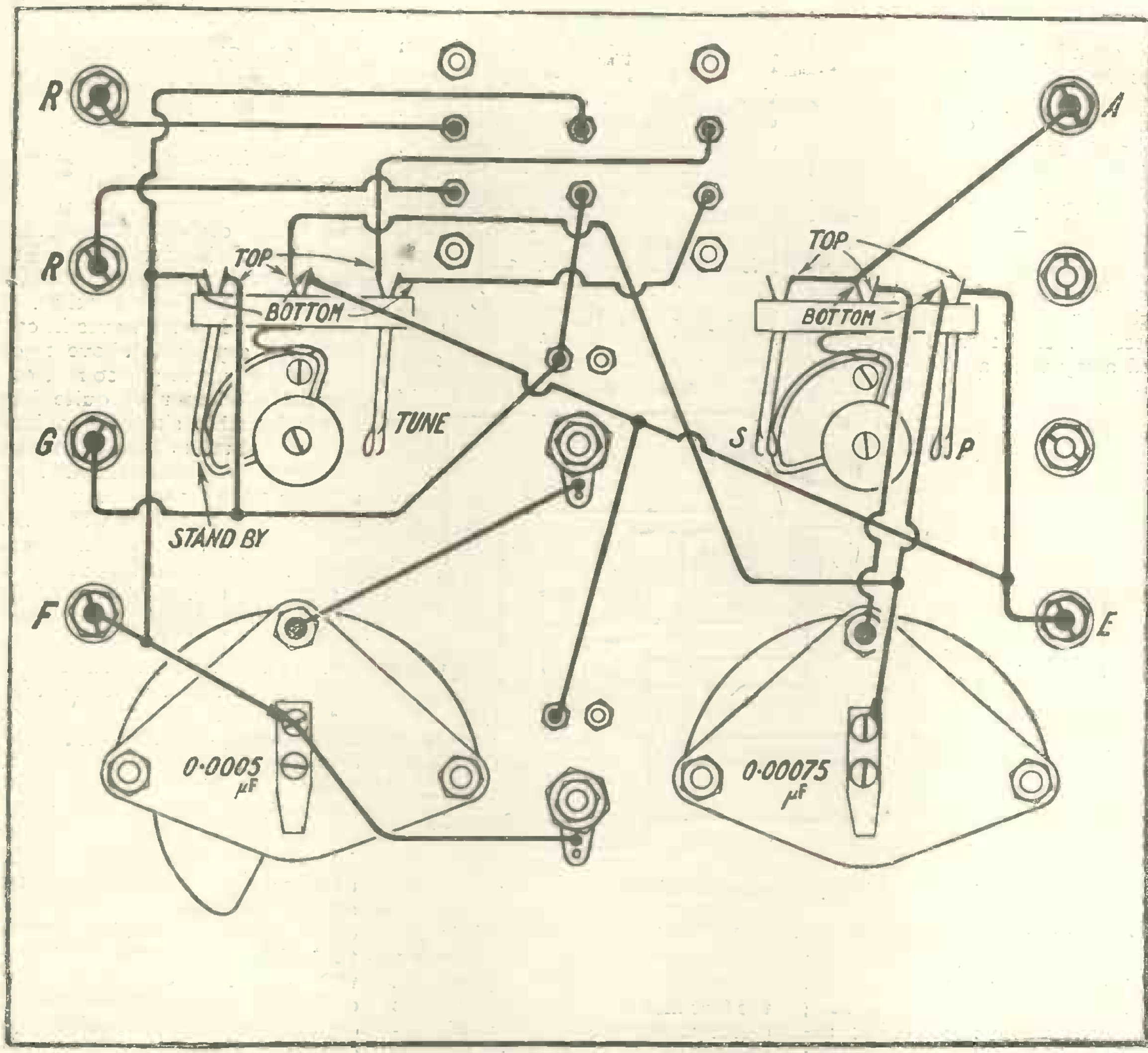


Fig. 13.—In following the diagram try to copy the arrangement of the wires visible in the photographs. Blueprint No. 59, price 1s. 6d. post free.

the smaller condenser are then recorded for various wavelengths with a given coil, it will be found that these are approximately constant with any given aerial and earth. Alternatively, both these condensers can be regarded as adjustable factors, and a little practice in the handling of this particular arrangement of the tuned circuit will show that quite useful effects can be produced.

Coupled Circuits

Fig. 7 shows the conventional loose-coupled tuning arrangement, with the aerial condenser in parallel, and reaction upon the secondary circuit. To obtain this, turn the series-parallel switch pointer to the left, the tune-standby switch pointer to the left, and the "on-and-off" switch blade between them to the right. The connection shown dotted in this diagram can be made by turning the small switch near the bottom of the panel to the right also. This sometimes will be found to have a valuable stabilising effect in sets which are followed by several stages of low-frequency amplification. A variant of this circuit is shown in Fig. 8, where the aerial tuning condenser has been switched into the series position, but the former arrangement is usually found the better one.

When it is desired to use the loose-coupled circuit it will generally be found best to tune in the desired station first with one of the simpler circuits using direct coupling, then switch over to the loose coupled arrangement, changing the coil which was in the middle socket to the left-hand moving socket, leaving the aerial tuning condenser at the same reading, which will be approximately correct when the secondary circuit is brought into use. Insert a coil of suitable size (normally one size larger than the aerial coil) in the centre socket, place the coils at an angle of about 30 degrees to one another, and vary the capacity of the secondary-circuit condenser, adjusting the reaction to the desired degree, until the signals are once more picked up. It will probably be noticed when they have been tuned in once more that so long as both aerial and secondary circuit are in tune with each other the set will not oscillate, although the reaction is brought up to a fairly strong value. When, however, either of the two circuits is detuned, the set begins to oscillate strongly, which may be somewhat puzzling at first. This simply means that when the two circuits are in tune with each other energy is fed back from the secondary into the aerial circuit, where it is absorbed and hence damping is applied to the secondary circuit. As soon as the circuits are thrown out of tune with one another this ceases, and self-oscillation is the result.

The Aperiodic Aerial Circuit

Fig. 9 shows the conventional aperiodic aerial circuit, which is obtained as follows: Place the tune-

(*Continued on page* 400).

My Story by *a Buyer*

New ideas have always interested me because so many of them last and become a normal and pleasurable part of our lives. Broadcasting got me that way. Here is something, I thought, that is going to keep me in touch in my own home with all that is going on in the world as quickly, if not more quickly, than a newspaper; that is going to give me classical and inspiring music when I want it, that is going to give me music when my friends and myself want to dance. In short, here is something that is going to make life a brighter and jollier affair. Then came the problem of how to enjoy it best. I had a good receiving set and my interest was often satisfied by headphone reproduction; but what about my friends? Here's for a loud speaker!

Three factors weighed with me—efficiency, price and size. I could not afford something my pocket couldn't pay for, I had no desire to be driven out of house and home by noise, and I had no desire to put in my ordinary sized room a loud speaker so large in size as to interfere with what I have always flattered myself to be artistic surroundings. Off I went to a radio dealer and I asked him—"Have you a loud speaker that is small in size, artistic in shape, ample in volume and inexpensive in price?" I did not put it quite so briefly as that, but that was my meaning. Back came the answer at once—"I certainly have. The 'Sterling Baby' Loud Speaker is exactly what you want." At once he demonstrated the powers of the "Sterling Baby," and I thought here is my problem solved. In exchange for really very little money the "Sterling Baby" became installed in my home and has given undiluted and undiminished pleasure for months on end. My friends became pleased and interested, and to them I have always said—"You have heard this Sterling Loud Speaker, go to any dealer you will, ask him to demonstrate, and you will then be confirmed in your belief that no instrument of radio reproduction excels the "Sterling Baby."

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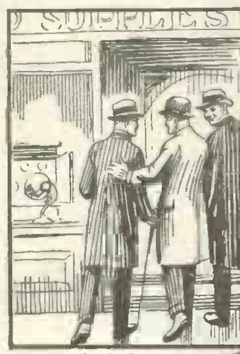

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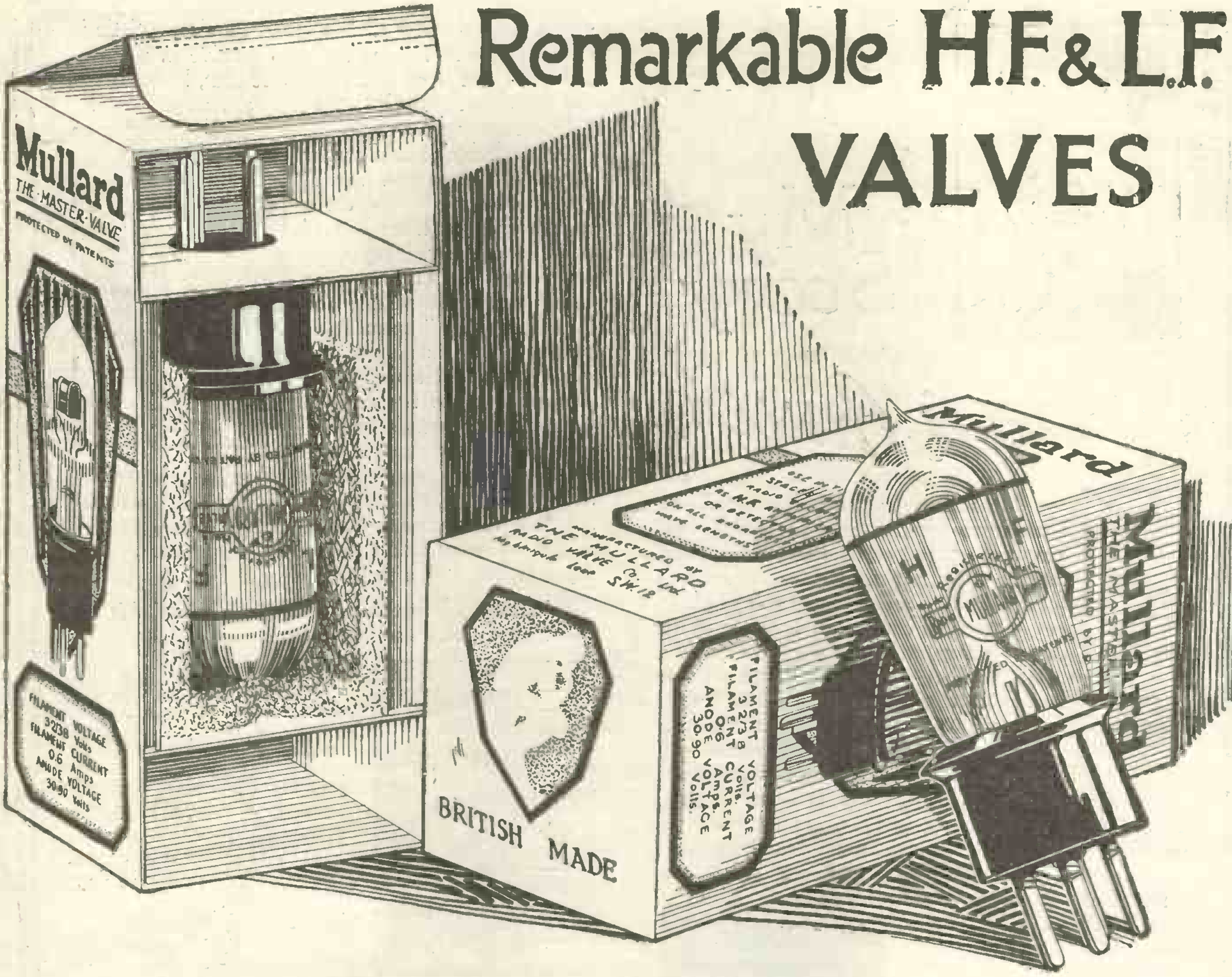

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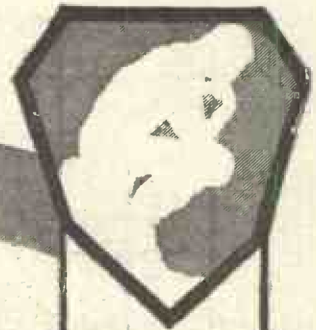

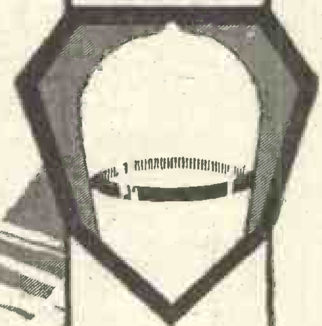

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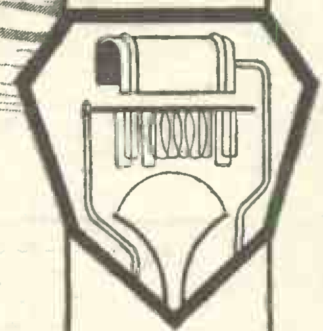

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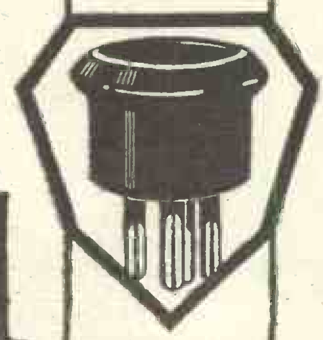

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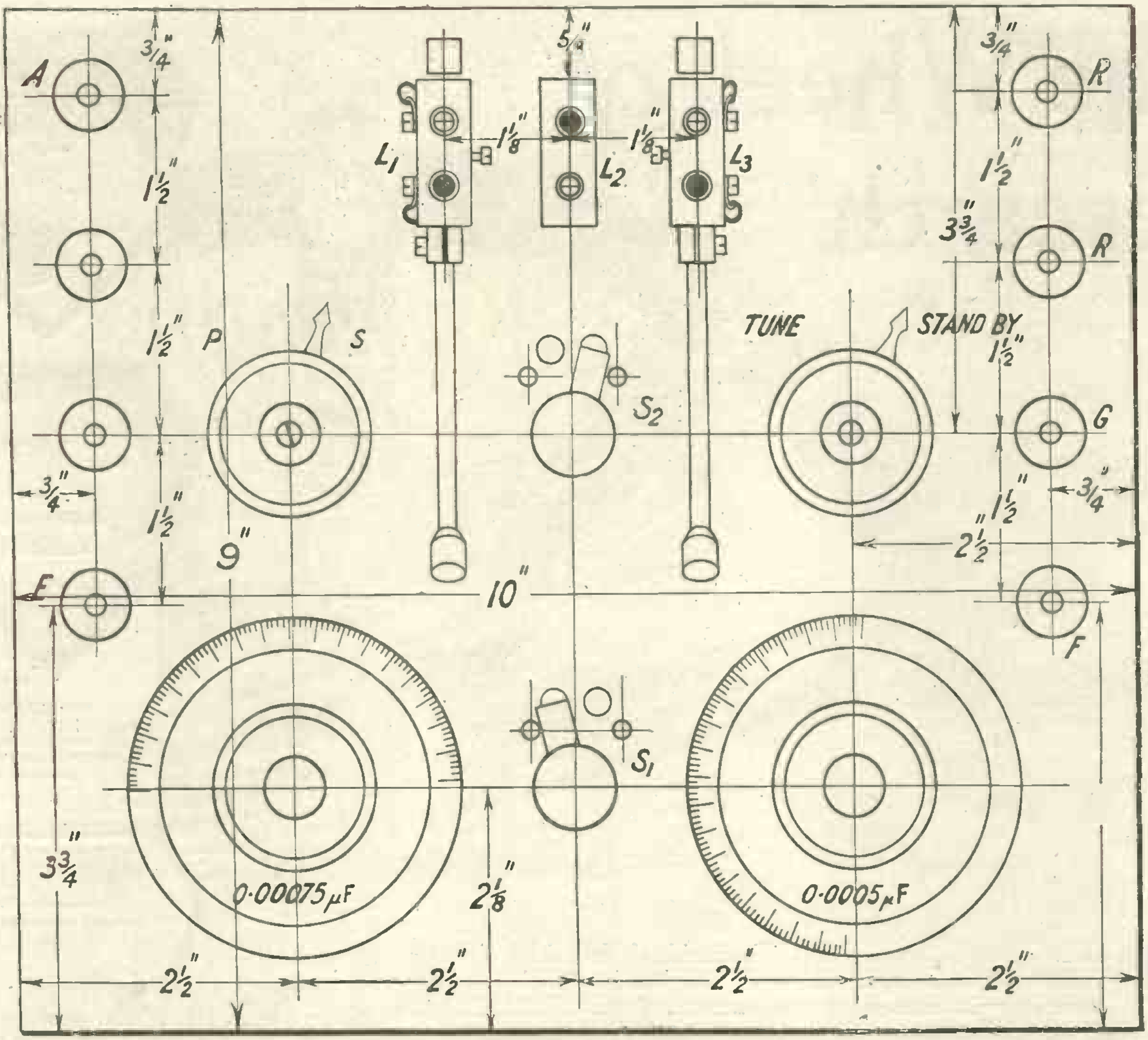


Fig. 14.—If the same types of component are used as were employed by the author these dimensions will serve as a drilling guide.

(Continued from page 396)

standby switch in the standby position, and switch the secondary circuit condenser into circuit. Insert in the middle socket a suitable coil having the necessary double windings, and take two flexible leads from the aperiodic turns of this coil to the two dummy terminals upon the left-hand side of the panel. Transfer the aerial wire to the upper of these terminals, and the earth to the lower one.

A suitable coil for this purpose may be made as follows: Wind upon the usual "lattice" former a coil of 70 turns of No. 22 d.c.c. wire, consisting of seven layers of 10 turns in each, spaced by the usual zig-zag turns. Interpose between the first and second layers a separate layer consisting of 10 turns of No. 18 or No. 20 d.c.c. wire, which forms the aerial winding. This coil can be mounted upon the usual plug, the ends of the larger winding being connected to the plug and socket. To the two ends of the 10-turn winding solder two pieces of flex 6 inches in length.

An Ultra-Selective Circuit

With the aid of the coil which I have just described, it is possible to obtain a remarkably selective circuit, which I have found very little more difficult to tune than the conventional loose-coupled one. The circuit is illustrated in Fig. 10, and it will be seen that the usual aperiodic 10-turn winding is connected in the aerial circuit, and that the secondary winding is tuned by means of a parallel condenser, and is coupled to yet another closed circuit consisting of coil and condenser in parallel, across which the valve is joined. Reaction can be introduced if needed, as shown, into this latter tuned circuit. There are thus two closed tuned circuits, with a fixed coupling to the aerial circuit, and a variable coupling between them. Exceedingly high selectivity is obtainable, so high, indeed, that a wavemeter is really necessary in tuning-in a distant station, although there are only two fully tuned circuits.

To obtain this circuit, place aerial and earth under the two dummy terminals as before, insert the coil with the double winding in the left-hand moving socket, connecting the two flexible leads to the two dummy terminals carrying the aerial and earth. Switch what was previously the aerial condenser into the parallel position, and place the usual secondary coil in the middle coil socket, using a suitable reaction coil in the other moving socket. See that the secondary condenser is switched across the middle coil socket, and the circuit is complete. Fairly close coupling should be used at first between the left-hand moving coil and the fixed-coil, the usual gradual weakening being employed as signals are picked up and tuned in. This circuit is well worth trial, its only drawback being that it somewhat reduces the stability of the valve circuits which follow.

Above & below the Broadcast Wavelengths

A SHORT time ago I raised with the Editor a point which may be of interest: What exactly are the broadcast wavelengths? But a few months ago it was quite easy to answer this question, for, with the exception of casual transmissions from one or two stations using fairly long waves, the whole of broadcasting both in Western Europe and upon the far side of the Atlantic was done on wavelengths between 300 metres and 550 metres. The broadcast band then was quite obviously the 250 metres lying between these limits. Everything from, say, 280 metres downwards or from 575 metres upwards could be justly regarded as outside the broadcast limits. To-day, however, the situation has become a little complicated. At the lower end of the scale we have Brussels transmitting upon 262 metres—for a short time this station used 225 metres—and there is KDKA, whose short wave transmission is given on rather less than 100 metres.

Continental Waves

Above 550 metres matters are becoming even more complicated, for we have the Dutch stations on 1,050 metres, Haeren in Belgium on 1,100, Koel, in Czecho-Slovakia, on 1,150, our own Chelmsford on 1,600 metres, Radio-Paris on 1,780, Komarov on 1,800, Budapest on 2,000, Lyngby on 2,400, Eiffel Tower on 2,600, Königswusterhausen (weekdays) on 2,800; the same station's Sunday transmissions on 4,000, and the concerts and lectures given from Cartagena in Spain on 12,000 metres. Strictly speaking, therefore, I suppose that the broadcast band ranges now from about 98 metres to 12,000, with, of course, considerable gaps. If one were to confine oneself to writing upon those transmissions which take place on less than 100 metres or over 12,000 metres, there would not be much to say, and comparatively few readers would possess sets capable of dealing with either the very long or the very short wave stations.

It is most difficult to make classifications in wireless. Where, for example, do the short waves end and the medium waves begin? Where,

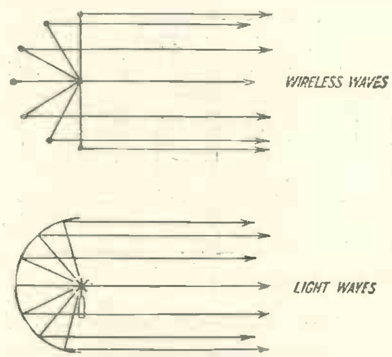


Fig. 1.—Beam wireless and the searchlight compared.

again, are we to draw the line between medium and long waves. Personally, I should make the divisions as follows: *very short waves* up to 180 metres, *short waves* 180 to 600 metres, *medium waves* 600 to 1,500 metres, *higher waves* 1,500 to 12,000 metres, *long waves* 12,000 metres upwards. This is satisfactory up to a point but there can be really no hard and fast line, for it is absurd to say that if a transmitter raises his wavelength from 180 metres to 181 he has passed, by so doing, to a waveband of an entirely different class.

Receiving Sets

Again, we might classify roughly, according to the type of receiving set required. Thus, a set equipped with resistance capacity coupling between its high frequency valves will be quite efficient on wavelengths down to 2,000 metres, and will do moderately well even down to 1,000 metres. The average receiving set using either transformer or tuned anode high frequency coupling, and not designed especially for the avoidance of stray capacities, will function quite well down to about 250 metres. Below this limit careful design is essential owing to the effects of stray capacities upon the very high frequencies that are being dealt with. But here again the dividing line cannot be hard and fast, for no one can argue that resistance capacity coupling will work well upon 1,000 metres and become hopelessly inefficient upon 999, or that a set of conventional design, which gives a fair measure of stability at 250 metres, will burst into the wildest oscillation when tuned down to 249 metres. All that we can do, I think, is to form our own general idea for the classification of wavebands and to realise that the demarkation is not definite, and the divisions must be elastic rather than of the cast-iron type. It would be fair, I think, to regard the broadcast wavelengths as those mainly devoted to vocal and instrumental transmissions. In this case they may be taken as lying between 300 and 500 metres. Nearly all the stations which do occasionally transmit vocal and instrumental items on the higher waves make a mere sideline of broadcasting, their main energies being devoted to commercial or scientific work. The outstanding exception is Radio-Paris, which is entirely a broadcasting station. Chelmsford is, of

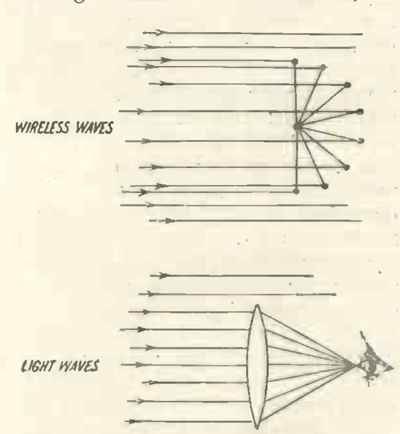


Fig. 2.—The wireless reflector compared with a lens.

course, used for commercial and experimental work with the call sign of 2BS.

Reflectors

One of the most interesting contributions to the study of wireless of recent times was the paper read by Senatore Marconi before the Royal Society of Arts on July 2, in which he discussed his latest experiments with waves ranging from the neighbourhood of 100 metres downwards. I expect that most people noticed in that paper certain references to the use of reflectors for receiving sets. We have heard much of the use of conductors arranged around the vertical aerial at the transmitting end, so as to focus the radiations into a beam or pencil, but probably few people have realised that it was possible to apply similar process to the receiving aerial for work upon the very short waves. A beam transmitter has often been compared with the searchlight, the principles of the two being essentially the same (Fig. 1.) In both, parabolic reflectors are employed to focus waves and to confine them to a comparatively narrow path. Both light and wireless waves are, of course, ether vibrations, the difference between them being that the wavelength of the shortest light wave is only a minute fraction of an inch whilst the shortest wireless wave hitherto used has a length of about 1½ metre; further, light waves do not bend to follow the curvature of the earth, whilst wireless waves do. Now the natural receiving station for light waves is the human eye, which has the focussing apparatus in its lens. The purpose of the lens is to collect all rays falling upon a comparatively large area and to focus them to a point. If the area covered by the lens of the eye is insufficient to detect faint light waves, we can aid it by making use of a telescope whose object glass covers a much greater amount of space (Fig. 2). We may say, then, that if the beam transmitter is the wireless searchlight, the receiving aerial furnished with parabolic reflectors performs with regard to wireless waves precisely the same function as does the telescope towards light waves. These reflectors spread over a fairly wide area, collecting a greater amount of energy than the aerial itself would do, and focussing its energy upon the single wire which leads to the receiving set.

This system seems to be capable of enormous development, and one wonders whether it is not due to certain natural focussing effects that reception is phenomenally good in some localities. Everyone has had experience at one time or another of wireless blind spots, or weak spots, which may cover large areas or may be confined to quite a small space, or may even occur in a case of individual houses in the same town.

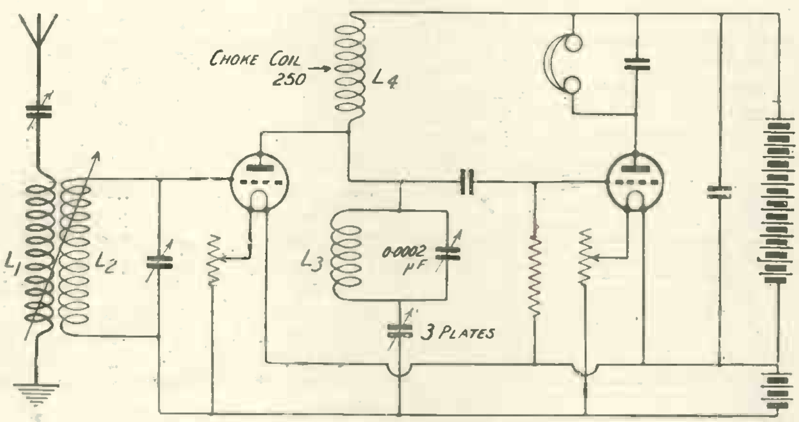


Fig. 3.—The Cowper circuit.

Frame Aerials.

The users of frame aerials have frequently found that reception is far better in one room of the house than in another. It may be below the normal standard in most rooms and found to be up to it in that where the best results are obtained; but not infrequently the best room gives results which are very much above the normal. I know of one instance which is rather curious. In one room of a particular house the frame aerial gives very much better results than are obtainable anywhere in the same locality with most efficient outside aerials. It is found in this room that the frame is not directional, but that one position gives the best reception of any station that will come in with its help. Here, I think, we have most probably a case of adventitious focussing due to the arrangement of the electric light wires, and the gas and water pipes which pass through the walls. If the reader employs a frame aerial to any extent, he may find it well worth his while to test out the signal strength obtainable in several rooms, and also to try various parts of a large room. In my own house there is only one room which will give any results at all with a frame aerial. This is one on the top floor at the front. Very faint signals are obtainable if a large set is used in the room next door, but in no other room can anything be obtained, even with two stages of high frequency amplification.

The Cowper Circuit.

For the reception of waves below 300 metres I have recently been trying a modification of the tuned anode circuit designed by Mr. A. D. Cowper, and described by him in Vol. 4, Nos. 10 and 11 of Wireless Weekly. The circuit which he gives there (Fig. 3) contains only one tuned anode, and when used for a single stage of high frequency amplification it is most efficient, giving great signal strength combined with selectivity and stability. By means of the 3-plate condenser oscillation may be controlled perfectly, and the set becomes as stable as can be desired. Application of this circuit to a double tuned anode receiver presents certain difficulties on account of the large number of inductances that would be required. Everyone who has worked with tuned anodes knows the difficulty of arranging inductances so that interaction between them does not take place to such an extent as to cause the set to become unstable. For this reason I tried the effect of substituting a resistance with a value of 50,000 ohms for the radio choke coil shown in the first diagram. This gave extremely good working, and I rigged up the circuit which appears in Fig. 4, which, as will be seen, is a combination of the standard tuned anode coupling and of the Cowper method.

The Condenser.

The reason why this was done was that only one 3-plate condenser happened to be available at the time, and this was used in the plate circuit of the second valve. With this composite circuit reception is extremely satisfactory. I should say that the set is one which has been specially designed for the elimination of unwanted capacity, and also of interaction between inductances. Though the grid of the valve is connected to the slider of the potentiometer, very little positive potential is used for stabilising purposes, and the damping is therefore not very great. Arranged on the lines shown in Fig. 4, the set is wonderfully easy to control. If the potentiometer is set so that the grid of the first valve is about one volt positive, a very loose coupling between L_1 and L_2 can be used, and the set can be brought into a condition of complete stability by means of the 3-plate condenser in the plate circuit of the second valve, even when both anodes are very sharply tuned. I hope shortly to try the effect of using the Cowper system for both high-frequency valves, substituting in both cases a fixed resistance for the choke coil originally suggested.

Wavelength Changes.

One very great advantage of the modified Cowper circuit is that if one wishes to change from short to long waves, the receiver can be adapted in a moment simply by making a disconnection at the point X in Fig. 5. It then ceases to be a tuned anode coupled set, resistance capacity coupling being brought into use automatically in this simple way. A set of this type is about as handy a receiver as one can have, since it is equally suitable for all wavelengths if a small switch is fitted at the point mentioned. The common opinion about resistance capacity coupling, by the way, seems to be another example of the way which we have in wireless of accepting as gospel anything which is told us three times. A study of some text-books would lead one to believe that the tuned anode is remarkably efficient on short and medium waves, but that its good qualities begin to wane on wavelengths over about 1,500 metres. Some authors tell us that resistance capacity coupling, on the other hand, is of very little use below 1,000 metres, but that it very conveniently begins to get better and better in every way just at the point at which the tuned anode starts to show a falling-off. Those who care to test out the truth of these statements for themselves will find that in main they are distinctly misleading.

Resistance versus Tuned Anode.

Certainly I have yet to discover the wavelength upon which resistance capacity coupling is superior to the tuned anode, or that at which the tuned anode begins to show a marked falling-off in efficiency. Provided that you can obtain large enough inductances with a low distributed capacity, the tuned anode circuit appears, so far as I have tested it out, to be a very great deal better than resistance capacity even on the higher waves. I admit that the difference between the two is not enormous when you rise above 4,000 metres, still there is no doubt that the tuned anode has it. A further point is that with tuned anode you obtain very great selectivity, whereas with resistance capacity a good deal of interference may be experienced on crowded wavebands, since even with a loose-coupled tuner the only sharply tuned circuits are the aerial and the grid circuit of the first valve. On very long waves where the frequencies become very low, the standard .00025 or .0003 μF grid condenser is rather too small, its reactance to these frequencies being very high. It therefore often pays to use a much bigger condenser in this position. This can be done quite easily if the existing grid condenser is connected to two terminals on top of the panel. One can then wire a second fixed condenser in parallel, thus adding the two capacities together.

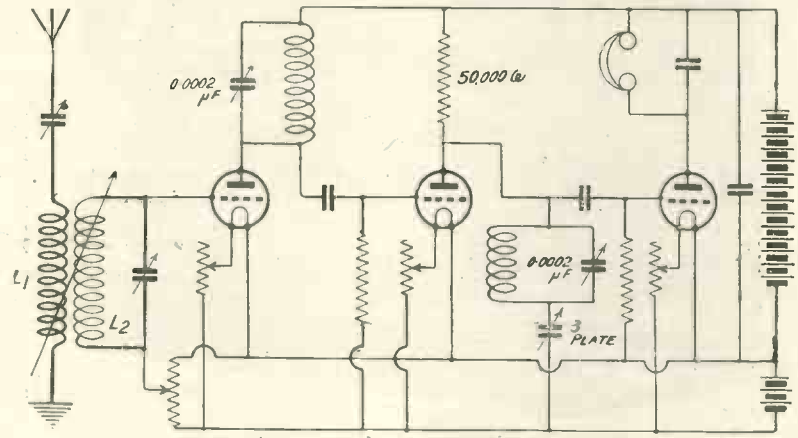


Fig. 4.—A modified Cowper circuit.

The Double Condenser

One is often asked whether the double condenser is really effective for controlling two high-frequency valves simultaneously. These condensers, which are made now by a good many firms, are rather ingenious aids to simplicity in searching and tuning. There are two tiers of fixed plates, each tier being well insulated from the other. The spindle also contains two tiers of plates, but there is no insulation between these since they are meant to be connected to a point common to both circuits, namely, the high tension positive lead. Fig. 6 shows the way in which a double condenser is wired into a circuit containing two transformer-coupled high-frequency valves. The answer to the question mentioned at the beginning of this paragraph is that these condensers are quite efficient subject to three important provisos. The first is that the two portions of the condenser itself shall be of equal capacity, the second that the anode inductances or primaries of the high-frequency transformers shall be of equal inductance value with a similar distributed capacity; the third proviso is that the wiring of the set shall be such that the two circuits shall be equally balanced as regards both high-frequency resistance and capacity between leads. It is now possible to obtain double condensers of quite a number of makes which really are evenly matched. Square law condensers of this type are delightful to use, for they are made as precision instruments, and in addition to the careful matching of the halves one has a steady increase in the *wavelength*, and not in the capacity, as the knob is rotated. Inductances, too, if of good make, will usually be found to be quite well matched; I say *usually* because one does come across curious instances of ill-matched pairs. I have two coils of the same number made by a well-known firm which, though bought at the same time, and as a pair, are very different from one another. As an example of what I mean I may say that with a double tuned anode set if coil No. 1 is placed in the first valve holder and coil No. 2 in the second, the readings of the anode condensers (using separate condensers) when the set is tuned to 200 metres are 23 and 41 degrees respectively. That this is not due to bad wiring or to faulty arrangement of the components is proved by the fact that if the coils are changed over, the first condenser must be tuned approximately 41 degrees and the second to 23 in order to obtain sharp tuning. Transformers, too, are a little liable to err in the same way, and if they are bought as a pair they should be carefully tested by trying them first

(*Continued on p.* 463.)

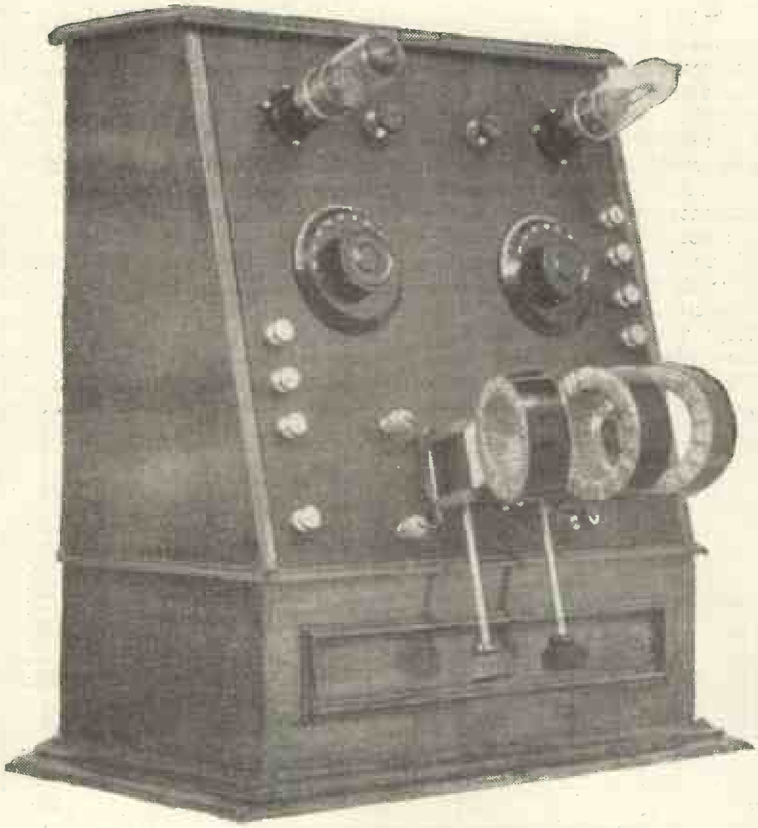


Fig. 1.—The completed receiver ready for use.

A Two-Valve Double Reaction Receiver.

By HERBERT K. SIMPSON.

A description of a two-valve receiver employing a principle of great interest and utility.

THE principle of double reaction is very rarely incorporated in receiving sets described in the technical press, and many experimenters will find that much interesting work can be done with a set employing this method.

The principle, which is due to Mr. John Scott-Taggart, was first described by the inventor in MODERN WIRELESS for February, 1923, and the actual circuit used in the present receiver is similar to circuit No. ST104 in "More Practical Valve Circuits."

A direct-coupled aerial circuit is used, the incoming oscillations being impressed upon the grid of the valve V_1, the latter having in its anode circuit the coil L_3 and condenser C_2, which form the tuned anode circuit, tuned to the incoming wavelength. The valve V_2 is coupled, by means of the condenser C_3, to the anode of V_1, and the coil L_2 is in the anode circuit of V_2.

Reaction is obtained by coupling L_2 to L_1, and also L_3 to L_2, a double reaction effect being thus obtained.

The Finished Receiver

Fig. 1 shows a photograph of the finished receiver, with valves and plug-in coils.

The aerial tuning condenser is seen on the left, while that on the right of the set is the anode tuning condenser. The aerial coil is in the left-hand socket of the three-coil holder, the centre socket being that into which is plugged the coil in the anode circuit of V_2. The tuned anode coil is plugged into the right-hand socket of the coil-holder.

Parts required.

The following is a list of component parts necessary for the construction of this receiver :—

Cabinet or box, with panel space 12 in. by 12 in.

Ebonite panel, 12 in. by 12 in. by ¼ in. (Peter Curtis, Ltd.).

1 Variable condenser 0.0005 μF maximum capacity (Jackson Bros.).

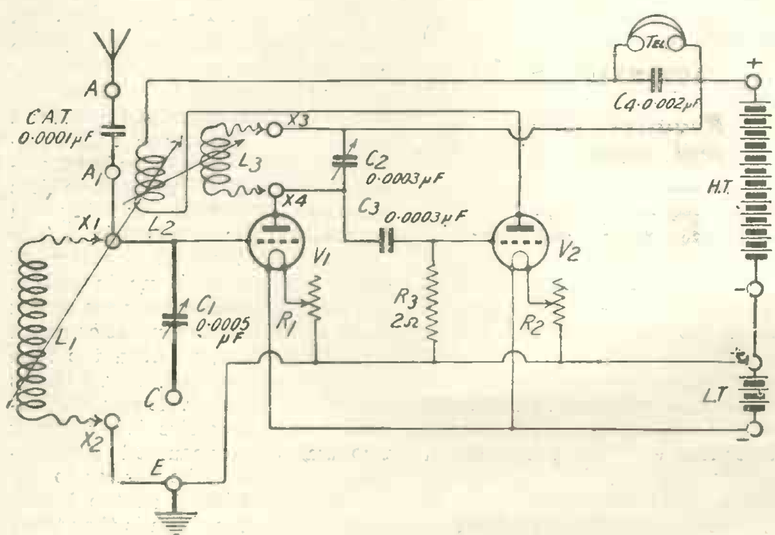


Fig. 2.—The theoretical circuit diagram.

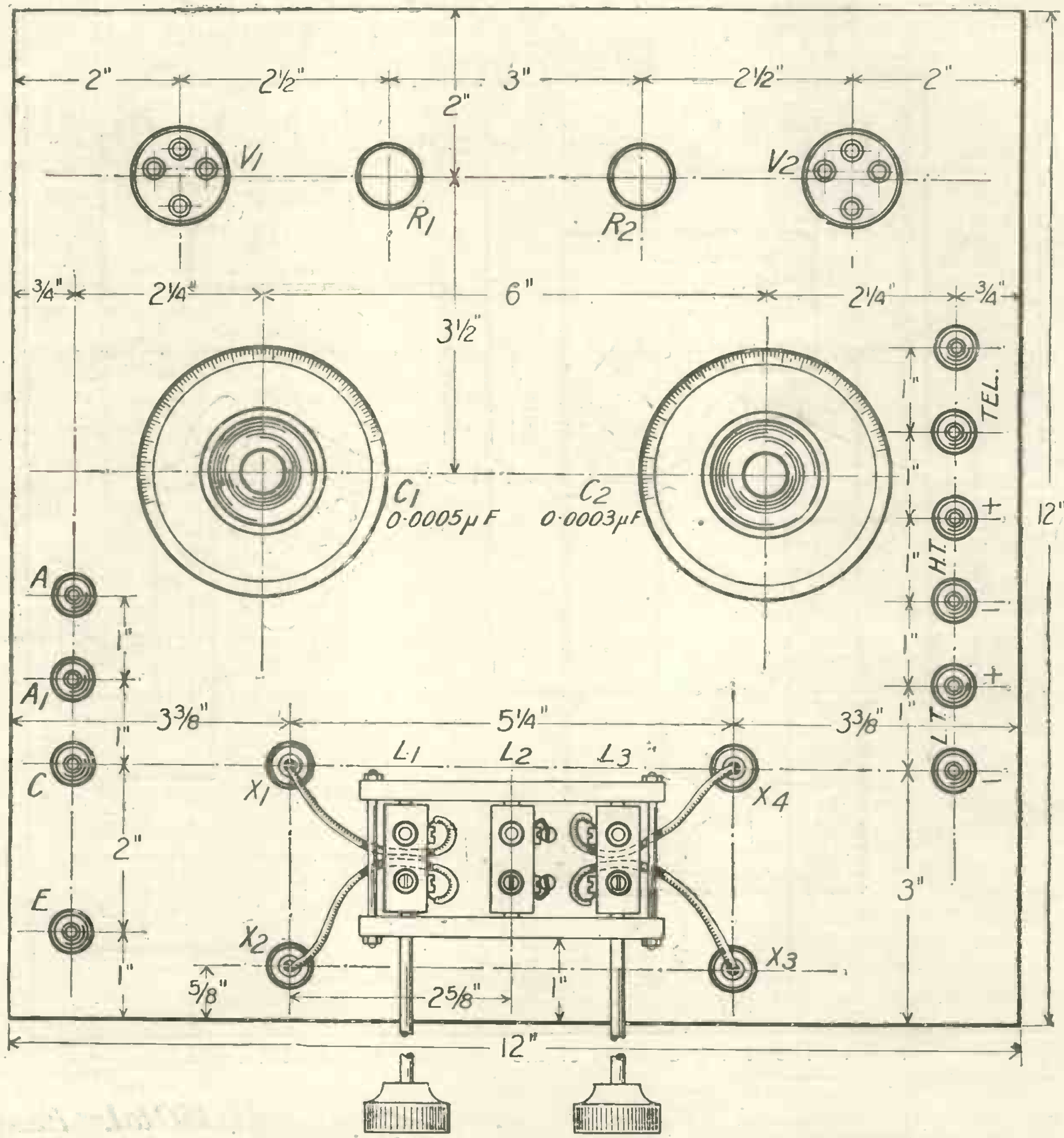


Fig. 3.—The panel layout and drilling diagram. Blueprint No. 61a.

1 Variable condenser 0.0003 μF maximum capacity (Jackson Bros.).

1 3-way coil holder (Goswell Engineering Co., Ltd.).

2-valve holders (Goswell Engineering Co., Ltd.).

2 Lissenstat Minor filament resistances (Lissen, Ltd.).

Fixed condensers of the following capacities—0.0001 μF, 0.0003 μF, 0.002 μF, one each (Dubilier, Ltd.).

1 Grid leak, 2 megohms.

4 Clix, complete with insulators and locknut.

4 Clix, with locknut only.

10 Terminals.

Square section wire, screws, rubber covered leads.

The Panel

The ebonite panel measures 12 in. square by ¼ in. thick, and should be of the best quality. If, however, unguaranteed ebonite is used the surface skin should in all cases be removed, in order to eliminate surface leakage.

Fig. 3 is a drilling diagram, and all the necessary holes may be marked on the panel with the aid of this drawing. When marking out do not use a pencil, as the lead will form a series of leaks all over the panel. A scriber should be employed, and the lines lightly scratched on the reverse side of the panel.

Make a mark against all holes of the same smallest size, and drill these first, then change the drill to the next larger, and proceed with all holes of this size. Time is saved by this method, which is obviously quicker than haphazard drilling.

Mounting the Parts

Having drilled the requisite holes, the component parts may be secured in their allotted places. It will be

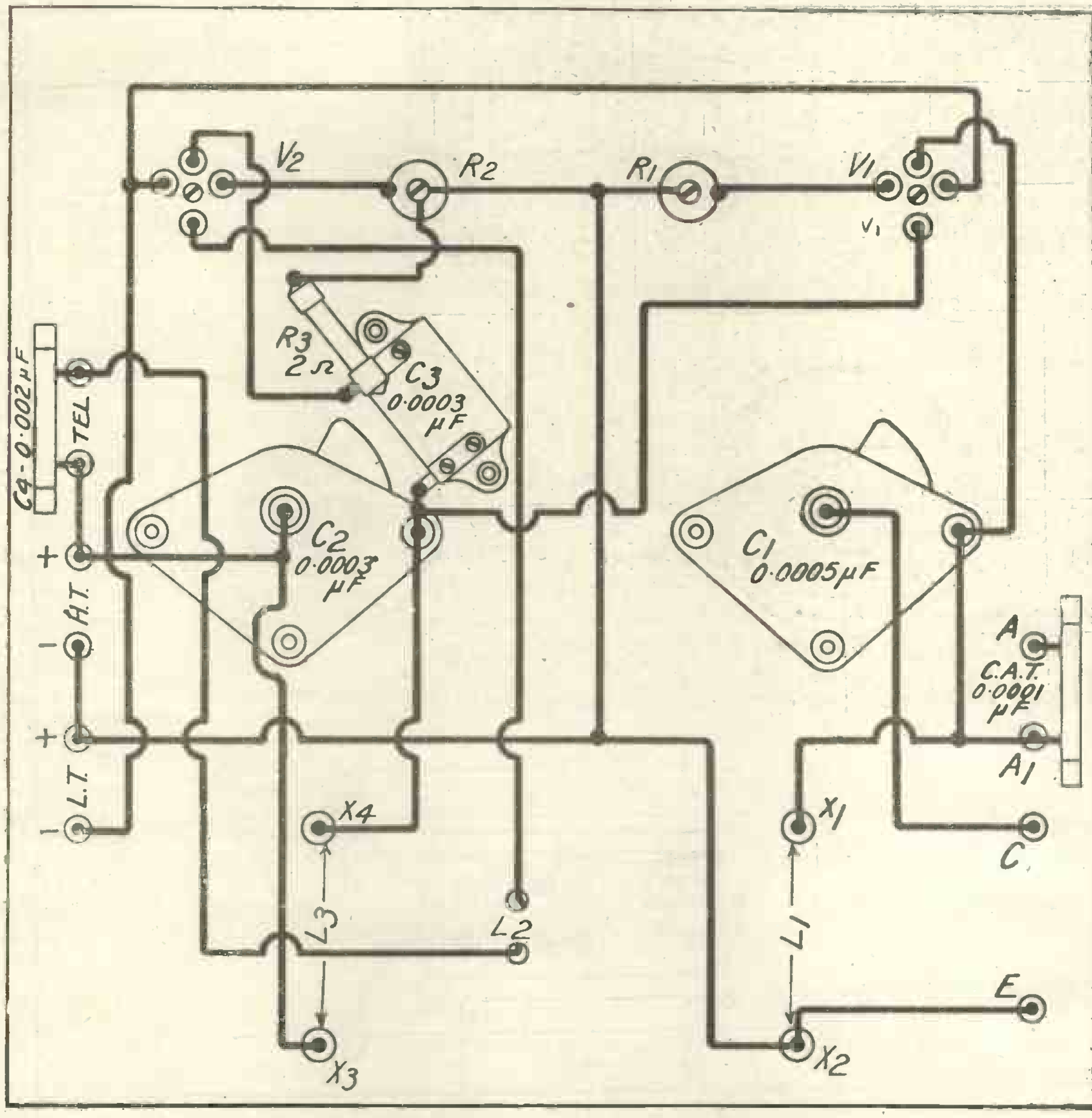


Fig. 4.—The wiring diagram of the receiver. Blueprint No. 61 B.

found easier to fix the smallest parts first, such as terminals, etc., and to leave the variable condensers and coil holder until the last. The weight of the panel is thus kept down as far as possible while work is in progress.

Wiring is carried out with $\frac{1}{16}$ in. square rod, and will give a very much neater appearance to the finished set, as well as being more efficient, than the older method of wiring with thinner wire covered with sleeving. Each piece of rod should be bent exactly to shape, to fit between the necessary points, before soldering up, and if care is taken over this, the use of square rod will present no difficulty. A wiring diagram is g'ven in Fig 4, which wlll be found clear and easy

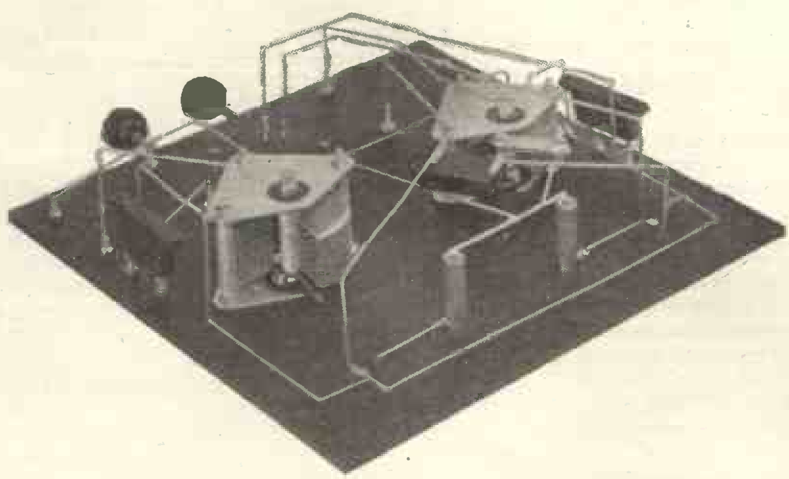


Fig. 5.—A photograph showing the underside of panel.

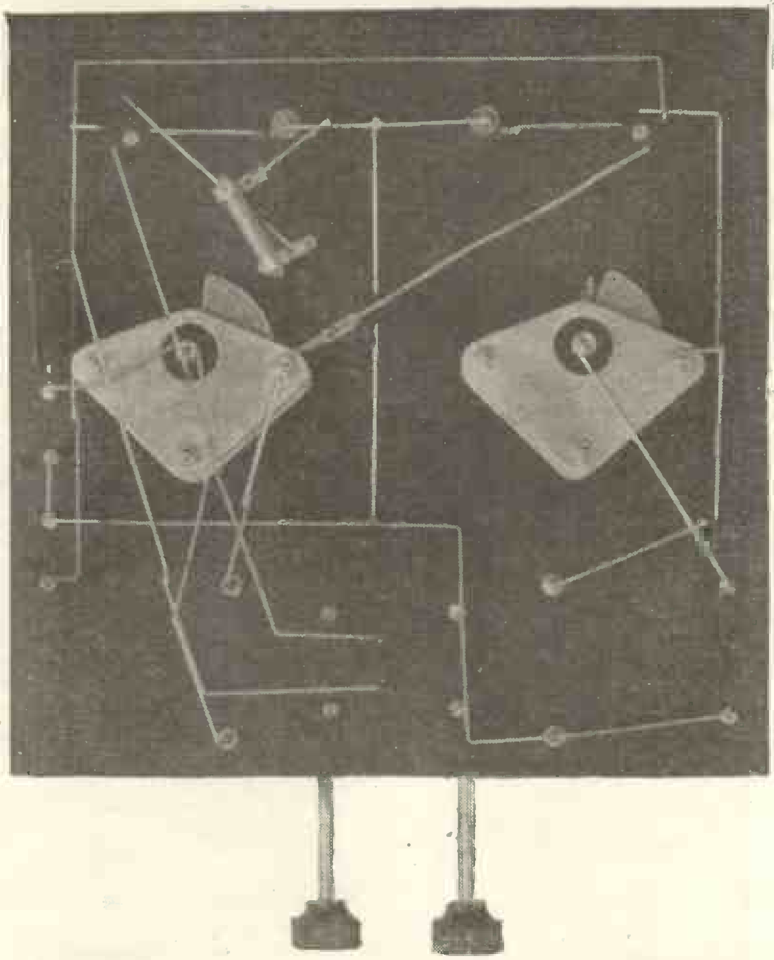


Fig. 6.—A plan view of wiring, which also shows the layout of the parts.

to follow, while photographs of the wiring are also shown.

Coils and Valves

When using constant aerial tuning, the aerial coil L_1 should be a No. 50 for wavelengths up to 420 metres, above which a No. 75 may be used. The tuned anode coil L_3 may be a No. 50, while the reaction coil L_2 may be a No. 75.

For the higher wavelengths, such as that used by 5XX, a No. 150 may be used in the aerial socket, a No. 250 in the tuned anode, and a No. 150 in the reaction. Almost any good make of valve will give satisfactory results in this receiver, and as suitable filament resistances are incorporated in the set, dull emitter valves may be used if desired.

A high-tension voltage of about 60 volts may be used, and the filament voltage will, of course, depend upon the type of valve used.

Operating the Set

When complete, the receiver may be joined up to an aerial and tried out.

Reaction may be introduced into either the aerial or anode circuits, by suitable adjustment of the coils, details of which will be given. Provision is made, in this receiver, for the reversal of the connections to the aerial and anode coils, thus enabling the direction of reaction to be properly adjusted. To obtain reaction on to the aerial circuit, the anode coil is moved at right angles to the centre, or reaction, coil, and the aerial coil moved towards the centre coil until the correct degree of reaction is obtained. If no increase in signal strength is obtained by bringing these coils together, the connections to the aerial coil should be reversed by means of the Clix X_1 and X_2, thus reversing the reaction.

Reaction into the Tuned Anode Circuit

If it is desired to react into the tuned anode circuit, the aerial coil is kept well away from the reaction coil, and the tuned anode coil is adjusted to give the desired reaction effect. The same remarks apply as to reversal of the connections to the movable coil if reaction does not increase the signal strength. The connections in this case are reversed by means of the Clix X_3 and X_4.

Double Reaction

A double reaction effect is obtained in the following way: Open out the coils at right angles, then gradually bring the anode coil up to the reaction coil, retuning on the anode condenser C_2. When the best position has been found, bring up the aerial coil gradually, re-adjusting the variable condensers to give the best results.

TEST REPORT.

The following stations were received using a No. 50 coil for aerial, No. 60 for anode, and No. 75 for reaction: 5 WA, 6 BM, 5 NO, and 5 IT.

The condenser readings were as follows:

For 5 WA, aerial condenser 18 deg., anode condenser 19 deg., signal strength moderate on loud-speaker. For 6 BM, aerial condenser 70 deg., anode condenser 42 deg., moderate telephone signals received. Newcastle, 5 NO, required 76 degrees of the A.T.C., and 52 degrees of the anode condenser, signals being readable in the telephones.

Birmingham, 5 IT, was tuned in with 126 degrees of the aerial condenser, and 82 degrees of the anode, giving comfortably readable signals in the headphones.

The Chelmsford station, 5 XX, was received at moderate strength on the loud-speaker, using a No. 150 coil in the aerial, No. 200 in the anode, and a No. 250 in the reaction socket, 78 degrees of aerial condenser and 80 of the anode condenser being required.

Radio-Paris was received at good strength using the same coils as for 5 XX, 120 degrees of aerial and 110 of anode condenser being required.

2 LO, at 10 miles, was comfortably audible on the loud-speaker in a small room using the coils as for 5 WA, with 50 degrees of aerial condenser and 29 of the anode. This station was also heard at good 'phone strength on a 2 ft. frame.

Full sized blue prints of figs 4 and 6 are obtainable, price 1s. 6d. each, post free.

A DEVON READER'S EXPERIENCES

To the Editor MODERN WIRELESS.

SIR,—I have built the four-valve family receiver and have pleasure in giving you a rough idea of the results obtained. In the first place I feel sure the apparatus is capable of giving better results than I have obtained because it is a hook-up circuit of the roughest description; I have had a nice cabinet made for it, but do not want to spoil it with possible alterations and improvements, so am experimenting with the hook-up circuit for the present.

(1) Alterations to the original circuit.

(*a*) .001 aerial condenser with .001 fixed condenser; this second condenser can be cut out or used in series or parallel by means of spade terminals.

(*b*) No switch to cut out HF valve, I find that by turning off the HF rheostat I get reception on the D valve OK with the additional advantage of anode reaction if required; the HF tuning condenser is quite easy.

(*c*) IS connected to grid instead of OS, this will be altered in the finished circuit; the OS has been tried and gives less distortion.

(2) Aerial System.

(*a*) 100 ft. 7/22 enam. wire including lead in without join; 30 ft. high both ends, pointing due E and W, lead in N.E. Aerial practically unshielded, lead in shielded both sides and back by house.

(*b*) Natural earth, directly under lead in, two leads 7/22 about 5 ft. long, insulated, each soldered to separate pieces of galvanised wire netting 1 ft. by 6 ft., one piece directly over the other, 1 ft. underground.

(3) Results. (London 10 miles to north).

(*a*) Detector with anode reaction, Stirling-Brown phones, 2LO audible 18 ft. from phones.

(*b*) D and 2 LF, Browns' small LS, no intentional reaction, and slightly detuned on Vernier to prevent overloading. Open air (2LO) announcer distinct at over 100 ft. indoors. Band music through 9 in. brick wall, neighbour says can hear it above his crystal set when wearing phones.

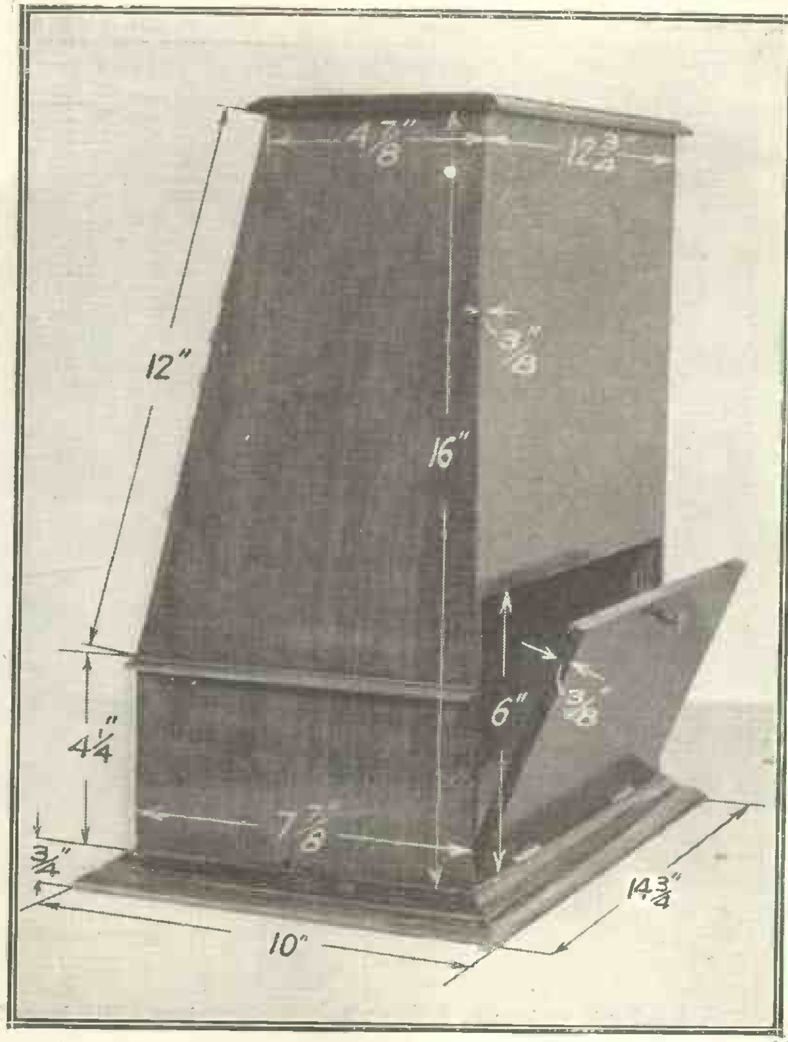


Fig. 7.—A photograph of the cabinet of the Double Reaction Receiver, with the dimensions marked.

(*c*) All four valves, no reaction, Radiola same strength as London.

(*d*) Ditto with reaction. Birmingham, Cardiff and Bournemouth average strength, ¾ London, but at times not so loud.

More trouble with these stations since April.

(*e*) Brussels (old wave length) and Ecole—as above at times but a lot more trouble to get.

(*f*) Manchester. 4 valves full reaction. Varies a good deal.

Newcastle and Glasgow, rarely LS strength but at times exceptionally good.

Aberdeen. This was a very easy station to get at full earphone strength in the spring; it is now, however, difficult to get at all, and then only very faintly.

(4) Selectivity and Stability. London can at times be quite cut out at 400 M and above, but always at 420 M. Set very stable and have never been troubled by head capacity on any station I have tuned in.

(5) Experiments with Aerials.

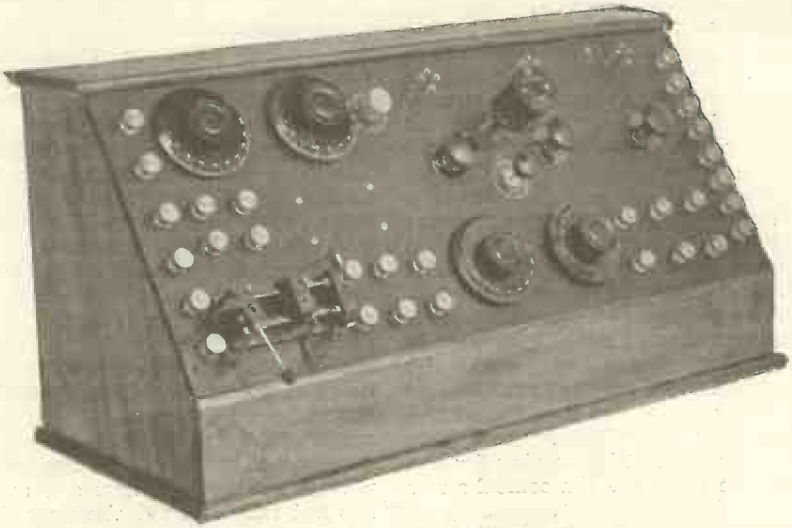
(*a*) 12 yds. double flex laid around room on floor. Four valves and reaction. London full strength. Radiola no trace.

(*b*) Loud speaker system used as aerial. London comes in full strength.

(*c*) 7/22 indoor aerial 15 in. long (all coils used), London 6 ft. from LS using all valves and reaction; the set is, however, very unstable, and susceptible to body capacity. (ATI used in (C) Lissen 40).

Yours truly,
J. E. CHAMBERLAIN.

S. Devon.



An excellent example of a reader's work in copying the original design

Interesting Experiences in the Radio Press Service Department.

by

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

ONE of the greatest advantages of the new organisation, from the point of view of the individual members of the Radio Press staff, is that it provides a unique opportunity of getting into the closest touch with large numbers of our readers, more particularly those who have experienced some sort of difficulty, and of learning just what their views and troubles really are. It seems inevitable that the opportunities thus afforded should react greatly to our readers' advantage, in that the experience gained in this way will increase yet further the helpfulness of the constructional and other articles appearing in this journal. During its short existence the Service Department has had many strange experiences, none more so, I think, than this one, which illustrates the extraordinary confidence placed in Radio Press and all its works by our readers.

A Strange Difficulty

A visitor presented himself early one morning in the Test Department, and asked for a consultation with myself, upon what he described as a "little wireless difficulty." He explained at the outset of the interview that he hardly liked to trouble us with so small a matter, and went on to explain that he lived at, shall we say, Brighton, and that his office was in, shall we say, City Road, and that as he only came up to town twice a week, he found it somewhat difficult to keep in touch with his business from his home. He expressed somewhat strong view regarding the inconveniences of the ordinary line telephone, and explained that he intended to erect a wireless transmitter and receiver at each end, and keep in constant telephonic communication with his office throughout the day. He made it a condition that the receiving set should use no batteries of any sort whatever, and had prepared quite elaborate plans of crystal sets for use at each end, and he had provided himself with complete scale drawings of the aerial and earth arrangements. The transmitters were to work from the lighting main supply, and it was in regard to this part of the equipment that he wished to have some advice, since he explained that he knew nothing about wireless transmitting gear.

An Explanation

So far, all had gone well, but when I explained that to maintain reliable communication over such a distance with only crystal receivers he must expect to use a good deal more power than that employed by 2 LO, and that I knew no way of achieving the desired end with the 10 watts which he had heard were allotted to private persons, I am afraid that he began to entertain a suspicion that his confidence had been misplaced. Explanations followed, of course, and I think my visitor left feeling that the real obstacle in his path was the Postmaster General. (Needless to say, the details of this incident have been altered out of recognition.)

From Egypt

Even more surprising was the attitude of an Egyptian visitor who was considering the purchase of the Radio Press Envelope describing the "Simplicity" receiver, and seeing my name upon the cover as the author he came to me for some information as to the capabilities of the set. He was the principal landowner of a small village on the upper reaches of the Nile, and what he wanted was a written guarantee from me that if he made up this set he would be able to receive the French broadcasting stations upon any and every night of the year, and upon my declining to commit myself in this way (naturally !) he made some pointed remarks regarding people who had no confidence in their own sets !

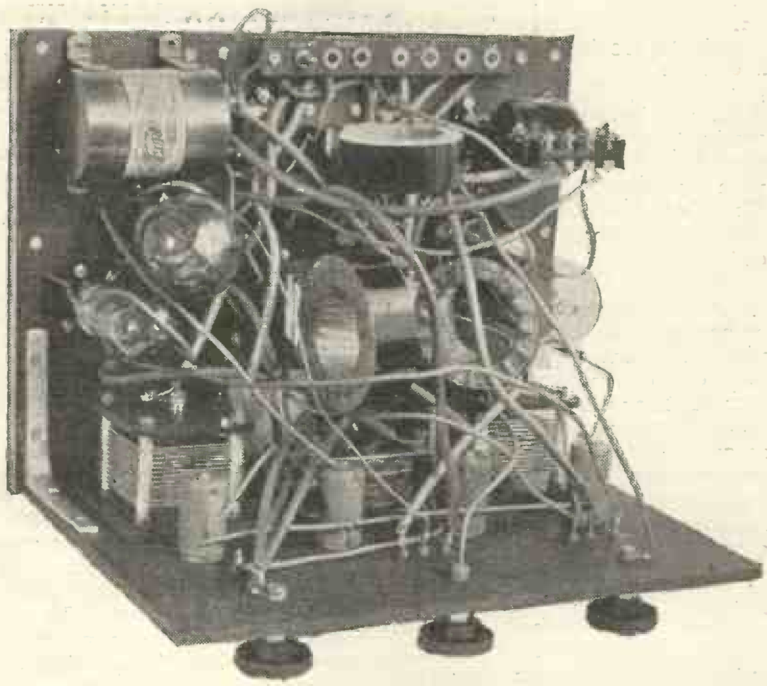
Soldering

Among the more serious lessons derived from our work, a somewhat unexpected one, which is proving exceedingly serious nevertheless, is the question of the standard of soldering efficiency achieved by our readers. Strangely enough, a very large number of faults have been traced directly to ineffective soldering, and I would like to take this opportunity of impressing strongly upon all and sundry the extreme importance of taking pains with soldering and making really certain that every joint is a good one. It may seem a little thing, and that just one poor joint in the set may not matter, but the fact is that what is likely to happen is that a whole series of poor joints may be set up, and the faults which result are some of the most perplexing with which we have had to deal. A really hot soldering iron properly tinned is, of course, one of the most important factors in good soldering, but the choice of a suitable soldering paste is almost equally important.

Corrosive Fluxes

Corrosive fluxes should on no account be used, since it is so difficult to remove them when the work is finished, and their action may be most destructive if they are allowed to remain. Incidentally, almost all the soldering pastes used should be carefully cleaned off when the joint has been finished, wiping with a piece of clean rag being suggested, since many of these are semi-conductive and may set up high-resistance leaks in all sorts of unexpected places. For example, we had one 3-valve receiver which gave the owner a great deal of trouble until he brought it to us, and then the application of the Megger to the valve sockets indicated that the average insulation resistance was in the neighbourhood of 50,000 ohms, and an examination of the back of the panel showed that the ebonite between the valve legs was heavily smeared with a certain soldering paste, mixed with brass filings resulting from the cleaning of the various metallic junctions. Removal of this by scraping put the whole trouble right.

Without experience it is, no doubt, difficult to tell whether any given soldered joint is a really good one, but a test which the beginner will find useful is the mere mechanical one of testing the actual strength of the joint by pulling fairly strongly upon each wire which has been soldered into place. A good soldered joint should withstand a considerable strain. Incidentally, I should not like to give the impression that I deprecate the use of solder on account of its risks, since our experience of bad joints shows that even imperfect soldering is better than wires imperfectly gripped beneath nuts. As an example of the trouble which may occur when the latter method of wiring is used, I will instance a Family 4-valve receiver which was brought in, and upon which the principal symptom was an entire lack of tuning in the anode circuit. Tests applied to the variable condensers showed that there was no electrical connection from the centre spindle bearing to the spindle itself, and it was found that the following somewhat unusual fault was present. The bearing for the spindle consisted of a conical screw engaging in a corresponding conical depression in the end of the spindle, with locking nuts upon the ebonite end-plate. These nuts had been unscrewed for the purpose of inserting the connecting wire, and in doing so the bearing screw itself had been withdrawn, so that its point was no longer touching the moving spindle.



This is alleged to be "A Four-Valve Family Set."

One of the greatest trials of our existence, however, is the set which has been made up "with a few slight alterations" from one of the Radio Press designs. We have seen modifications of almost every conceivable kind, it seems, and the trouble which these sets has given us has led to the introduction of a special charge of an additional 25 per cent. over and above the ordinary test fee for dealing with cases of this nature. Incidentally, the results given by these sets furnish a very striking corroboration of the contention of every good set designer that if you alter the design it is impossible to predict how the new arrangement will function. It may work as well as, or even better than, the old design, but the odds are that trouble will result, unless the modifications are made by some person with a really good technical knowledge. No doubt there are plenty of our readers who are quite capable of doing this, but unfortunately such modifications are not as a rule made by the more advanced experimenter, but rather by the beginner who is building his first set, and has not fully realised the risks he takes when he puts the high-frequency valve at one end of the set, the detector at the other and, say, the low-frequency valves in between, or makes some other drastic alteration of that sort.

Sympathy

We have naturally endeavoured to take a sympathetic interest in all such cases of alteration, and have tried to ascertain the motive which inspires our readers to make these alterations, since we find that in some cases they are well aware of the risks which they run, and it seems that one of the most potent motives is the possession of some cabinet with an arbitrary panel dimension which does not suit the set particularly well, and necessitates a complete rearrangement of the parts. One of the photographs illustrated in this article is a case in point, in which the Family 4-valve receiver has been compressed on to a square panel, with extraordinary effects upon the internal arrangements.

Modifications

We have, indeed, met with just one or two cases where the constructor really believed that he was improving the design, one of these being a Puriflex, whose constructor was quite convinced that he had turned out a far better instrument than the original! Such cases are rare, and the type of alteration to which I should like to devote a little attention is the question of the use of components of other makes than those specified upon the original design. In many cases, the constructor does not realise that he is modifying the design in any way by using other makes than the original one, and of course in the case of the majority of the components, so long as he uses good quality parts, there is no reason why

B.B.C. WIRELESS DRY BATTERIES *For* *B.B.C.* *Sets*

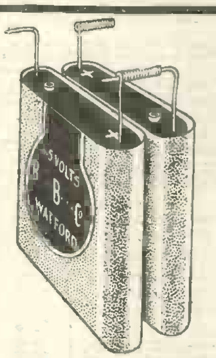
No. 1 W.

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.

PRICE CARRIAGE PAID, 7/- PER DOZEN, WITH PLUG.

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No. 2 W. Slab. 16½ volts, 3-volt tappings. Size approx. 9 x 1 x 3 ins	Price 3/-	each
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No. 5 W. Block. 60 volts. 3-volt tappings. Size approx. 9¼ x 3¼ x 3¼ ins.	„ 12/-	„

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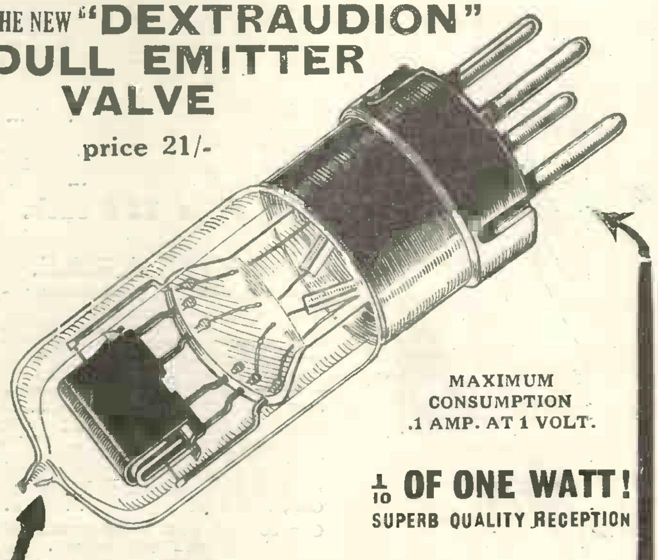
CLARENDON RD., WATFORD, HERTS.

THE NEW "DEXTRAUDION" DULL EMITTER VALVE

price 21/-



MAXIMUM CONSUMPTION .1 AMP. AT 1 VOLT.

1/10 OF ONE WATT!

SUPERB QUALITY RECEPTION

THE "DEXTRAUDION" DULL EMITTER VALVE—

represents without question the greatest advance in thermionic tube construction. While the consumption has been reduced to such an extent that it may be almost classed as a COLD-EMITTER, the QUALITY OF THE RECEPTION ENTIRELY SURPASSES ANYTHING HITHERTO OBTAINED WITH ANY OTHER VALVE.

It is a wonderful detector and L.F. Amplifier, and gives marvellous rendering on a loud speaker. **YOU HAVE NEVER HEARD ANYTHING LIKE IT !**

Full particulars, with characteristic curves, of this phenomenal valve, together with 40 PAGE RADIO LIST, sent post free on receipt of 4d. in stamps and mention of this advertisement.

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he should not make alterations in such matters as, say, filament resistances, coil-holders and so on. This more particularly applies to what are known as "straight" circuits, but in the case of reflexes the constructor cannot be warned too often that any alteration whatever is undesirable, since any circuit which is of a critical nature is liable to be completely upset by the use of, say, a different type of low-frequency transformer from that which the original designer found successful. Actual physical disposition of parts is of course important in critical circuits also, and it is quite impossible to predict what effect any given alterations will have without trial, and it is consequently of the greatest importance that the design should be duplicated as exactly as possible. Incidentally, it is only in such cases as this that our guarantee of the production of results equal to those of the original set holds good, since if any serious alteration is made we are quite unable to give any assurance as to the results which will be obtained.

Keep to the Design

Strict adherence to a design is also of great moment in the case of receivers employing one or more high-frequency valves, since such sets are necessarily more critical, and there may be factors at work which the inexperienced constructor cannot guess at, but which were nevertheless carefully taken into account by the original designer, and turned to due account. An interesting example of a trouble of this nature occurred recently in the case of a Transatlantic receiver, of the original form containing two high-frequency valves and detector. The set was a fairly good copy of the original, but it entirely refused to oscillate, and signals were exceedingly weak. Upon being brought up to the oscillation point by means of an added reaction coil results were fair, and it was found, among other things, that the halves of the double condenser were imperfectly matched, and results were very much improved by the use of a small vernier across the deficient half. Even this, however, failed to make the set oscillate, and all the usual tests were applied in vain.

A Condenser Fault

An explanation of the trouble was then found in the fact that the double condenser was not put in the symmetrical position half-way between the two transformers used in the original design, but was on the contrary quite close to one of them and at a distance from the other. The complicated inter-capacity effects between the condenser and the two transformers appeared to be such as to make it quite impossible properly to match the two circuits, and the whole thing was an excellent example of what may happen in fairly sensitive sets when the proper disposition of the parts is departed from.

An Appreciation.

To the Editor of MODERN WIRELESS.

SIR,—I must really write and thank you for the valuable information contained in your two valued papers, MODERN WIRELESS and *Wireless Weekly*, having taken them since their birth.

Before these started my first set was a crystal bought of parts at Woolworths, and since then have made "All Concert," "Family 4-valve," ST 100 (this is made portable in an attaché case), and all these are working wonderfully.

The 4-valve Family receiver was made exactly as sketches, except sec.-par. switch, separate vernier condensers, and extra terminals for grid bias and switch for using the H.F. Det. valves, either as bright or dull emitters. My aerial is 70 ft. long, 30 ft. down lead and 50 ft. high. Earth about 10 ft. direct to zinc earth. My aerial and earth are exceptionally well insulated, nearly 48 insulators in series. London comes in on the loud speaker on 1 valve, audible all over a medium-sized room, and with 3 valves all the B.B.C. stations on the 'phones, with 4 valves on the loud speaker.

All the components are made for wood panels (which I think are a great boon to pupils of Mr. Harris, who use wood instead of ebonite), Royal and Powquip transformers, 6 v. accumulator, 100 v. H.T., with 3 v. grid bias for 4th valve only.

I am now starting on the greatest adventure, the 5-valve Trans-Atlantic, and if I get a success as with others I shall be more than pleased.

Before closing I must thank your staff, especially Mr. Harris and Mr. Kendall, who have shown great interest in my sets. Had it not been for these two I think I should have given up wireless, but they have spurred me to higher ambition. Wishing your journals every success. — Yours faithfully,

R. WALDO EMERSON.

St. John's Wood, N.W.8.

The Cowper Neutrodyne Control.

To the Editor of MODERN WIRELESS.

SIR,—I constructed the "Dual Receiver with Neutrodyne Control," designed by Mr. A. D. Cowper, M.Sc., Staff Editor, and published in your April number.

I enclose two photographs* of same; you will notice the valve (a B.T.H. B5) mounted behind the panel. This layout gave very good results on a 90-ft. aerial, 5 ft. above a pitch roof, getting Bournemouth, Manchester and Cardiff very well on phones and Glasgow (7 miles away) on small loud-speaker. Since photographing the set I have fitted it with the Myer's Universal Valve on front of the panel with much better results. In fact I don't know if louder signals could be had from a single-valve combination. Many of my friends and the Secretary of our local Radio Club are very interested in this Neutrodyne set, and I believe it would be very popular here if Mr. Cowper, in a future article, would let readers of MODERN WIRELESS know how to load the set to take the new station (5 XX), 1,600 metre wave.

Yours truly,

W. H. SMITH.

Dalmuir, Scotland.

[*Not clear enough for reproduction.—*Ed.*]

Special Notice.

Included in our pages this month readers will find a loose order form, specially designed to safeguard them in dealing with advertisers. This form is valuable, and even if readers do not wish to purchase anything at the moment, they should carefully retain it for future use. Remember that Radio Press, Ltd., takes the greatest care to see that all its readers are satisfied. Use the form and if you do not obtain satisfaction write to us.

The receiver in use.

A Crystal Set with Loose Coupling

By W. H. FULLER

The use of plug-in coils in a coil holder adds considerably to the selectivity of a crystal set.

FOR selective reception with crystal receivers it is generally acknowledged that the form of tuning known as loose-coupling is superior to any kind of single circuit tuning. A number of crystal users appear to be under the impression that a considerable falling off in signal strength invariably accompanies the use of loose-coupled tuning, while actually this is only the case where serious jamming has to be cut out or reduced as much as possible. In cases where there is no interference to eliminate, by coupling the primary and secondary coils results equal and sometimes surpass those obtained in ordinary circuits of the single tuner type. Thus it will be seen that the loose-coupled receiver is suitable for use under almost all conditions. At short range it is unlikely that there will be any jamming serious enough to interfere with the desired signals, and the coils may be closely coupled. At moderate and long ranges the coupling between the two coils will depend upon the amount of interference experienced.

The loose-coupled receiver described in this article employs ordinary plug-in coils which are inserted in the sockets of a two-coil holder. The appearance of the finished receiver may be gathered from the photograph in Fig. 5. The variable condenser on the left of the panel is used for aerial tuning, and may be placed either in series or parallel with the aerial by means of the three terminals on the same side of the panel. On the right of the panel is the variable condenser which tunes the secondary or closed circuit. The terminal in the top right-hand corner is connected to one side of this condenser, and its use will be explained later. The other two terminals on the same side of the panel are the telephone terminals.

Provision is made for changing the connections to the secondary coil by means of two terminals seen to the right of the coil.

Between the two variable condensers is seen the crystal detector, which is of an unusual type known as the "Eccentro."

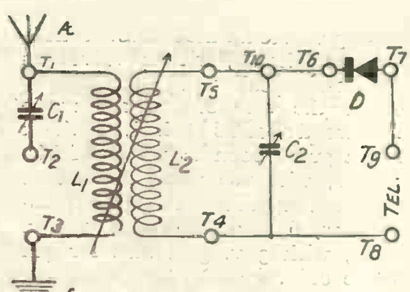

Fig. 1.—The circuit of the receiver.

The Circuit

The circuit diagram is shown in Fig. 1. The aerial is joined to either T_1 or T_2 according to the method of tuning required. Between these two terminals is connected the aerial tuning condenser C_1, whose capacity is .0005 μF. L_1 is the aerial coil variably coupled to the secondary coil L_2. The latter coil is tuned by the variable condenser C_2 of .0003 μF capacity, in parallel. The crystal detector and telephones are connected in series across the secondary coil.

The terminal T_{10} in the diagram corresponds with the top right hand terminal in Figs. 3 and 6, its purpose being to enable the set to be used as a loose-coupled tuner for a valve set if desired.

Components Required

The following is the list of components required for the construction of the receiver, and since many desire the names of the manufacturers, these also are given:

Ebonite panel 12 in. by 8 in. by ¼ in., (Peter Curtis, Ltd).

Sloping type cabinet for above panel.

"Eccentro" crystal detector (W. Joanes).

Two-coil holder (Goswell Engineering Co., Ltd.).

1 Variable condenser, .0005 μF. (Raymond).

1 Variable condenser .0003 μF. (Raymond).

10 W.O. type terminals.

Copper wire and rubber sleeving for wiring purposes.

4 short lengths of flexible wire.

The Panel

The ebonite panel is 12 in. long, 8 in. wide, and ¼ in. thick, and it will be seen by reference to Fig. 2 that relatively few holes have to be drilled. Before attempting the actual drilling of the holes, it is advisable to mar-

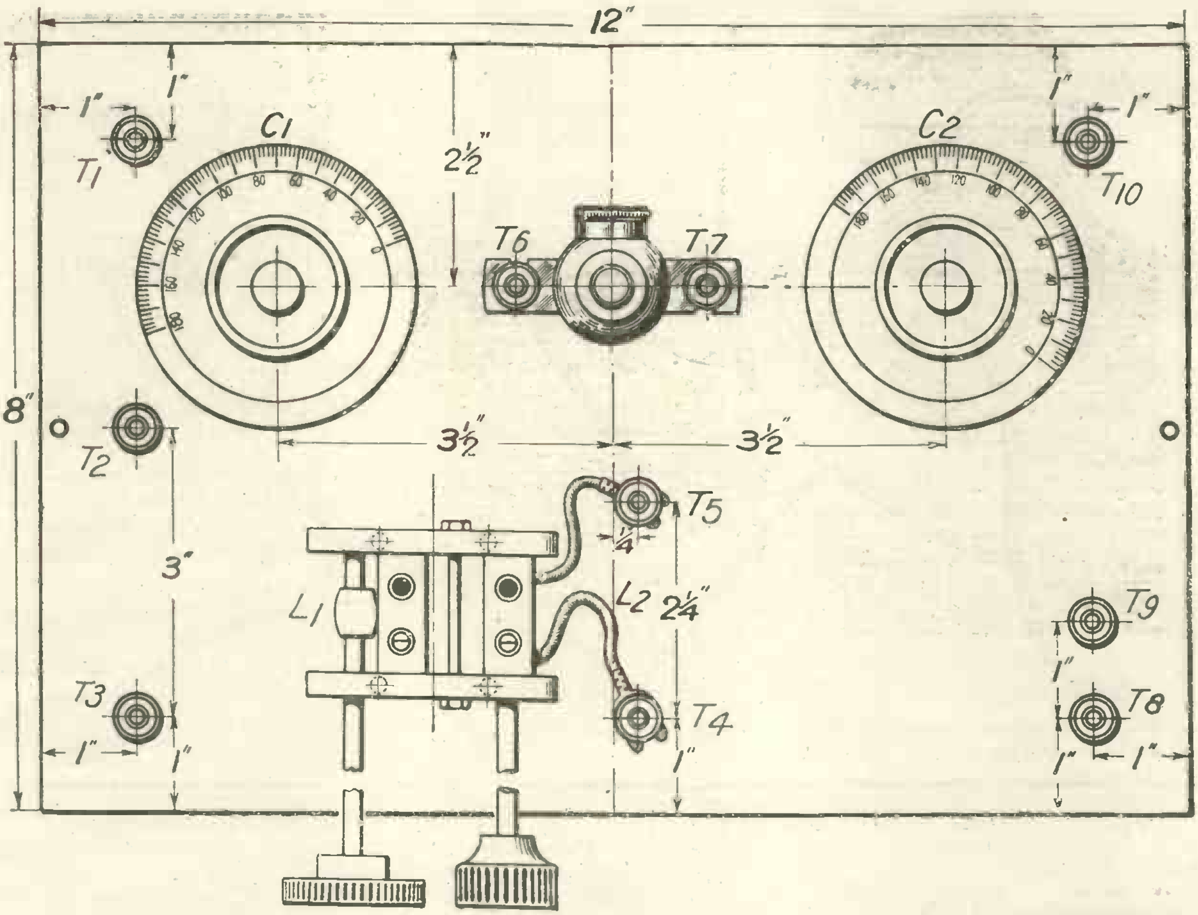

Fig. 2.—Panel layout and terminal markings. This illustration is exactly half scale.

their positions with the aid of a sharp-pointed instrument; now, upon applying the drill, it will be found that the usual tendency to wander from the correct position has been overcome.

Having drilled all the holes, the terminals should be mounted first, including the two to which the crystal detector is to be attached. The four flexible leads mentioned previously should be joined to the screw-head terminals on the sockets of the coil holder, and the two from the fixed socket taken through a hole in the panel after mounting the holder, as in Fig. 4.

The variable condensers may now be assembled, and should appear as in Fig. 4.

The wires are secured to the terminals by means of lock-nuts which should be clamped as firmly as possible. The few connections necessary are shown in Fig. 4, from which it will be seen that it is practically impossible to make any mistake in the wiring.

The crystal detector, which has been left until last owing to risk of damage, is now fixed in position by means of the terminals provided for this purpose, and the panel is complete.

The Cabinet

Should the reader desire to construct the cabinet for the set, this may be carried out by following the measurements given in Fig. 7, which supplies all the details necessary. If it is desired to purchase the cabinet ready made, a number of dealers can supply one of the correct size for this set.

Operating the Set

When first operating a set containing more than one circuit,

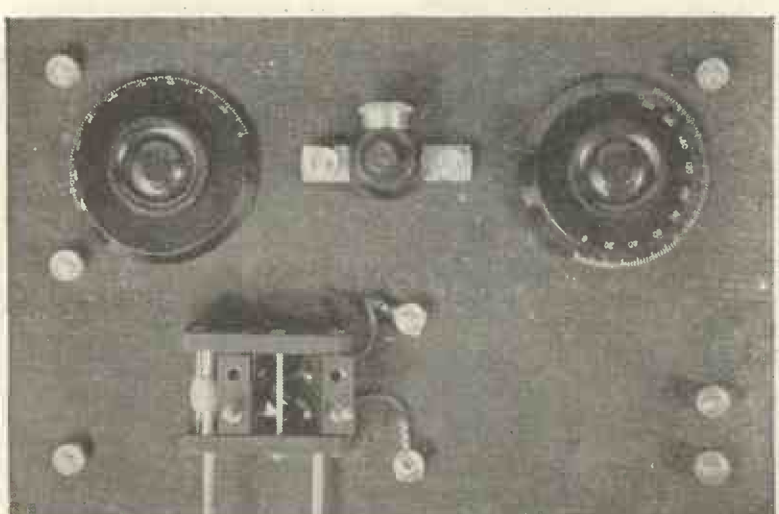

Fig. 3.—A view of the front of the panel.

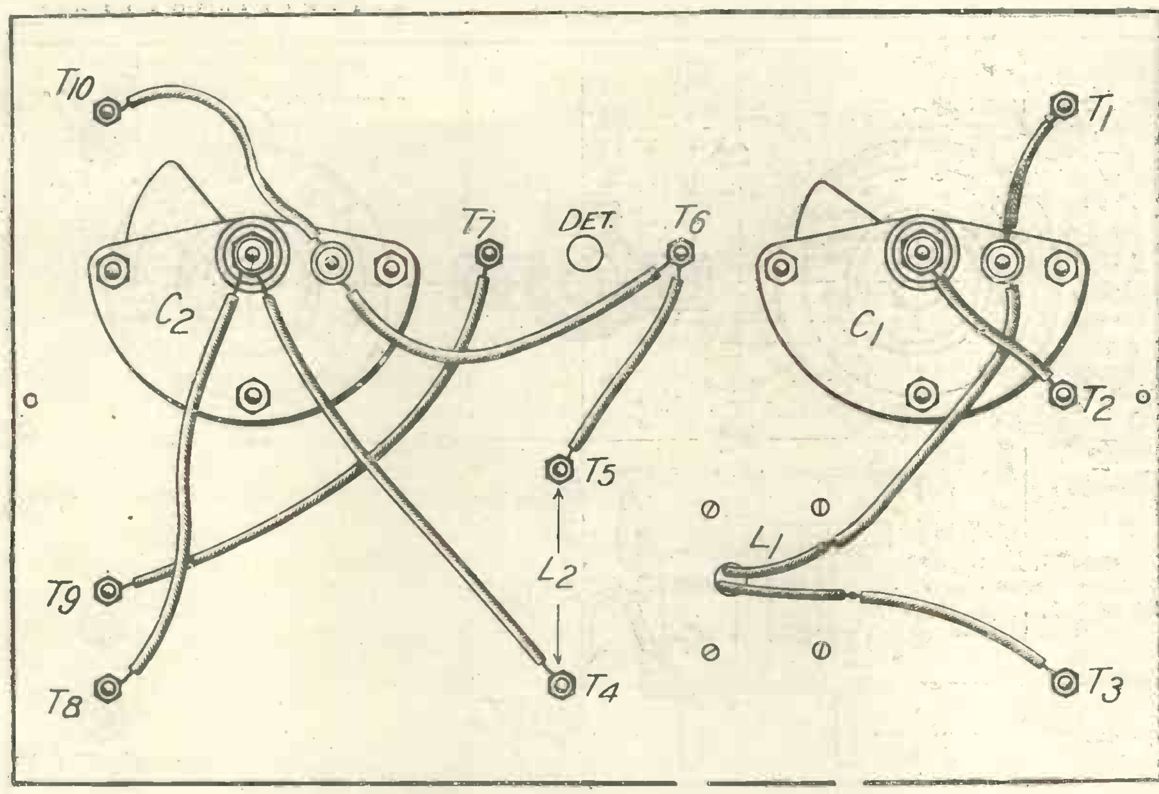

Fig. 4.—Wiring diagram. Note the simplicity of the wiring.

one is liable to become confused owing to the number of adjustments required. Those experienced in handling such sets will make some of these adjustments simultaneously, as, for instance, the altering of the coupling between the two coils, and a consequent variation of the capacity of one of the variable condensers, in order to retain the wavelength to which the set was previously tuned.

Assuming that the constructor is using loose coupled tuning for the first time, parallel aerial tuning should be used. That is to say, the condenser should be placed across the aerial coil, and for this purpose a piece of stiff wire is connected between the two lower terminals on the left of the panel, and the lead-in from the aerial is taken to the top terminal on the same side, whilst the earth lead may be connected to either of the two terminals joined together.

The size of the aerial coil will depend upon the size of the aerial on which the set is used, and on the wavelength which it is desired to receive, and it may be necessary to try two or three coils before the correct size is found. A No. 25, 35, or 50 coil will be suitable for broadcast reception if the aerial used does not differ greatly from the average. As regards the secondary coil, it is much easier to state a suitable size in this case, and a No. 50 or No. 75 coil is suitable for broadcast wavelengths.

When trying coils they should be kept close together and tuning carried out on both condensers simultaneously. If no signals are heard the adjusting knob on the detector should be rotated and tuning repeated, and when signals are received they should be tuned to the greatest strength possible by means of the condensers mentioned. If best signals are received with the condensers at minimum or maximum capacity, a different size of coil should be substituted for that in the fixed socket, remembering in making the alteration that in the case of best results being obtained with maximum capacity a larger coil is needed, and a smaller coil in the case where best signals were previously obtained with minimum capacity. The latter is only a general rule as,

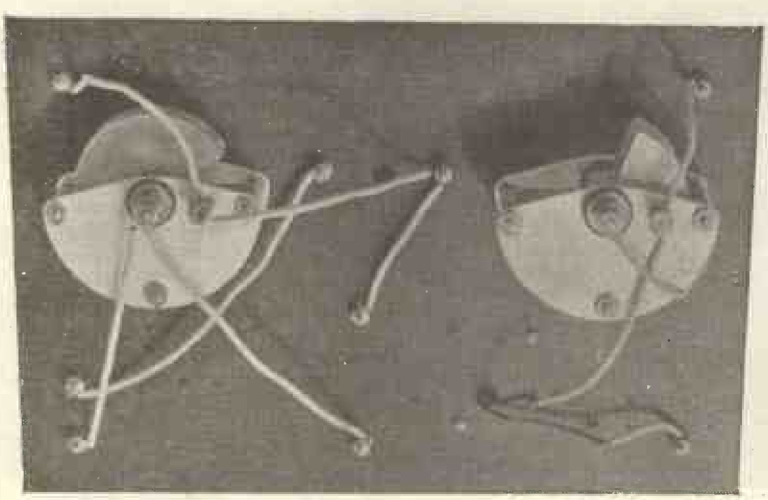

Fig. 5.—A photo of the underside of the panel.

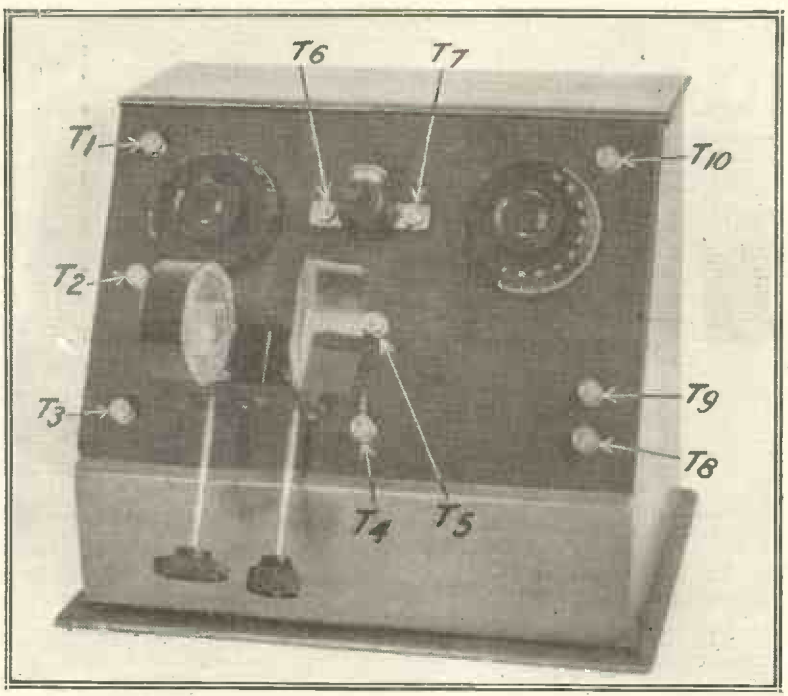

Fig. 6.—The completed receiver with terminals numbered.

in the case of minimum capacity, if the receiver be tuned to the correct wavelength, a substitution of coils will effect no improvement.

A No. 75 coil will often be found superior to a No. 50 for the secondary inductance.

Careful adjustment of the detector may now be undertaken, after which fine tuning on each condenser should bring in signals at their best strength, the two coils being all the time closely coupled.

A Tuning Unit.

The receiver may be used as a selective tuner for a valve set if desired.

If the first valve of the receiver is used as a high-frequency amplifier T10 should be connected to the grid of this valve, and T8 to the negative side of the filament. Where the first valve is a detector, T10 must be joined to the side of the grid condenser remote from the grid of the valve, while T8 goes to the positive side of the filament. The telephones, of course, are connected in each case to the valve set, and the aerial and earth to the crystal set in the manner previously described. T9 is not used at all.

Series Aerial Tuning

This method of tuning is obtained by joining the lead-in to the middle terminal on the left-hand side, disconnecting the link between this and the bottom terminal, and connecting the earth lead to this latter. A larger aerial coil will be necessary for this form of tuning.

Eliminating Interference

When the distance from a broadcasting station is such that the received signals are insufficiently loud to render occasional interfering spark signals unnoticeable, the latter may be reduced and sometimes entirely cut out by careful tuning, with but little loss in volume from the station desired.

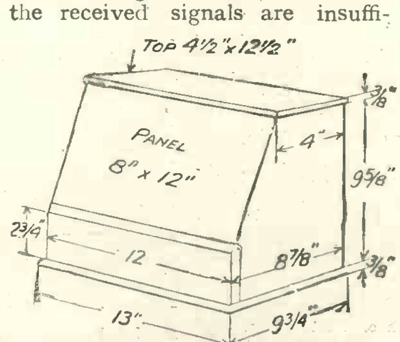

Fig. 7.—Dimensioned view of box.

The general method is to loosen the coil coupling a little, and then retune on the variable condensers to bring in the required station again. A certain amount of selectivity may be obtained by manipulating the condensers alone, and by combining this with variation of the coil coupling, very interesting effects are obtained.

The Family Four.

To the Editor of MODERN WIRELESS.

SIR,—I have much pleasure in writing you, at your suggestion, after having completed one of your 4-valve family receivers and can only say how pleased I am at the results obtained, and show it to my friends with pride. Your instructions being so explicit, I have had no difficulty, whatever, in the construction, which says a good deal, as I had no knowledge of Wireless whatever. I found it cost me a little more than you estimate, but I have put the best components throughout and have also built it on an ebonite panel. The whole is mounted in a mahogany cabinet with a glass front, showing all the wiring under the panel.

Living as I do in one of the worst parts of the country for wireless reception, I naturally have had some difficulty in getting 2LO, but Radio Paris can be heard all over my house (3 storeys) with the loud speaker, and on Sunday I heard Madrid quite plainly. I am working on a natural earth 8 ft. from the receiver, which is a 3 in. copper pipe sunk 5 ft. in the ground, and this I fill with water when working I also find your table of coils very precise, and am only a few degrees out on my condensers from the settings you give. On Radio I find I get slightly better signals with 200, 250, 200 Igranic coils than with 200, 300, 250, but not enough to worry about.

Trusting other users of your plans may reap as much pleasure as I am doing.

Yours truly,
ARTHUR S. BAZELEY.

Penzance.

To the Editor of MODERN WIRELESS.

4-VALVE FAMILY.

SIR,—I am writing congratulating you on the above which I have just constructed, and consider one of the best circuits yet out. My results to date are all British stations and various amateurs; some at Banbury, 2LO on three valves, 1 H.F., 1 D.L.F.; greater volume than S.T. 100 and quite as clear using 90 volts H.T. Speaker Amplion £5 5s. model. Brussels on speaker almost strength of London, also various Paris stations on phones.

Yours truly,
JOHN WAITE.

Bromley, Kent.

Call Signs

FOR BRITISH EXPERIMENTAL TRANSMITTING STATIONS

Revised to 15th August, 1924

Every endeavour has been made to bring this list up to date, and those experimenters whose call signs are of more recent date are invited to send particulars to the Editor for inclusion in subsequent lists.

2 AA	Radio Communication Co.	Slough.
2 AAA	A. L. Crane	44, Brookbank Road, Lewisham, S.E. 13.
2 AAF	C. Holt	Bay Horse, 141, Lee Lane, Horwich, Lancashire.
2 AAI	P. S. U. Smith	47, High Street, Stroud, Glos.
2 AAX	L. Smith	College House, London Road, Braintree, Essex.
2 AB	J. O. Walker	16, Ash Road, North Lane, Headingley, Leeds.
2 ABZ	E. G. Osborn	31, Princes Park Avenue, Golders Green, N.W. 11.
2 ACK	C. Brosser	Pleasant Harbour, East Aberthaw, near Cardiff.
2 ACP	L. Norris	136A, Brownhill Road, Catford, S.E. 6.
2 ACS	H. Frost	37, Marine Terrace, Margate.
2 AD	Messrs. Siemens Bros. & Co.	Woolwich.
2 ADJ	W. Johnson (Jr.)	3, Prince Alfred Street, Lerwick, Shetland, N.B.
2 ADN	G. Sykes	13, Longford Street, Gorton, Manchester.
2 ADO	J. Nelson	7, High Street, Prescot, Lancashire
2 AF	A. R. Taylor	49, Idmiston Road, Norwood.
2 AFB	W. N. Maddock	Elmsdale, Hewell Road, Redditch.
2 AFJ	W. Lindow	12, Arkwright Street, Bolton, Lancs.
2 AFL	P. N. Langham	102, Wilberforce Road, Leicester.
2 AFR	C. J. Kearsey	Holmdene, 139, Fawnbrake Avenue, Herne Hill, S.E. 24.
2 AG	T. Moor	Castlemaine, Lethbridge Road, Southport.
2 AGP	S. Meadowcroft	44, Carill Drive, Fallowfield, Manchester.
2 AH	A. R. Taylor	49, Idmiston Road, Norwood.
2 AHG	S. M. Evans	120, Manor Park, Lee, S.E. 13.
2 AHT	A Turner	Fern Lea, Whitefield Road, Ashton-on-Mersey.
2 AHY	H. S. Woodhouse	42, King's Road, Leytonstone, E. 11.
2 AIN	H. A. White	1, Canterbury Road, Brixton, S.W. 9.
2 AIP	H. King	2, Henslowe Road, East Dulwich, S.E. 22.
2 AJ	Radio Communication Co.	Barnes.
2 AJB	N. Blackburne	Chatsworth, Carlisle Parade, Hastings.
2 AJY	F. C. Osorio	65, Dartmouth Road, Cricklewood, London. N.W. 2.
2 AK	R. M. Radio. Ltd.	Townsend Mills, Worcester
2 AKG	A. N. Porter	20, Luccombe Hill, Redland, Bristol.
2 AKI	Capt. J. M. D. O'Brien	Rathgar Avenue, West Ealing, W. 13.
2 AKS	W. T. Crewe	The Dawn, 111, Princes Park Avenue, Golders Green, N.W. 11.
2 AL	W. Halstead	Briar Royd, Briar Lane, Thornton-le-Fylde.
2 ALA	H. W. Milnes	East Terrace, Northallerton, Yorks.
2 ALG	F. N. Coni	The Cottage, Leigham Avenue, Streatham Hill, S.W. 16.
2 ALR	B. C. Elliott	3, Argyle Road, Ealing, W. 13.
2 ALU	C. R. Green	9, Ladbroke Gardens, Notting Hill, W. 11.
2 ALZ	H. S. Newcombe	31, Ackroyd Road, Forest Hill, S.E.
2 AM	A. Perl	5, Charon Road, Chiswick, W. 4.
2 AMP	E. Styles	62, Bishopton Road, Bearwood, Smethwick.
2 AMX	J. H. Walker	259, Westburn Road, Aberdeen, Scotland, N.B.
2 AN	A. W. Sharman	1, Morella Road, Wandsworth Common, S.W.
2 ANB	A. J. Thornton	38, Battersea Park Road, S.W. 11.
2 ANK	T. A. Reed	Arranmore, Newquay.
2 ANN	F. Harrison	190, Almond Street, Derby.
2 ANO	F. G. Turner	88, Chesterton.
2 ANX	E. Kirkby	36, Rhodes Street, Halifax.
2 AO	O. Reilly	26, Junction Road, Eastbourne.
2 AOL	E. Bateman	Monkleigh, Drove Road, Patcham, near Brighton.
2 AOO	A. Sandford	36, Wattis Road, Bearwood Smethwick.
2 AOS	A. E. Oliver	2, Salisbury Street, South Shields, County Durham.
2 AP	F. J. W. Adams	Alexandra Hotel, Stonehaven, N.B.
2 APG	B. W. Warren	6A, Queensland Avenue, Coventry.
2 APS	H. J. Stamper	1, Charnwood Road, Loughborough.
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2 ARB	W. H. Neeld	42, Redbridge Lane, Wanstead.
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2 ASL	G. W. H. Tripp	Harford House, Chew Magna, Somersetshire.
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2 ATM	A. E. Sutton	37, Belfield Road, Rochdale, Lancs.
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2 AUG	E. Walford	Gables, Stoneleigh, near Kenilworth.
2 AUV	S. J. Matthews	27, Elgin Road, Seven Kings, Essex.
2 AV	D. H. W. Swiney	Southend.
2 AW	H. H. T. Burbury	Crigglestone, Wakefield.
2 AX	G. Sutton, A.M.I.E.E.	18, Melford Road, S.E. 22.
2 AY	D. F. Owen	Limehurst, Sale, near Manchester.
2 AZ	William Le Queux	93, Marina, St. Leonards-on-Sea.
2 BA	W. Eccles	Finsbury Technical College, Leonard Street, E.C. 2.
2 BC	D. F. Owen	Limehurst, Sale, near Manchester.
2 BD	Aberdeen Station, B.B.C.	17, Belmont Street, Aberdeen, N.B.
2 BN	L.N.W.R.	Crewe Station.
2 BO	Marconi's Wireless Telegraph Co., Ltd.	Writtle, Essex.
2 BQ	L.N.W.R.	Euston Station
2 BS	Marconi Station	Chelmsford.
2 BZ	B. Davis	23, Ferncroft Avenue, Heath Drive, N.W. 3.
2 CA	C. E. P. Jones	20, Princes Road, Wimbledon, S.W. 19.
2 CB	C. E. Davies	208, Walworth Road, S.E. 17.
2 CC	H. S. Nicholls	The Whins, Stocksfield-on-Tyne.
2 CD	Burton-on-Trent Wireless Club.	Headquarters: "Burton Daily Mail" Offices, High Street, Burton-on-Trent.
2 CH	Science Society	Oundle, Northants.
2 CI	R. Brooks-King	Widcombe, Taunton, Somerset.
2 CK	City and Guilds College (Engineering).	Exhibition Road, S.W. 7.

The "Last Word" in High Tension Batteries

NOTE.—These remarks were made by Mr. Frank Phillips, M.I.R.E., A.M.I.E.E., Chief Engineer of Burndept Ltd., in a memorandum to the Sales Department, and the Sales Department considered that they would interest many Radio enthusiasts, so (by permission of the Chief Engineer) they are printed exactly as received.—Sales Dept., Burndept Ltd.

I WANT to impress upon you Sales people that High Tension Batteries have given us more trouble during the past year than any other component: the reason is simple . . . *the cells inside the average H.T. battery are too small for present-day needs.* Most batteries designed during the war, when *light weight* was more important than *long life,* were quite good enough a couple of years ago, when we listened on our two-valve sets to an occasional transmission; but as we now sell four- or five-valve sets, which are perhaps used four hours regularly *every day,* we must stop putting small cell batteries into these sets. I have made up my mind that in future this company is going to sell one kind of H.T. battery only, and that it will be so large and so well made that it will last for nearly a year, but because it *is* large it can't go inside sets, so all our designs are being changed to permit of external H.T. batteries. That makes the set lighter, too, and keeps the inside free from corrosion from leaky electrolite.

The average H.T. battery is made of small cells weighing about ¾ oz. each. In the new Burndept Battery the cells weigh about 4 oz. The average battery is not a very attractive piece of work and is generally greasy, so that one needs a nice-looking case to keep it in. The new Burndept Battery is strongly cartoned in a box which has the appearance of polished mahogany.

With our friends, Siemens, I have been working on this battery for months, and between us we have produced something so good that as soon as it becomes known it will be recognised on sheer merit as the only H.T. battery worth buying. As it is a Burndept-Siemens product, designed by me, it will be obtainable only from us and from our agents.

I will now describe the battery in detail. The case is of very stout and strong composition covered with special polished mahogany finished coating, with a lid to match. The overall size is 9¼ by 9¼ by 3⅝ in. and there is no external printing or marking. On removing the lid, the top of the battery is seen to be covered with a new hard insulating compound, dull red in appearance, perfectly smooth, practically unbreakable. Rising from this surface are five very strong brass contacts which are clearly marked –, 20, 45, 48, and 50 volts. The battery is intended to be used normally to give 45 volts, which is the proper operating voltage for all High Frequency and Detector Valves of the popular dull emitter type; it is intended that, as the battery ages and the voltage drops, it may be kept up to the full 45 volts by moving the connection successively to the 48 and 50 volt positions; in this way the battery will retain its full rated voltage of 45 until the very end of its life. When higher voltages are required for Power Valves, two or more batteries should be joined in series.

On test the new battery proves to be absolutely noiseless; this is due, firstly, to the care used in making the cells (every zinc cell is mercury amalgamated, every seam is run over with melted ozokerite, and special care is taken with the depolariser), and, secondly, to the very high insulation of the battery, which is made in an inner container and flooded with paraffin wax, and then is placed in the outer container, which is insulated with our new compound. The battery actually weighs 12½ lb., and on account of its size and quality you can safely tell our customers that

it will operate a five-valve set four hours a day for at least 8 months—privately, it is certainly good for a year.

As I am afraid that battery purchasers do not *invariably* receive *absolutely unused* batteries, I am having these batteries **packed and sealed individually, each in a strong carton, so that they will reach the customer untouched.**

In future Burndept Ltd. will not deal in or stock any H.T. batteries (except those required for replacement in sets sold) other than the new battery, as that, I think, is the best way of making the public realise that the new battery is, like all our other products, in a class by itself.

The official name of the new battery will be **"The Burndept Super Radio Battery,"** 45-50 volts, catalogue number **202**, price **£1 4s. 0d.**

F. PHILLIPS.

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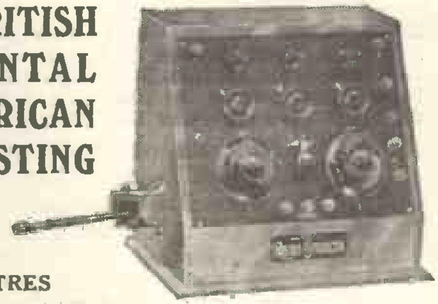

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2 OY	Capt. E. J. Hobbs, M.C., A.M.I.R.E.	4th Tank Battalion, Wareham Dorset.
2 OZ	Worcester Cadets' Signalling Company	Junior Technical School, Worcester.

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WEMBLEY

April-October 1924

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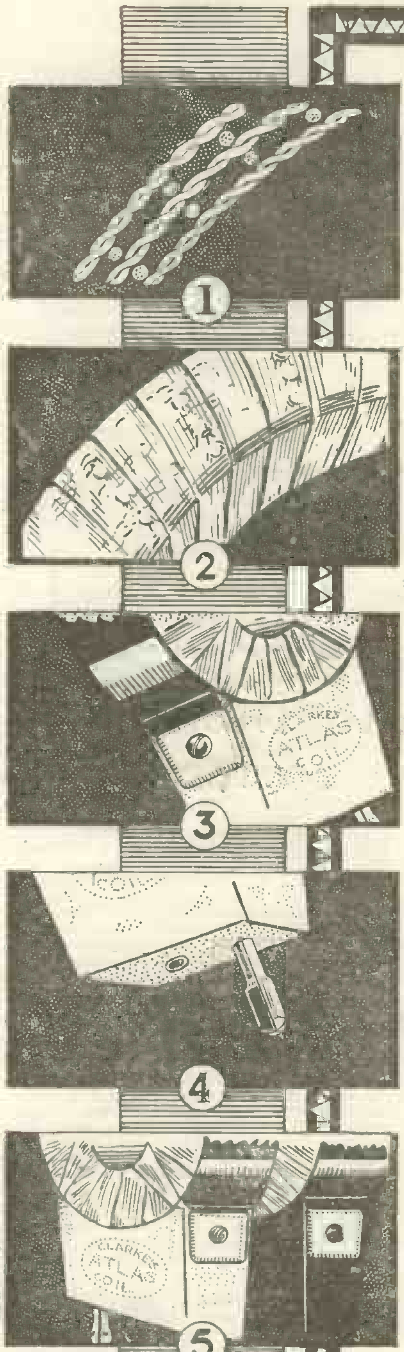

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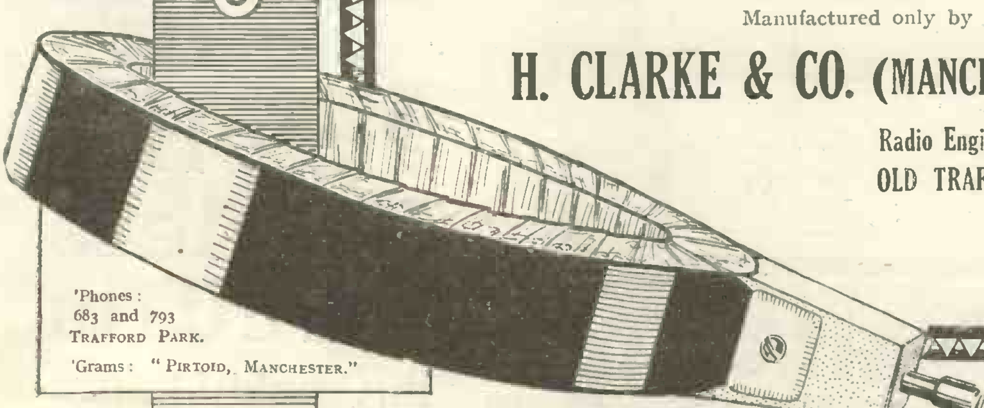

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5 DQ	C. H. Stephenson	Pen Manor, Wolverhampton.
5 DS	A. W. Fithian	51 St. James's Road, S.W. 17.
5 D.T.	S. C. Tucker	Ryda' Mount, 72, Dacres Road, Forest Hill, S.E.23
5 DV	D. Whittaker	56, Park Road, St. Annes-on-Sea.
5 DY	The Chelmsford Radio Engineering Co.	Rainsford End, Chelmsford, Essex.
5 FA	F. L. Deveaux	85, Bingham Road, Addiscombe, Croydon.
5 FD	A. Alfred Hewitson ...	Northdene, Grosvenor Road, Birkdale, Lancs.
5 FF	H. Anson	[illegible], Nottingham Place, Marylebone, London, W. 1.
5 FH	L. H. Lee	155, Rosefield Road, Smethwick, Birmingham.
5 FI	H. D. Webb	59, Bradford Street, Wallsall.
5 FL	T. W. Pevensey	Lewisham, S.E.
5 FM	Rene Stone Selwyn Electrical Engineering Co.	202, Walworth Road, S.E. 17.
5 FR	J. L. Jeffree	19[illegible], St. James's Road. Croydon, Surrey.
5 FS	W. A. Andrews	1, Balmoral Mansions, St. Andrew's Park, Bristol.
5 FU	University College ...	Nottingham.
5 FV	N. H. Gwynn-Jones ...	Burford House, Malvern.
5 FW	S. I. Hoel	Aylesbury, 21, Bromley Road, St. Annes-on-Sea, Lancs.
5 FX	Gent & Co., Ltd.	Faraday Works, Leicester.
5 FZ	Lincoln Wireless Society	Technical School, Monks Road Lincoln.
5 GB	Leonard Humphries & Co.	Wireless Contractors, 61, Geraint Street, Windsor Street, Liverpool.
5 GD	E. C. Burdett	3, Stockfield Road, Streatham.
5 GF	H. Stopher	14, Johnson Terrace, Cricklewood, N.W. 12.
5 GI	R. Horrocks	65, Leander Road, Thornton Heath, Surrey.
5 GJ	J. Bevis	Radex Villa, Linford Estate, nea Stanford-le-Hope, Essex.
5 GM	A. E. Greenslade	Jelf Road, London, S.W. 2.
5 GN	Messrs. Greenslade & Brown	Lansdowne Road, Clapham, S.W. 8.
5 GP	J. E. Simpson	Baskerville, Epsom Road, Guildford, Surrey.
5 GQ	F. W. Nightingale ...	Pitsford School, Northampton.
5 GT	E. Stanley Dobson ...	Lawn House, Richmond Place, Ilkley.
5 GX	P. D. Tyers	50, Mildred Avenue, Watford.
5 GY	G. H. Horwood	Buckland, 557, Lordship Lane, East Dulwich, S.E. 22.
5 HA	R. Watson	The Beeches, Streatley, near Goring, Berks.
5 HC	J. A. Beveridge	Dunelm, 8, Cluny Drive, Edinburgh.
5 HD	H. St. John Ward	Blenheim Chambers, 1, Crowtree Road, Sunderland.
5 HI	L. W. Birch	3[illegible], Limesford Road, Waverley Park, S.E. 15.
5 HL	G. E. Vowles	St. Leonards, Hooley Street, Sherwood, Nottingham.
5 HM	J. Fitton	The Wireless Stores, 27B, Milnrow Road, Rochdale, Lancs.
5 HN	D. R. Etchells	Great Bents, Oakon, near Wolverhampton.

5 HP	Cunningham, Ltd.	169-171, Edgware Road, W.2.
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5 JC	Ivor Morris	The Compton, Cemmaes Bay, Anglesey.
5 JD	F. Bulmer	4, Carlton Terrace, Scarborough.
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5 JH	E. C. Waddington ..	171, Alexandra Terrace, Great Horton Road, Bradford.
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5 JY	F. L. Aspden	6, Southport Road, Chorley, Lancs.
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5 KC	T. Dootson	12, Gilnow Road, Bolton, Lancs.
5 KF	W. Bird	Llangrove, Hednesford Road, Cannock, Staffs.
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5 KN	E. J. Earnshaw	95, Mayfield Road, Sanderstead.
5 KO	F. W. Higgs...	45, Howard Road, Westbury Park, Bristol.
5 KP	A. T. Wallace	Brettenham, Hedge Lane, Palmers Green, N. 13.
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5 KX	W. Ward	Agent for 5 KW portable.
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5 OY	Belvedere, Erith and District Radio and Scientific Society.	Hagis, The Radio Club House, Halt Robin Road, Belvedere, Kent.
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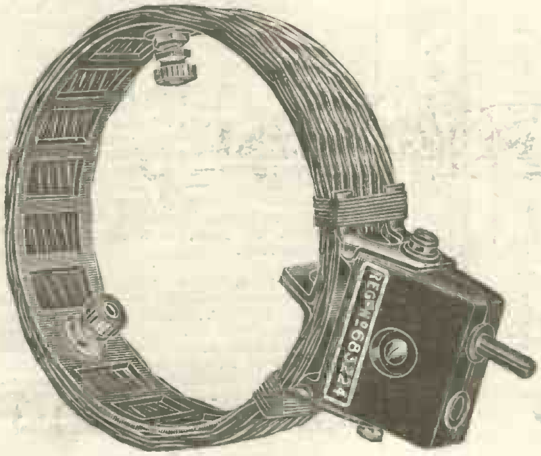

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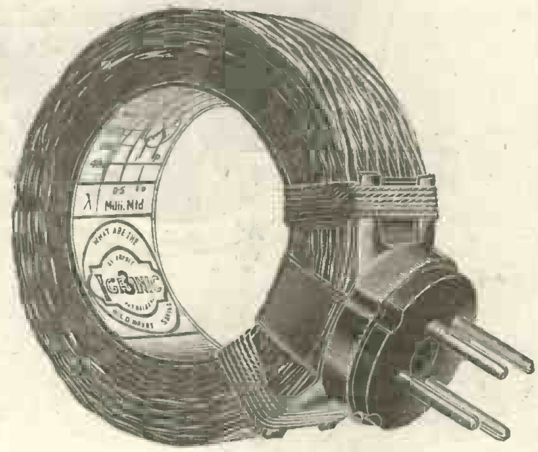

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UNITUNE (Regd.)
APERIODIC FIXED COUPLER

De Forest Patent No. 141344. Other Patents Pending.

Unrivalled for reception on short wave-lengths from 80-180 metres and from 300-600 metres

The difficulties usually encountered in short-wave reception are entirely overcome when the Unitune Aperiodic Fixed Coupler is employed and excellent results are easily obtained. This form of coupling combines many of the advantages of both direct and loose coupling without their attendant disadvantages.

Both coils are of the well-known Honeycomb Duolateral form of winding giving maximum efficiency and possessing a minimum of self-capacity which is absolutely essential for successful short-wave reception. The aerial coil is aperiodic or untuned, and is responsive to all wave-lengths within certain limits. The secondary winding is calibrated for various wave-lengths with given values of capacity in shunt. These wave-lengths remain constant no matter what size of aerial is employed.

The UNITUNE Fixed Coupler may be used in any receiver employing standard coil holders without any alteration to internal wiring by simply plugging into the A.T.I. socket, removing the aerial lead from the set and connecting it to the top inside terminal of the coupler. The lower terminal should be connected to the "earth" terminal of the set and to earth.

Type.	*Wave-length Range.*	*Price.*
UNITUNE MINOR	80-180 Metres	7/6
UNITUNE MAJOR	300-600 ,, ...	9/-

IGRANIC HONEYCOMB
HIGH - FREQUENCY TRANSFORMERS

De Forest Patent No. 141344. Other Patents Pending.

For extremely efficient high-frequency coupling these transformers are eminently suitable.

They provide for a maximum transference of energy without distortion. They incorporate the well-known Honeycomb Duolateral method of winding in both primary and secondary coils, resulting in a highly inductive coupling and small self-capacity between the windings, which are thoroughly insulated from each other.

They are easy to use and are exceedingly stable in operation, considerably reducing the tendency of a receiver to burst into self-oscillation.

Igranic Honeycomb H.F. Transformers should be tuned by means of a .0005 mfds. variable condenser across the secondary winding and give the wave-length ranges stated below, although a .001 mfds. condenser may be employed with No. 4 transformer, adding considerably to the range given without any appreciable decline of efficiency.

A four-pin plug is fitted for mounting purposes for use with any standard type of valve holder. These plugs are secured to the transformers in such a manner as to give an angular setting of the coils when the valve holders are mounted with their grid and anode sockets in a vertical line, thus reducing any possible mutual coupling between two or more transformers to a minimum.

Two of these transformers may be tuned by means of a double variable condenser of conventional pattern.

No.	*Wave-lengths obtainable when secondary shunted by .0005 mfd. variable condenser.*	*Price.*
1	250-500 Metres	8/-
2	450-830 ,, ...	9/6
3	800-1700 ,, ...	11/-
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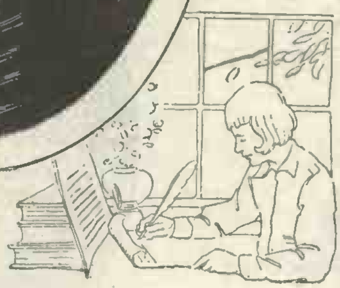
RADIO IGRANIC ELECTRIC Co. Ltd. WINDINGS

Cardiff: Western Mail Chambers.
Bradford: 18, Woodview Terrace, Manningham.
Newcastle: 90, Pilgrim Street.

Works: Elstow Rd., BEDFORD.



Johann Bach was born in 1685—the year that witnessed the birth of Handel. From his earliest days he showed a marked love for music. Yet his parents prohibited him from using his elder brother's scores. Bach, however, undaunted, used to rise at night and steal away to copy them by moonlight—permanently injuring his eyesight by so doing.

WHEN one considers the wide variety of instruments in the orchestra to which the Loud Speaker has to respond in a perfectly life-like manner, it is obvious that some means other than the ordinary telephone principle of a flat diaphragm must be used. In the BROWN Loud Speaker, you have an entirely different method of reproduction—the only true method of preventing distortion. If you could examine one you would find that the diaphragm is cone shaped, and anchored at its centre to a steel reed. The steel reed in its turn is made to vibrate to and from the poles of an electro-magnet.

Thus the diaphragm moves only from its centre outwards, exactly like the mica diaphragm on the sound box of a Gramophone.

Whenever the BROWN Loud Speaker is compared on actual tests with any other, no one can fail to be struck with the masterful way in which it renders the extremes of the harmonic scale. From the shrill tones of the piccolo to the deep notes of the double bass, every instrument is reproduced with life-like fidelity. Before you decide on your Loud Speaker, get your Dealer to give you this test—you'll be convinced at once.

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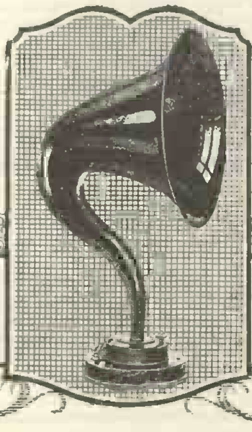

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Type H.1., 21 in. high:

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2,000 ohms	£5	8	0
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Brown Loud Speakers

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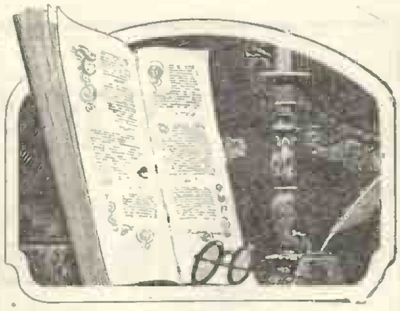

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5 YO	J. E. NOBLE	The Homestead, Golcar, Huddersfield.
5 YQ	J. GALLOCHER	4, Havelock Terrace, Paisley.
5 YR	F. H. WEBBER	14, Bridge Street, Tiverton, Devon.

5 ZG	H. Taylor	30, Park Road, Barnoldswick, Yorks.
5 ZH	Cromwell Engineering Co.	81, Oxford Avenue, Merton Park, S.W. 20.
5 ZK	City Accumulator Co. ...	13, Queen's Road, St. John's Wood, N.W. 8.
5 ZO	W. F. Mills	11, Stoney Hey Road, New Brighton, Cheshire.
5 ZQ	H. Jessop	144, Halifax Road, Brighouse, Yorks.
5 ZR	F. Austen	52, Church Street, St. Peter's, Broadstairs.
5 ZT	E. S. T. Edwards	18, Ripon Street, Moss Side, Manchester.
5 ZV	W. Herring	221, Newark Road, Lincoln.
5 ZX	T. L. Rawson	Belrock, Belfield Road, Didsbury, Manchester.
5 ZY	L. Headlam	Stakesbury Road, Whitby, Yorks
6 AA	Durham and Northumberland Colliers' Fire and Rescue Brigade.	The Rescue Station, 854, Scotswood Road, Newcastle-on-Tyne.
6 AB	Durham and Northumberland Colliers' Fire and Rescue Brigade. (Portable.)	The Rescue Station, 854, Scotswood Rd, Newcastle-on-Tyne.
6 AF	R. H. Rice	70, Seaside, Eastbourne.
6 AG	W. H. Fortington ...	237, Dudley Road, Rotton Park, Birmingham.
6 AH	R. H. P. Collings	4, Dean Place, Liskeard, Cornwall.
6 AI	H. Andrews	Cynlin's Garage, Ystradgynlais, Swansea.
6 AJ	G. Ensoll	25, Victoria Road, Dukinfield, Cheshire.
6 AL	J. P. Morter	49, Westow Hill, Upper Norwood, S.E.
6 AO	A. V. Ruddlesden ...	24, Wakefield Road, Dewsbury, Yorks.
6 AP	J. A. Hobson	Hill Close, Berkswell, near Coventry.
6 AQ	A. H. Bird	35, Bellwood Road, London, S.E.15
6 AV	F. A. Elliff...	10, Stumperlowe Park Road, Fulwood, Sheffield.
6 AW	E. J. Jarvis	Naseby Cottage, High Street, Waltham Cross.
6 BB	J. Bolt	Crouchley, Lymm, Cheshire.
6 BBC	Experimental B.B.C. Station	Derby House, Hendon, N.W. 4.
6 BC	W. D. Clague	White House, High Heworth, Gateshead-on-Tyne.
6 BJ	C. Solomon (Portable) ...	10, Cavendish Road, Brondesbury, N.W.6.
6 BM	Bournemouth B.B.C. Station.	
6 BN	G. E. Minvalla	Dorothy, 25, Weighton Road, Anerley, S.E. 20.
6 BO	L. C. Haggel	35, Cunningham Park, Harrow.
6 BP	A. E. Hayward	Devonia, Higham Road, Tottenham, N. 15.
6 BQ	J. L. Cannon (Portable) ...	14, Woodcroft Avenue, Broomhill, Glasgow, W.
6 BR	G. H. Ramsden	Overdale, Ilkley.
6 BT	C. A. Jamblin	82, York Road, Bury St. Edmunds
6 BV	V. F. M. Oliver	Whitmore Lodge, Sunninghill, Berks.
6 BW	J. C. Mason	8, Westmorland Road, New Briton.
6 CC	B. A. Matthews	Westgate, Frederick Road, Wylde Green, near Birmingham.
6 CE	W. C. Lingard	Bridgeholme Green, Chapel-in-le-Frith, Derbyshire.
6 CG	A. W. Eagle	42, Park Lane, Tottenham, N. 17.
6 CI	C. E. Tilley	10, Guthlaxton Street, Leicester.
6 CT	F. C. Deal	77, Hertford Road, near Edmonton, N. 9.
6 CW	D. Burne-Jones	Gwalior, 1, Rustic Avenue, Streatham, S.W. 16.
6 DC	G. Young	37, Barnard Road, Mount Estate, Gorton, Manchester.
6 DD	J. W. Barber	205, Brockley Road, S.E. 4.
6 DI	F. L. W. Dean	9, Working Street, Cardiff.
6 DJ	A. C. Copsey	27, Southerland Road, Tottenham, N. 17.
6 DK	F. A. Boyce	111, Stoke Road, Slough.
6 DM	C. Knight-Coutts	16, Vine Street, Evesham.
6 DP	Norman Crowther... ...	219, Roundhay Road, Leeds.
6 DU	R. J. Newton	1, Jerningham Road, New Cross, Cross, S.E.14.
6 DW	Douglas H. Johnson ...	131, Clapton Common, London.
6 DZ	Capt. L. A. K. Halcomb ...	South Dene, 106, Millhouses Lane, Sheffield.

6 FA	G. E. Wardle	Kingsdown, College Road, N. Blundellsands, Liverpool.
6 FB	W. Grocott	Church Road, Oxley, Nr. Wolverhampton.
6 FC	L. S. Taylor	6, Bankfield Road, Huddersfield, Yorkshire.
6 FG	N. Hendry	Hertford House, Sanderson Road, Newcastle-on-Tyne.
6 FH	G. W. Livesey	3, Spring Bank, Market Drayton.
6 FJ	C. V. Jarvis	21, Baltic Road, Tonbridge, Kent.
6 FK	Worcester Cadet Signal Co.	Junior Technical School, Worcester.
6 FL	Sheffield Relay Station, B.B.C.	
6 FQ	A. B. Richardson	9, Quarry Road, Hastings.
6 FV	W. H. Taylor	37, Bridge Street, Warrington.
6 FY	J. T. Thornton	Green Hill, 73, Birkby Lodge, Road, Birkby, Huddersfield.
6 GM	E. A. Wilson	Roxburgh, 42, Heber Road, N.W.2.
6 GO	L. A. Sayce	5, Toward Terrace, Sunderland.
6 GQ	J. S. Sout[illegible]	Greyfriars Ironworks, Elgin.
6 GT	G. Turton	3, Lydford Road, Maida Hill, W.9.
6 GW	P. Brian	79, Lakey Lane, Hall Green, Birmingham.
6 GX	C. Reynolds	71, Siddall Street, Oldham.
6 GY	T. McL. Galloway ...	Wyntersted, Dollar, N.B.
6 GZ	R. C. Neale	Farnborough Road, Farnborough.
6 HD	National Wireless and Electric, Ltd.	Church Road, Acton, W.3.
6 HG	A. Franks, Ltd.	Deansgate.
6 HH	Glevern Radio Society ..	Custom House, Gloucester.
6 HK	J. W. F. Cardell	Tretherras, Newquay, Cornwall.
6 HO	National Wireless & Electric Co., Ltd.	Church Road, Acton, W.3.
6 HR	W. D. Keiller	51, Highworth Road, New Southgate, London, N. 11.
6 HS	H. Saville	Delamere Works, Longford Road, Stratford, Nr. Manchester.
6 HV	W. J. Butler	15, Algernon Road, Edgbaston, Birmingham.
6 HX	C. H. Nokes	Misidia, High Street, Ripley, Surrey.
6 HY	F. Dyer	59, Antill Road, Tottenham, N.15
6 IC	A. Jowett	310, Hopwood Lane, Halifax.
6 IG	E. Brady	Radio Engineer, 6, Coltsgate Hill, Ripon, Yorks.
6 IL	J. H. Roscoe	Roscoe Radio and Motor Co., 183 Chester Street, Birkenhead.
6 IM	L. G. Kamm	88, Hornsey Lane, Highgate, N
6 IR	G. Hornsby	14, Baring Street, South Shields.
6 IV	P. B. Snoaden	34, Chandos Road, Harrow.
6 IW	Leeds Y.M.C.A. Wireless Society.	Y.M.C.A., Albion Place, Leeds.
6 IX	W. G. Fudger	Brora, Priviswood Road, Godalming.
6 JB	Wimbledon Radio Society	Red Cross Hall, 57, Church Road, Wimbledon.
6 JJ	J. O. P. Smith	The Croft, Dingwall, N.B.
6 JL	P. N. Goulston	Edgeleigh, Warwick Avenue, Coventry.
6 JS	P. R. Solder	76, Albert Road, Alexandra Park, London, N. 22.
6 JV	Capt. H. J. B. Hampson ...	477, Earlham Rise, Norwich.
6 JW	V. Plascott	39, Waterloo Road, Southampton.
6 JX	R. J. W. Lankester ...	Wanderings Farm, Kingston Road, Kingston-on-Thames.
6 JZ	V. A. G. Brown	Fawley Lodge, Coley Avenue, Reading.
6 KC	Radio Speciality Co. ...	41, Limbrick, Blackburn.
6 KJ	W. Krohn	18, Highcroft Gardens, N.W. 11.
6 KK	J. Cookson	Central Radio Stores, Blackpool.
6 KU	H. G. Clacy	114, Bradshaw Road, Watford, Herts.

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6 LB	L. J. Fuller	Glenburn, Seagry Road, Wanstead, Essex, E. 11.
6 LD	H. Horrocks	23, Mount Avenue, Littleborough, Manchester.
6 LJ	S. K. Lewer	London, N.W.
6 LV	Liverpool Relay Station, B.B.C.	
6 LW	R. C. Davies	Sunny Side, 22, Grainger's Lane, Cradley Heath, Staffs.
6 MC	J. A. Badham	114, Fitzwilliam Street, Huddersfield.
6 MD	R. J. Brown	Greba, Gledhow Lane, Roundhay, Leeds.
6 MF	S. Hill	Langford House, Langford, near Bristol.
6 MG	B. W. D. Lacey	197, Alcester Road South, King's Heath, Birmingham.
6 MJ	H. A. Freer	110, Humberstone Drive, Leicester.
6 MQ	G. C. Patching	84, Allcroft Road, Kentish Town, N.W. 5.
6 MT	South Wales Wireless	Radio House, Cambrian Road, Newport, Mon.
6 MU	E. J. White	Lansdowne Villa, 83, Rochdale Road, Blackley, Manchester.
6 MZ	J. S. Owner	Beachley, Hucclecote, near Gloucester.
6 NF	A. D. Gay	49, Thornlaw Road, W. Norwood, S.E. 27.
6 NG	J. W. C. Cropper	10, Manor Street, Hooley Hill, near Manchester.
6 NH	J. W. Davies	Doddington, Caterham Valley, Surrey.
6 NJ	C. W. Watson	Butts Mills, Barnoldswick, Yorks.
6 NL	British Radio Mnfg. Co.	9, South Castle Street, Liverpool.
6 NP	W. Gill	7, Church View, Heckmondwike.
6 NR	N. Rushton	10, Ashley Street, Manchester Road, Bradford, Yorks.
6 NS	J. Frater	Felling-on-Tyne.
6 NT	H. Plumer	20a, Tradescant Road, South Lambeth Road, S.W. 8.
6 NV	T. E. Henshelwood	22, Victoria Park Road, Inverness.
6 NZ	W. B. Chivers	115, Arden Road, Birchfield, Birmingham.
6 OB	G. H. Barrett	Wealdstone, Harrow.
6 OD	G. E. Hebden	124, Scotforth Road, Lancaster.
6 OM	I. Auchterlonie	The Gables, Cayton, Heswall-on-Tyne.
6 ON	W. H. Felton	47, Sompting Road, Worthing, Sussex.
6 OX	B. Quentin	Lislet Lodge, St. Sampson, Guernsey.
6 OY	P. L. F. Jones	181, Hampstead Way, Golders Green, London, N.W. 11.
6 OZ	H. Thompson	7, Rye Street, Chorlton-on-Medlock, Manchester.
6 PD	A. J. Dixon	White House, Hertford Road, Enfield Wash, Middlesex.
6 PG	C. H. Targett	21, High Street, Dartford, Kent.
6 PJ	F. Ison's Stores	47, Orford Road, Walthamstow, E. 17.
6 PK	Universal Radio Co.	129, New Bridge Street, Newcastle-on-Tyne.
6 PL	J. F. Brockbank	51, Palatine Road, Withington, Manchester.
6 PR	J. P. Price	Coombehurst, Coombe Hill Road, East Grinstead.
6 PT	L. Lott	Gant's Muir, Berrow Road, Burnham-on-Sea, Somerset.
6 QB	L. H. Thomas	33, Harpenden Road, W. Norwood, S.E. 27.
6 QC	H. J. Stamper	The Grammar School, Loughborough.
6 QG	C. G. Carlton	Thorn Park House, Lee, S.E. 12.
6 QK	P. J. Calvert	56, Eton Avenue, Hampstead, N.W. 3.
6 QO	C. Deal	The Limes, Kelvedon, Essex.
6 QU	A. Eaton	21, Dashwood Road, Prestwich, Manchester.
6 QY	J. A. Godfrey	160, Bethune Road, London, N. 16.
6 QZ	W. R. Emery	39, Kilmorey Gardens, Twickenham.
6 RK	R. Gregson	1, Bank Road, Blackpool, Lancs.
6 RO	A. Taylor	136, King's Road, Cardiff.
6 RQ	B. C. Thomas	Hilden, Bryncaerau Terrace, Llanelly, South Wales.
6 RS	F. C. Smart	The Retreat, Fields' Park Road, Newport, Mon.
6 RY	H. L. Bowen	13, Daniel Street, Bath.
6 SA	Prof. A. M. Low (Portable)	The Yews, Woodstock Road, Bedford Park, W. 4.
6 SB	R. Heather	102, Lyndhurst Road, Peckham, S.E. 15.
6 SG	L. W. Mant	35, Jessie Road, Southsea.
6 SK	A. E. Vollmer	57, Lyttelton Road, Leyton, E. 10.
6 SQ	C. Rogers	3, Alders Avenue, Chinley.
6 SR	R. T. H. Evans	6, Cwrt-y-Vil Road, Penarth, S. Wales.
6 TD	K. L. Palmer	Vyrnwy House, Llansaintffraid, Montgomeryshire.
6 TH	C. W. & W. H. Liles	Helena, 52, York Place, Newport.
6 TM	W. A. S. Butement	127, West End Lane, London, N.W. 6.
6 TN	E. H. Wright	Moy Villa, Harrington Road, Brighton, Sussex.
6 TU	J. K. Byers	33, Richmond Avenue, Margate.
6 TX	J. E. Fynn	Maxwell, 12, Monkhams Avenue, Woodford Green, Essex.
6 UC	A. C. Chatwin	162, Hagley Road, Edgbaston, Birmingham.
6 UM	Leeds Radio Society	Leeds.
6 UT	T. A. St. Johnston	28, Douglas Road, Chingford, Essex.
6 UV	G. L. Morrow	Pen Olver, Berkhamsted.
6 UW 6 UX	P. Wood	Central Fire Station, Blackpool, Lancs.
6 UY	H. N. Gray	78, High Street, Barry, South Wales.
6 VI	H. Brenchley	98, Springfield Road, Moseley.
6 VK	J. H. Bean	Inglewood, Mt. Vernon Avenue, Blairhill, Coatbridge.
6 VL	R. W. Leader	Portable Station.
6 VN	F. E. Wellbelove	37, St. John's Road, Erith, Kent.
6 VP	H. E. Nicholson	42, Southsea Avenue, Watford, Herts.
6 VX	S. St. Leigh-Clarke	91, Wellington Road, Wanstead, E. 11.
6 WH	E. W. & H. J. Kirk	2, Riddings Street, Derby.
6 WL	J. T. Dickinson	1, St. Austell Road, Lewisham, S.E. 13.
6 WV	V. W. Croak	26, Kenwyn Road, West Wimbledon.
6 XQ	H. Field	Baggrave Hall, Leicestershire.
6 XT	S. W. G. Farmery	The Moorlands, Whinfield, Adel, near Leeds.
6 XX	Radio Society of Great Britain	53, Victoria Street, S.W. 1.
6 XY	F. Cropper	42, Acres Lane, Stalybridge, Cheshire.
6 XZ	M. Marshall (Portable.)	Beach View, Island Road, Newquay, Cornwall.
6 ZX	H. Field	Baggrave Hall, Leicestershire.
6 ZY	L. Gordon	133, Old Street, Ashton-under-Lyne.

NOTE: When a call sign beginning with "G" is heard, such as G 2 MQ, the first letter is being used to distinguish a British station from a foreign with a similar call. The G prefix is used frequently when communicating across the Atlantic.

Reflex Wireless Receivers in Theory and Practice.—CHAPTER VII.

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

This complete series on Reflex Circuits began in our issue of March, 1924.

WE have so far considered, for the sake of simplicity, the use of loose coupling between the aerial and the valve. Such loose coupling involves extra coils and condensers, and other apparatus. It is also more difficult to tune a loose coupled circuit on account of the extra number of controls. A further disadvantage is that when a valve is being used to obtain high-frequency amplification it will have a much greater tendency to oscillate if loose coupling is employed. The only real advantage of loose coupling, in many cases, is that greater selectivity is obtainable. It is little wonder, therefore, that direct aerial coupling is the most popular arrangement.

Direct coupling, however, in the case of reflex circuits, introduces several important problems which have not received adequate attention until comparatively recently.

A typical direct-coupled arrangement using the reflex principle is that illustrated in Fig. 31. It will be seen that the low-frequency currents are fed back by means of a transformer T_1 T_2, the secondary T_2 of which is connected between the bottom of the circuit L_1 C_1, and the negative terminal of the accumulator B_1. This was, until about a year and a half ago, the common method of reflexing, although, of course, various kinds of circuits were proposed. Nevertheless, the regular method of feeding back the low-frequency currents was that illustrated in Fig. 31.

Let us examine closely the disadvantages of feeding back the low-frequency currents in this position. In reading the following remarks it must not be imagined that the arrangement of Fig. 31 will not work; the results are quite good, but various symptoms will be noticed. It will, for example, be impossible to touch the accumulator, or high-tension battery, or one of the terminals of the telephone receivers without affecting the signal strength. Touching any of these parts may, moreover, set up a low-frequency buzzing.

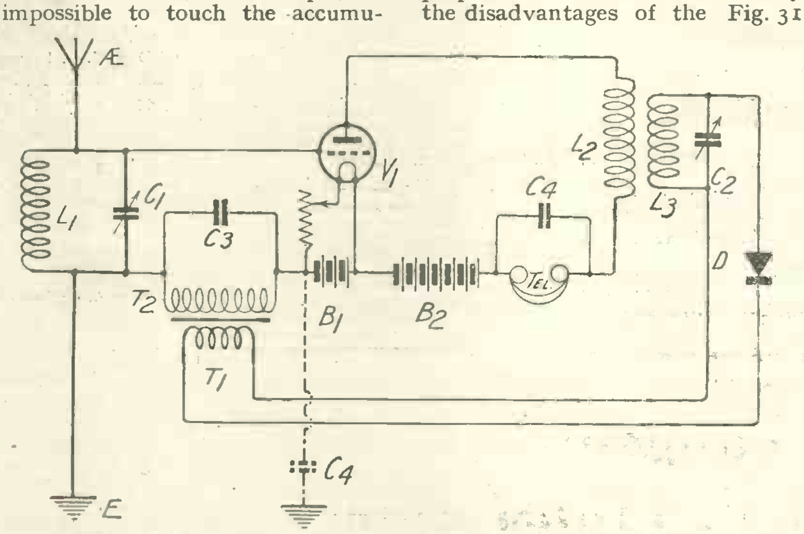

Fig. 31.—An old method of feeding back low-frequency currents.

The disadvantages of the Fig. 31 circuit are therefore:

1. A full build up of signal strength is not obtained.

2. The circuit is not stable, and is susceptible to squealing or buzzing when certain parts are touched.

Reasons for the Disadvantages

In view of the importance of this section of our discussion it is proposed to examine more closely the disadvantages of the Fig. 31 method of feeding back the low-frequency currents. In this figure a condenser C_4 is shown in dotted lines connected between the accumulator and the earth. This phantom condenser is not an actual one, but represents the capacity effect between the accumulator, etc., and the earth. The accumulator and the apparatus connected to it forms one plate of a condenser, the other side of which is the earth.

In Fig. 32 is shown an enlarged view, as it were, of a portion of the Fig. 31 circuit, showing the capacity effects in detail and a possible leakage effect.

The accumulator B_1 and the high-tension battery B_2 are usually bulky pieces of apparatus which, standing on a table, have an appreciable capacity to earth. The capacity to earth between the accumulator B_1 and the earth is shown as C_4, while the capacity to

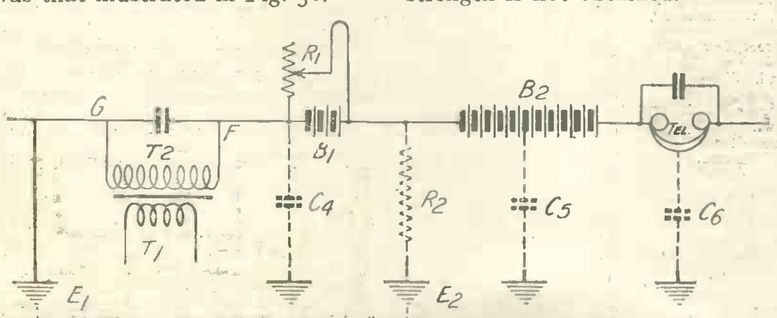

Fig. 32.—Possible capacities to earth of components used in the previous circuit.

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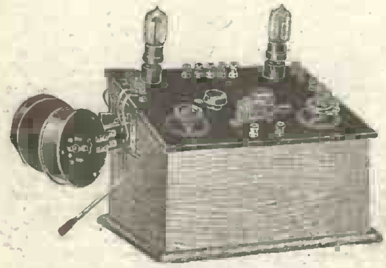

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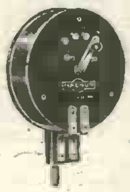

See report in July "Modern Wireless."

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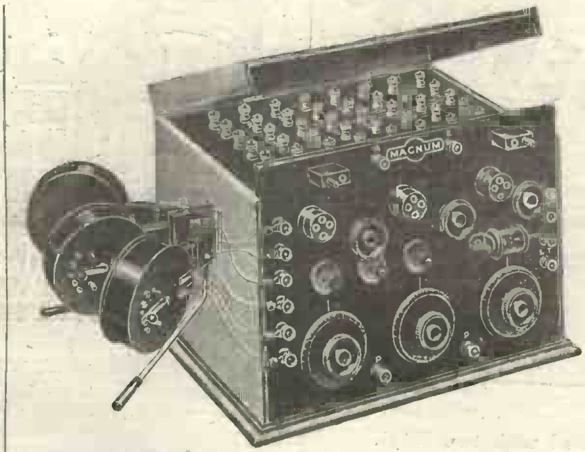

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11 Terminals (lacquered)	–	1	10
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1 Mansbridge Condenser, 1 mfd.	–	4	0
1 Dual Crystal Detector	–	5	6
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4 Lissenstats	1	10	0
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2 Variable Condensers, .0003, complete	–	14	0
1 Utility 6 P.C.O. Switch	–	10	0
15 Terminals (Lacquered), complete	–	2	6
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2 Coil Plugs	–	3	0
2 Switch Arms with Studs and Stops	–	4	0
2 Mansbridge Fixed Condensers	–	7	0
2 Dubilier 50,000 ohm Resistance	–	11	0
3 Dubilier 2 Meg.	–	7	6
1 Dubilier Condenser, .0001	–	2	6
1 Dubilier Condenser, .0003	–	2	6
1 Dubilier Condenser, .001	–	3	0
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4 ,, ,, ,,	W147/4	7/6
6 ,, ,, ,,	W147/6	10/-

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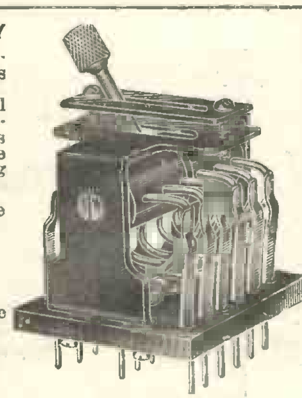

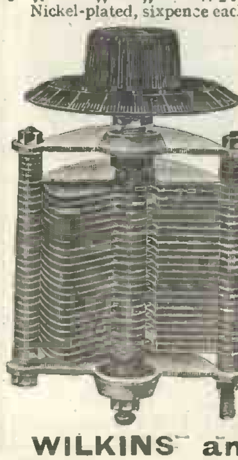

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earth of the high-tension battery B_2 is shown as C_5. The telephones, T, being on the head of the wearer, will also have a considerable capacity to earth. All these capacities are represented as one large capacity C_4 in Fig. 31. In addition, unless the accumulator, batteries, and phones are perfectly insulated from the earth, there will be a leakage

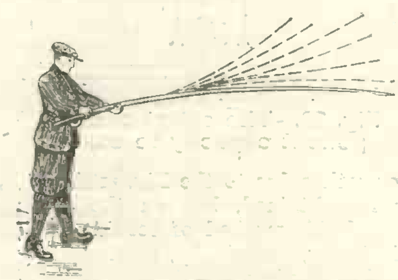

Fig. 33.—A fishing-rod analogy.

effect which is shown as R_2. The leakage effect, of course, will lessen the potentials established across T_2, and, therefore, lessen the low-frequency potentials applied to the grid of the valve, but the beginner may not understand why the capacity effect should have an injurious effect.

A convenient analogy which the writer has previously used is that of an angler and a fishing rod. Fig. 33 shows an angler holding the end of his rod, and, by a wrist movement, swinging the tip up and down. A free action is obtained in this case, but if a heavy weight is attached to the tip of the rod, as shown in Fig. 34, a wrist motion on the part of the angler will hardly move the tip of the rod at all. In the same way, the fact that one end of the transformer winding T_2 is connected to earth and the other end to an accumulator, battery, etc., of substantial mass, results in an effect very similar to that shown in Fig. 34. Instead of the "full swing" of potential at the end of the transformer winding T_2 in Fig. 32 with respect to earth (which corresponds to the angler's hand) the varying potentials across T_2 are reduced.

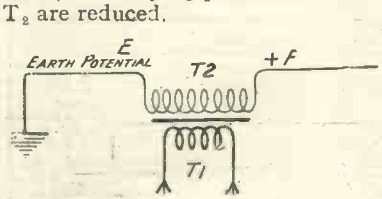

Fig. 36.—Illustrating how potential at end of T_2 varies with respect to earth.

Fig. 35 shows the transformer itself having a primary T_1 and a secondary T_2. One end of T_2 is marked E and the other F. At a certain given instant when a varying current is being fed into T_1, the end E will be negative and the end F positive. It is obvious that we want to get the largest potential difference across E and F, and consequently nothing must be done which will lessen, unnecessarily, the potentials established across the secondary.

If, as in Fig. 36, we connect the end E to earth, the end F will vary positively and negatively with respect to the end E, and therefore with respect to earth. The fact that one end of the secondary T_2 is connected to earth does not in any way affect the magnitude of the potentials established across E and F. It merely ties down, as it were, one end of the transformer, and makes it vitally important that we should not in any way tie down the other end of the secondary T_2.

In Fig. 37 we show the other end of the transformer T_2, formerly labelled F, connected to the grid G of a three-electrode valve. In this case the grid is a very light metal structure having a negligible capacity, and consequently the potentials on G will represent the full potentials established across T_2. If, on the other hand, we were to connect the right-hand side of the secondary T_2 to earth,

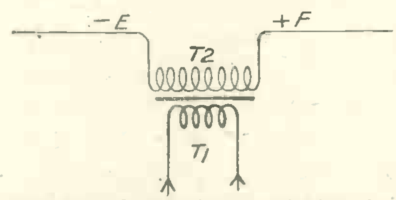

Fig. 35.—Conditions existing in a transformer at a given moment.

both ends of T_2 would be tied down and the secondary of T_2 would be practically short-circuited by the earth, since the current would flow from one "earth" to the other "earth"; the result would be that the potentials established across T_2 would be very much smaller than those normally obtained.

In Fig. 38 we have part of the effect in Fig. 31 illustrated. This effect is a leakage effect between the accumulator, high-tension battery and phones to earth, and is frequently in existence. The resistance R_2 in Fig. 38 will act as a partial short circuit for the secondary T_2, and, moreover, this leakage will vary from time to time and exactly the same results with the apparatus may not be reproducible at will. The leakage effect, however, is not the most serious because, provided the batteries, etc., are properly insulated, it will not occur. The most dangerous effect is the large capacity which the batteries, etc., have to earth. This effect is illustrated in Fig. 39.

If such a circuit be arranged, it will be seen that the condenser C4 shunts the secondary T_2, and if a large condenser is connected across the secondary T_2 the potentials established across this

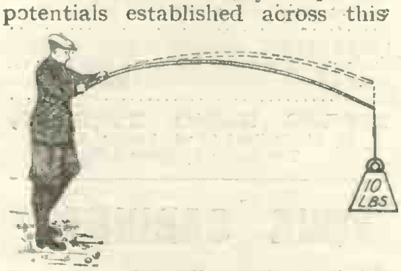

Fig. 34.—The effect of a weight at one end.

winding will be reduced. If, for example, to take an extreme case, the condenser C_4 had a value of five microfarads, the condenser, which, of course, acts as a conductor to varying currents, would virtually short-circuit T_2, and the potentials across this winding would be too small to be of any value.

In Fig. 40 is illustrated the state of affairs existing in the Fig. 31 circuit, and it will be readily seen that the large capacity effects between B_1 and the earth and B_2 and the earth, not to mention the capacity of the telephones to earth, will act as a parallel capacity across T_2, and this capacity will decrease the potentials established across T_2. It will be noticed that in Fig. 40, as in Fig. 31, there is a small condenser C_3 across T_2 already. The value of C_3 will depend very largely upon the particular transformer employed, and its sole purpose is to act as a by-pass for the high-frequency currents in the grid circuit. In most cases the condenser C_3 will have a capacity of .0003 μF, and if this is supplemented by the uncertain capacities of the batteries, etc., the value will, in many cases, be too high, and, moreover, the tendency towards buzzing will be increased. An additional and very

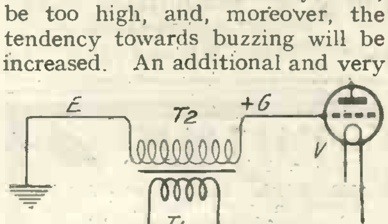

Fig. 37.—The secondary winding connected between grid and earth.

important disadvantage is that the batteries, phone terminals, etc., cannot be touched with the hand without varying the signal strength and, in many cases, producing low-frequency buzzing.

The trouble due to the filament earth connection of the transformer secondary is accentuated in receivers using reaction, because any variation of the capacity across T_2 will vary the amount of reaction; an increase of the

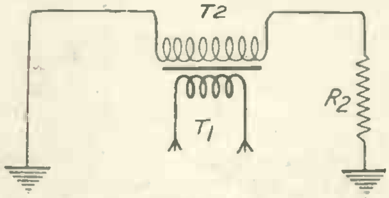

Fig. 38.—Leakage effect from components to earth.

capacity, for example, will increase the tendency for the valve to oscillate, and once the valve oscillates the tendency to buzz is very greatly increased, and in many cases the high-frequency oscillation only takes place for a fraction of a second and is immediately followed by a low-frequency buzzing. Touching certain parts of a receiver in a Fig. 31 arrangement, especially if reaction is added, usually starts

grid and the aerial. The end E of the secondary T_2 was, so far as low-frequency currents were concerned, at earth potential, whereas the end G was connected to the grid. None of the troubles experienced with the Fig. 31 circuit,

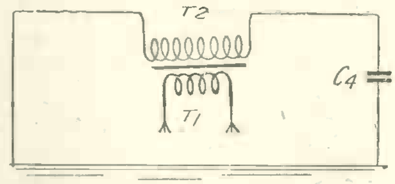

Fig. 39.—The effect of component capacity to earth.

or rather due to the Fig. 31 circuit, were obtained, but on the other hand this method of feeding back is wrong, technically, from another point of view. It is now a well-known rule in wireless design not to have any apparatus, such as transformers, potentiometers, etc., at a point at high-frequency potential to earth. Across the circuit L_1 C_1 high-frequency potentials are established, and consequently the whole secondary

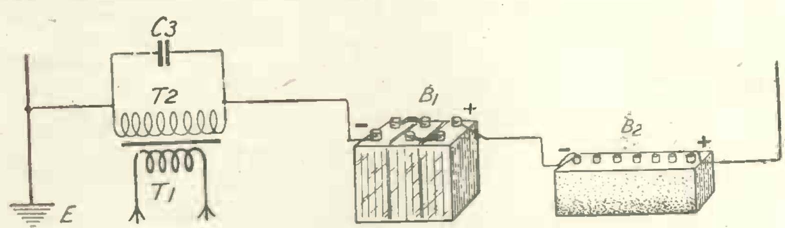

Fig. 40.—A portion of Fig. 31 represented pictorially.

the very unpleasant buzzing effect and the obvious remedy is to feed the low-frequency currents into the grid circuit in some other manner.

Round's Original Method

The method which was used by H. J. Round in early experiments with reflex circuits is that illustrated in Fig. 41. The low-frequency currents were now fed into the grid circuit by means of a transformer T_1, T_2, the secondary of which was connected between the

of the transformer is at a varying high-frequency potential to earth, and the transformer will consequently act in much the same way as the weight on the end of the fishing rod. This time it will be the high-frequency currents which will suffer, and these are much more susceptible to influence by parallel capacity. Every experimenter knows that if there is too great a capacity across his oscillatory circuit the potentials established across it will be small.

In Fig. 41 the substantial

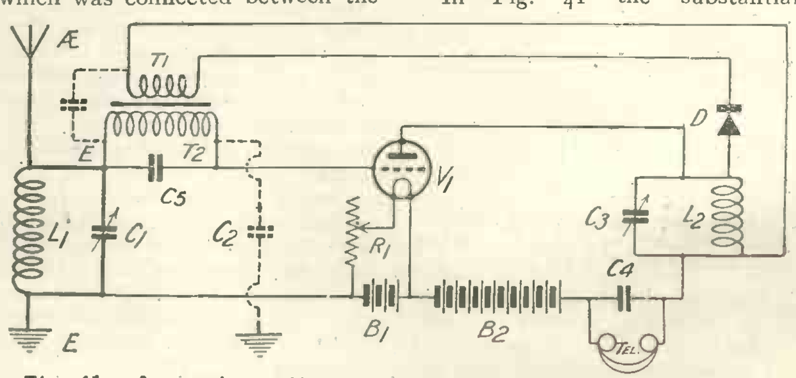

Fig. 41.—An early method of reflexing used by H. J. Round.

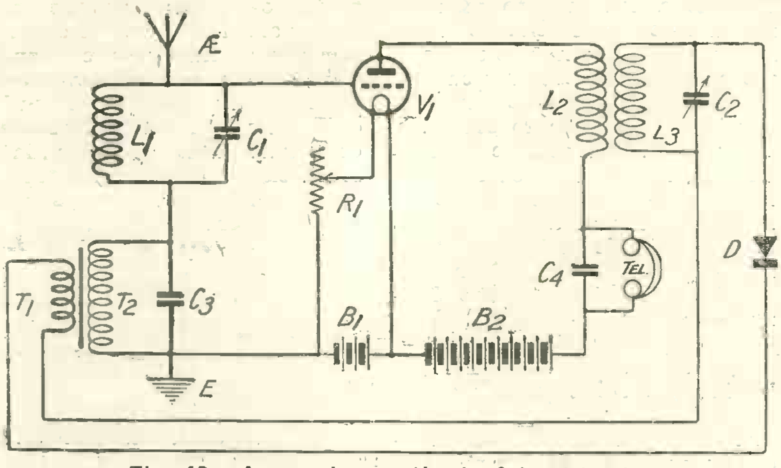

Fig. 42.—A popular method of feed-back.

capacity between the two windings of the transformers is shown in dotted lines, and likewise the capacity of the secondary direct to earth. The capacity between the windings is very important because the primary winding is connected, virtually, direct to earth as regards high-frequency currents. The net

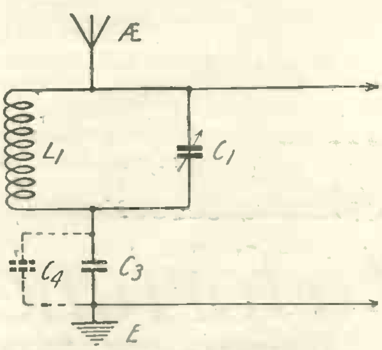

Fig. 43.—The actual aerial circuit of Fig. 42.

effect of this arrangement is that the potentials established across L_1 and C_1 are decreased.

The present writer of this series has developed two fundamental methods of feeding back low-frequency currents so as to avoid both the troubles experienced with Fig. 31 and those found when the Fig. 41 arrangement is employed. H. J. Round has also employed another method which has been largely used commercially. This is described later.

The first of the present author's methods, and the one which he has embodied in numerous reflex circuits, is that illustrated in Fig. 42. This method is rapidly becoming standard with experimenters, and no doubt the origin of the method will be clouded in obscurity, as so often happens in these cases.

It will be seen that the secondary of the transformer is now connected in the aerial circuit, as well as the grid circuit of the valve. A condenser C_3 is connected across T_2 and the capacity of this condenser may be fixed or variable. Experiment has shown that the best value is in the neighbourhood of .001 μF. If the condenser C_3 is of too small a capacity it will interfere too radically with the aerial tuning arrangement, since C_3 is an integral part of the aerial oscillatory circuit. If, on the other hand, the condenser C_3 is too large, the low frequency potentials established across T_2 will be reduced and there will consequently be a loss in efficiency.

The arrangement of Fig. 42 eliminates all trouble due to the transformer being at high-frequency potential to earth, and also all trouble due to the secondary of the transformer T_1 T_2 being tied down at both ends.

It will be seen that the secondary T_2 will choke back high-frequency currents in the aerial circuit, and therefore the condenser C_3 is required to complete the aerial circuit. Fig. 43 shows the aerial circuit as it really is, and from this

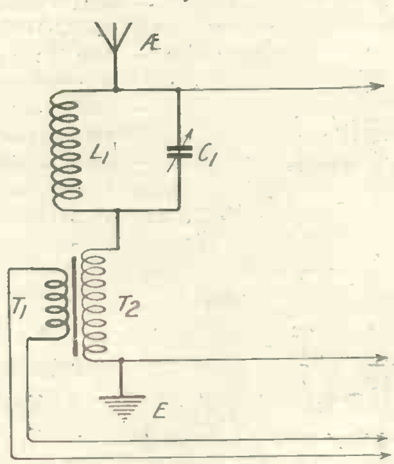

Fig. 44.—The aerial circuit of Fig. 42 with C_3 omitted.

it will be seen that the main capacity in series with the aerial is C_3, while there is also the self-capacity C_4 of the secondary of the transformer. This capacity is not sufficient of itself to make the circuit work effectively without C_3, but it will be seen that the size of C_3 will affect the tuning of the aerial circuit; the larger C_3 is, the higher

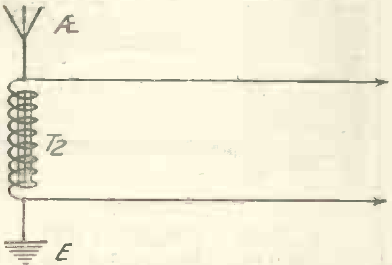

Fig. 45.—A circuit equivalent to Fig. 44.

the wavelength to which the receiver will be tuned, and *vice versa*. Consequently, in a reflex circuit a larger inductance will normally be required when parallel tuning is employed.

Effect of Transformer Secondary in Aerial Circuit

The only disadvantage of the Fig. 42 feed-back method is that there is a tendency to pick up interference from electric light mains, etc. This may be specially the case when alternating current is installed for domestic purposes, but it is impossible to state the effect of this interference without knowing the special circumstances. In some cases the interference is negligible, but in a few cases it may be desirable to use a feed-back method which cuts down the tendency to pick up this low-frequency disturbance.

It will be interesting, at this stage, to consider the effect of leaving out the condenser across the secondary of the transformer in the aerial circuit. If this condenser is omitted we have an aerial circuit of the kind illustrated in Fig. 44, and it will be seen that the iron-core secondary now is the controlling factor in the tuning of the aerial circuit. This iron-core secondary acts, of course, as a very high inductance, and we virtually have the circuit of Fig. 45 since the inductance L_1 of Fig. 44 has a negligible value in comparison with the inductance of T_2. It will be clear that in Fig. 45 the wavelength to which the aerial circuit is tuned is very high, and in practice the elimination of the parallel condenser across the transformer secondary has the effect of bringing in numerous continuous wave stations of high wavelength, these stations producing beats with each other with a resulting medley of sound. This symptom in a reflex circuit therefore indicates a faulty condenser across the secondary, or its absence.

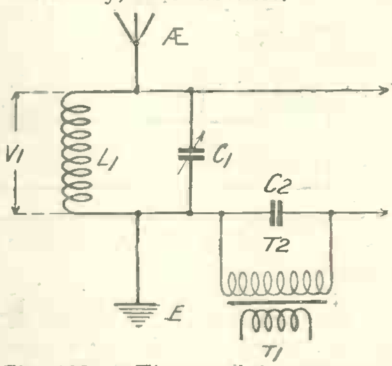

Fig. 46.—The aerial arrangement of Fig. 31.

Whether this condenser is across the secondary or not, the method of feeding back illustrated in Fig. 42 is certainly a little prone to pick up A.C. hum. This is because the aerial now acts as a collector which picks up the A.C. currents from the electric light system of

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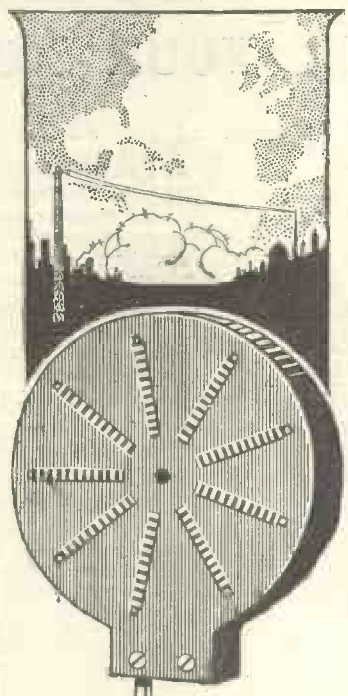

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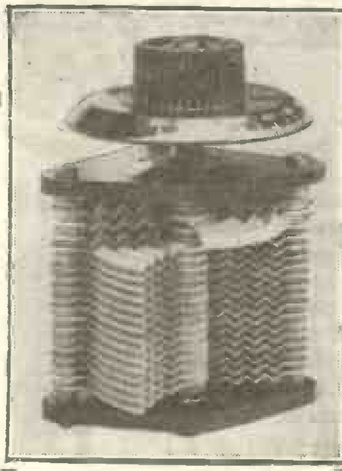

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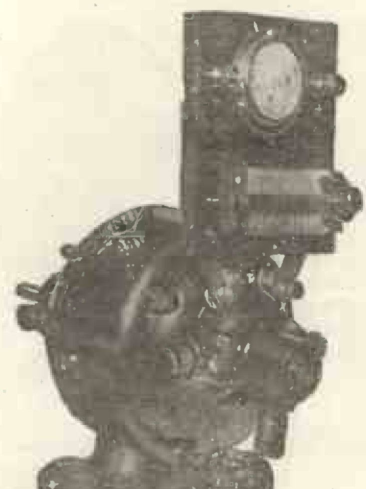

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the house, one side of which system is permanently connected to earth, in practically all cases. The low-frequency currents collected by the aerial pass through the secondary of the transformer, which acts as a high impedance to the low-frequency currents. These low-frequency incoming currents therefore set up potential differences across the secondary, and these are consequently communicated to the grid of the valve. If we have the transformer secondary in the position illustrated in Fig. 31, this trouble is not experienced, because the low-frequency currents collected by the aerial pass directly through the inductance L_1 and so to earth. Since the resistance of the inductance L_1 is negligible and the impedance is also negligible, no potential differences due to these low-frequency currents will be set up across L_1, and consequently no potentials due to the low-frequency currents will be communicated to the grid of the valve.

Fig. 46 shows the aerial arrangement of Fig. 31, while Fig. 47 shows

Parallel Input Arrangement

In Fig. 48 we have the method previously referred to, which is

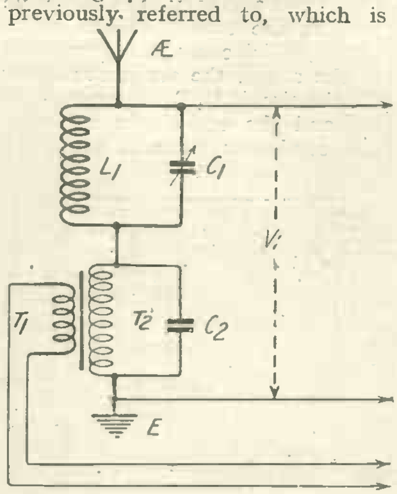

Fig. 47.—The aerial arrangement of Fig. 42.

an alternative of the Fig. 42 arrangement and which is very largely used in commercial sets. The arrangement shown in Fig. 48 is not exactly what is commonly

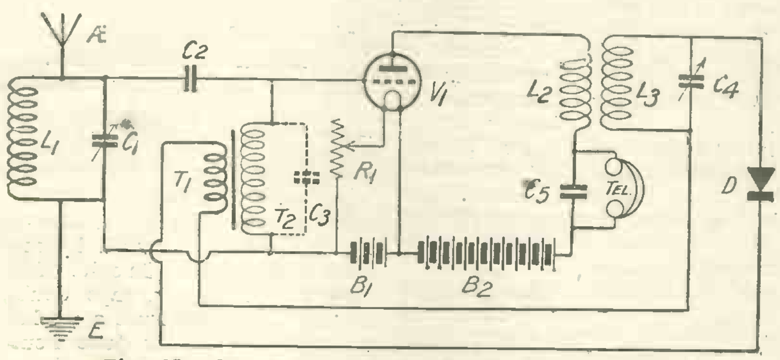

Fig. 48.—An alternative to the Fig. 42 circuit.

the aerial arrangement of the Fig. 42 circuit. The low-frequency potentials applied to the grid circuit through the passage of alternating currents passing between aerial and earth are, in the Fig. 46 arrangement, nil owing to the negligible resistance and impedance of L_1. In Fig. 47, however, the currents pass between aerial and earth, not only through L_1, but also across T_2. The potentials established across L_1, due to these low-frequency currents, are negligible, but those across T_2 may be appreciable in some cases, and these potentials are communicated to the grid of the valve.

These troubles are, however, rare, and when they occur either the second of the author's methods may be employed, or that illustrated in Fig. 48, which will now be considered.

used, but the principle is the same. It will be seen that the low-frequency currents produced by the rectification of the high-frequency currents by the crystal detector are fed into the grid circuit in parallel with the aerial input circuit, a condenser C_2 of, say, .0003 μF, being connected in the position shown to prevent the inductance L_1 from short-circuiting the low-frequency currents produced in the secondary T_2 of the transformer T_1, T_2. The secondary T_2 will, in most cases, have an appreciable self-capacity which is shown as C_3 in Fig. 48. To counteract this self-capacity reliance is not placed on the inductance of T_2, but a separate inductance outside the secondary is connected in series with T_2. Alternatively, a high resistance may be used.

The high resistance arrangement is illustrated in Fig. 49, the resistance R_2 of, say, one megohm being connected in series with T_2. This arrangement is not to be recommended, although it certainly helps to prevent the transformer secondary T_2 acting, on account of its self-capacity, as a partial short-circuit for the high-frequency current supplied by the aerial circuit.

Fig. 50 shows the common arrangement employed, and it will be seen that a high inductance L_4 is connected in series with the secondary T_2 in the position shown. This choke L_4, which is of the air-core pattern, will choke back any high-frequency currents which try to pass via T_2.

This arrangement possesses all the merits of previous arrangements and is also devoid of any serious tendency for the circuit to pick up low-frequency A.C. hum, etc. This, of course, is because the inductance L_1 short-circuits these currents, while not, of course, short-circuiting the high-frequency incoming signals.

A disadvantage of the Fig. 50 arrangement is that an additional coil L_4 is required, this coil requiring, for the best results, to have a minimum of self-capacity. Moreover, a different coil will be required for different wavebands, because obviously a small coil would not act as a choke at all

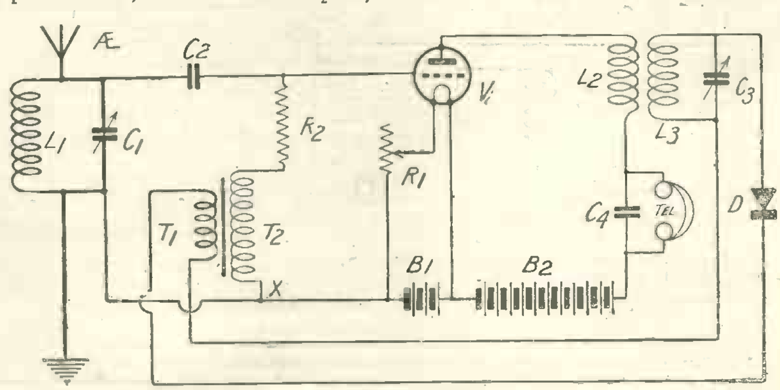

Fig. 49.—Another modification of Fig. 42.

for longer wave signals. The arrangement of Fig. 50, therefore, in this respect is not as good as the Fig. 42 simple circuit. Another trouble in connection with Fig. 50 is that the inductance L_4 tends to resonate on account of its own self-capacity and stray capacities, and if it is tuned to certain specified wavelengths there will be a tendency for absorption of energy from the main circuit. There are, consequently, complications which may arise on this account, but careful design may eliminate these troubles for a given waveband.

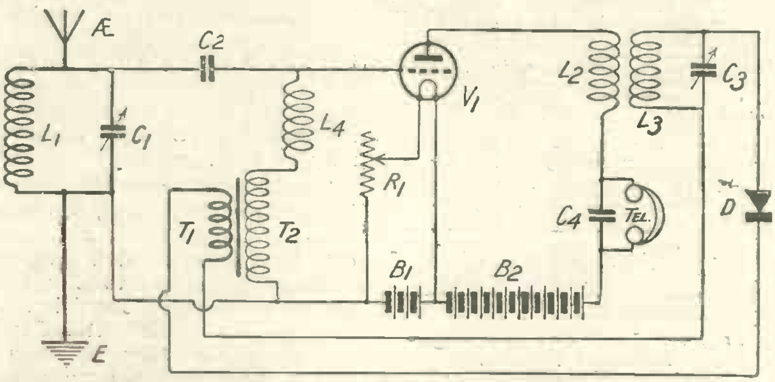

Fig. 50.—The Choke Coil method of eliminating A.C. hum.

A New Method of Feeding-Back the Low-Frequency Currents

The present author has introduced a new method of feeding-back the low-frequency currents so as to obtain all the advantages of Fig. 42 and at the same time to cut out any trouble likely to arise through A.C. mains, etc. This is depicted in Fig. 51. It will be seen that there is an inductance L_1 in the aerial circuit, a condenser C_1 (which may have a capacity of .0003 μF) and the usual circuit L_4, C_2; a condenser C_3 of .001 μF capacity is connected across the secondary T_2 of the feed-back low-frequency transformer.

This arrangement may take two distinct forms; the inductance L_1 may be a very high inductance choke coil and may take no active part in the tuning of the aerial circuit, which consequently consists of the aerial, the series condenser C_1, the circuit $L_4 C_2$, the condenser C_3, and the earth. In this case the condenser C_1 will act as a stopping condenser to prevent T_2 being short-circuited by L_1.

The author, however, prefers to use the circuit differently and to keep L_1 at a reasonable value. For example, L_1 may be a No. 75 plug-in coil, while L_4 is a coil of similar size. The condenser C_2 may have a maximum value of .0005 μF, while C_3 has a value of .001 μF. The condenser C_1 has a capacity of .0003 μF. These values will serve for tuning the stations on the 300 to 500 metre waveband. The inductance L_1 now takes an integral part in the tuning of the aerial circuit, which consists of the aerial, L_1, C_1, L_4, C_2, C_3 and the earth. All this circuit acts, contrary to the expectations of many, no doubt, as a single tuned circuit, and a variation of L_1 will affect the tuning of the main arrangement. As a matter of fact, the inductance L_1 apparently acts in parallel with L_4, reducing the total inductance in the circuit. No loss of signal strength whatever is noticed with this arrangement. It might at first be thought that the main circuit was L_4,C_2, coupled by means of C_1 to the aerial circuit, but experiments will very soon prove that the whole acts as a single circuit, an alteration in any of the constituents causing a radical change in the wavelength to which the circuit is tuned.

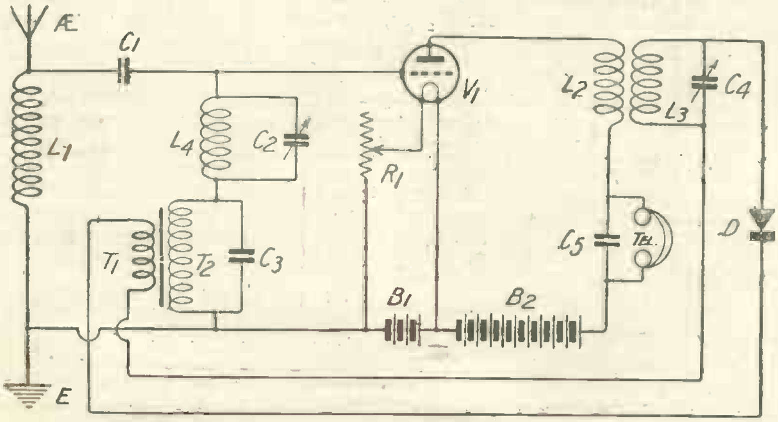

Fig. 51.—The author's method of eliminating A.C. hum.

For particularly difficult cases where there is a tendency to pick up A.C. hum, the new arrangement of Fig. 52 may be very confidently recommended.

In the next chapter it is proposed to deal with some practical reflex circuits embodying the principles outlined in the previous chapters. The arrangements so far described are not necessarily recommended examples, because in most cases the circuits have been simplified so as only to introduce the particular problem which is being explained.

(To be continued.)

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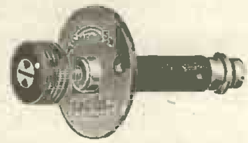

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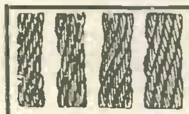

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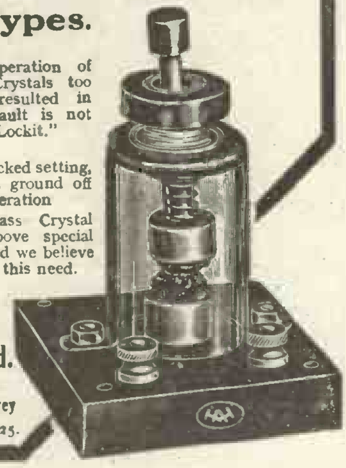

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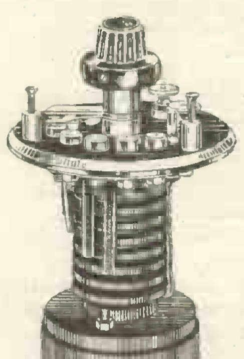

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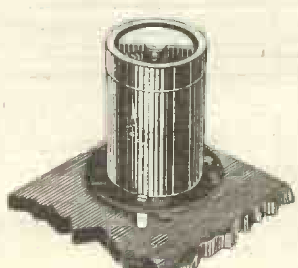

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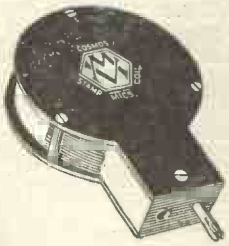

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75	300	10	340	740	1040	5 0
100	700	11	530	1130	1590	6 0
150	1000	16	640	1360	1900	6 6
175	1400	18	765	1610	2250	7 0
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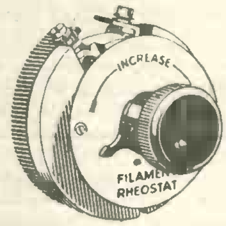

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Trouble Corner

By ADSUM

A Chat on Variable Condensers and Valve Troubles

Variable Condensers

I EXPECT that most of us have had trouble at one time or another with that very important piece of wireless apparatus, the variable condenser. It is naturally a delicate instrument with small spacings between its thin plates; hence quite a small amount of rough handling or an accidental fall may throw it out of action altogether by bending the moving plates so that at certain points in their travel they touch the fixed ones. When this kind of thing happens the cause of the trouble is usually quite obvious, since the plates can be heard scraping against one another when the knob is rotated. It is sometimes possible to straighten the plates if they are not badly bent, but the best remedy is usually to purchase a new set without bothering to waste time upon those which have been damaged. Sometimes, however, the plates may touch without any accident having happened to the condenser. This may be brought about in a variety of ways.

Faults Explained.

In Fig. 1 are seen drawings of typical variable condensers. The moving plates are held in position by being clamped upon the spindle between the two nuts A and B. So long as those nuts are tight the plates have no play, but if they become loosened a certain amount of wobble can take place which may lead to unwanted contacts. The remedy in this case is to tighten up the nuts, which can be done quite easily without dismounting the condenser if you have a 2 B.A. spanner. Or it may be that the moving plates are quite tight but that the fixed ones have become loose by the slackening of the nuts C, D between which they are clamped on the upright supporting pieces. Here, again, the remedy is obvious. It is not always realised that the nuts C, D are most useful when one is assembling a condenser which has been taken to pieces. Fig 2 shows a rather exaggerated form of a case which may sometimes arise. A careless inspection might suggest that the moving plates were out of the true, though actually it is the fixed ones that are at fault. To correct this state of affairs the nut D_1 is loosened whilst C_1 is screwed down. C_2 is slackened and D_2 screwed up, clamping the plates against it. This adjustment will enable the condenser to be set quite correctly in the majority of cases. If the spindle is not vertical it can be trued up by straightening the bottom plate. To do this the nuts Y_1 Y_2 are loosened. The plate can then be trued and clamped together with Z_1 and Z_2. Be careful to see that the nuts X_1 and X_2 are quite tight.

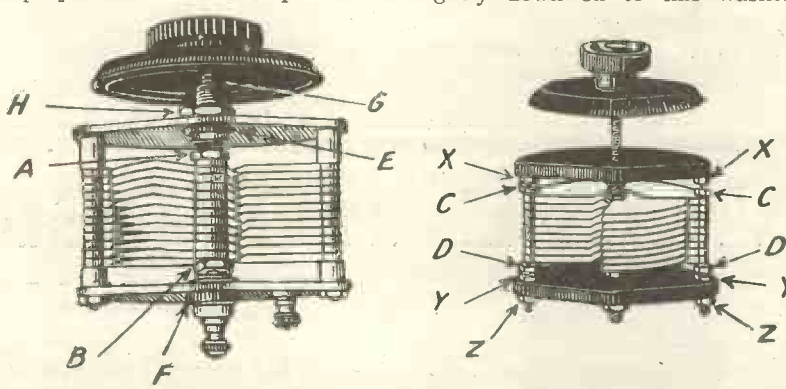

Fig. 1.—Variable condenser faults explained.

Wobbly Plates

A much more difficult trouble to deal with occurs when the moving plates have a tendency to wobble as they are rotated. The spindle may be perfectly true and the plates quite straight, yet when the knob is turned they do not run truly. This is caused usually by there being a certain amount of play between the spindle and the metal bush in the top plate (G, Fig. 1). Only a few days ago I was shown two quite expensive condensers in which the play was so bad that it was impossible to adjust the instrument to such a position that the plates could not be made to touch by exerting side pressure on the spindle. A condenser of this kind is utterly useless for wireless work, and if it is fitted to the set it will lead to continual annoyance. What one quite often finds is that though the spindle fits the metal bush fairly well the bush (G) is loose in the ebonite bush (E) fitted to the top plate. Luckily it is not difficult to effect a cure in this case. A small insulating washer should be cut from ⅛ in. ebonite, or even from stout indiarubber and placed over the metal bush G. The one-hole fixing must be sacrificed, for it will be necessary to turn the nut H tightly down on to this washer. To mount the condenser on the panel, drill and tap a couple of 4 B.A. holes in the top plate and fix it with screws passed through clearance holes drilled in the panel. Wobbling may also be caused if the lower end of the spindle is a bad fit in its seating, or if this seating is loose in the ebonite bush (F) which passes through the bottom plate. Here it is extremely difficult to work a cure, though a small spring washer placed on the spindle will sometimes correct matters. The best way as a rule is to have a new bush turned up at a cycle shop if a good workman is available for the job. Wobbly plates will seriously affect the working of the condenser, for the capacity will not increase steadily as the plates are meshed, but may go in all kinds of weird jumps and jerks. It may also be bad enough to cause very slight touching between the plates, which is not always easy to detect. Perhaps the best method of testing a suspected condenser is that shown in Fig. 3. Here the condenser is wired in series with the telephones and a flashlamp battery. The knob is now rotated, and if any noise is heard at a particular point in its travel the plates should be very carefully examined to see that touching is not occurring.

Bad Contacts

Clicks may, however, be due not to the moving plates touching the fixed, but to a bad contact between the spindle and the bush or other part to which connection is made. If the plates are obviously *not* touching then the noise must be caused by bad contact. If the contact is adjusted by means of a screw, one can usually set matters right without any trouble. If it has not, a spring washer placed upon the spindle will usually work a cure by keeping it up to its work. Another point which very often escapes attention is that the presence of dust or dirt upon condenser vanes is a fruitful source of annoyance in the set. It is surprising to notice how quickly condenser vanes collect dust, even if instruments are enclosed in a cabinet. It is as well to make a regular practice of cleaning the vanes thoroughly once a month by means of an ordinary pipe cleaner. This can be thrust between them and worked about until all dust is removed.

Stray Capacities

It is extraordinary what kittle-kattle wireless sets can be. Here

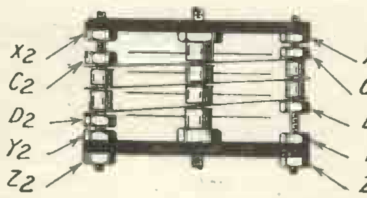

Fig. 2.—This needs adjustment!

is a case in point. Not long ago I made up a five-valve set containing two high-frequency stages, a rectifier, and two note magnifiers which worked so well that in a rash moment I told myself that I had really solved the problem of building large sets which would give perfectly pure reception with a large volume of sound! The set was as stable as could be wished, delightfully easy to handle, and in every way a thing of joy. One day a brother of mine came down for a short visit, and having heard the set was loud in his expressions of admiration. As he was not a wireless man I thought it was high time that he should begin, and gave him the set, believing that what I had done once I could repeat. I had a full-sized drawing, and with the aid of this I built a second edition of the first set which had proved so satisfactory. A few improvements were naturally made, but on the whole the new set differed hardly at all from the old. If you are a beginner you will be astonished (though if you are an old hand at the game you will *not* be) when I tell you that the new set, though its components were identical with those of the old, proved a real bad hat. It was very unstable, most difficult to operate, and altogether a sad handful. It gave volume of sound certainly, but there was bad distortion. The cause of all the trouble was traced eventually, after a very great deal of work, to the presence of stray capacities.

Where the Trouble Lay

These were not due to the wiring, for in both sets bare wire was used, and every care was taken to keep leads well separated. The whole of the trouble was caused by the addition of the tune-standby and series-parallel switches. Now, there is nothing against the use of such switches in the ordinary way; in fact, there is a very great deal to recommend them, but in this particular case it happened that I had two very neat little midget switches of which I thoughtlessly made use. These tiny switches are all very well on the low-frequency side of the set, but there is far too much capacity between their poles for them to be suitable for high-frequency work. When they were removed and replaced by switches of larger size the set behaved itself perfectly. Distortion vanished, instability was no longer a bugbear, and the set was as easy to handle as its predecessor. I believe that a very great deal of the trouble that amateurs have with high-frequency amplification is traceable to the use of a multitude of switches, usually of the small type. If you wish to avoid the worries that result from self oscillation do not overdo the switching arrangements of your set. It is no doubt delightful to be able to do all kinds of things merely by turning over a switch here or a switch there, but it is far from entertaining to have a set which misbehaves itself at every opportunity. If you must use switches fit only those of respectable size, or better still, use those which are designed especially for the elimination of capacity.

Valve Troubles

In a great many cases when one is asked to try out a friend's set which has been causing trouble, one tests it through carefully and is unable to find anything wrong. A number of one's own valves are then mounted in the holders and the thing works in every way as it ought to. There is no fault in the set itself; the reason why it will not work may safely be ascribed to some defect in the valves which its owner was using. Now, how exactly can a valve go wrong, and what are the tests which we can apply to discover whether it is faulty? The most obvious cause of its refusal to work is a broken filament. This is usually detected at once, though when very small dull emitter valves of the one-volt type are in use it may escape notice, since if the set is used in daylight hours the filaments of these valves are so dimly illuminated that the light emitted is hardly noticeable. When, therefore, your set suddenly becomes dumb always look carefully at the filament of each valve, and see that each lights up properly before making the other tests. Again, the filament may have sagged until it is touching the grid. Reference to this kind of trouble has already been made in these notes, and the means of detecting its presence has been pointed out. In case any reader has forgotten the tip which I have given, it consists in placing the valve in a socket where the grid is connected to the

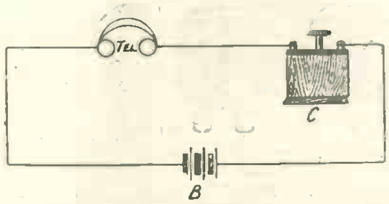

Fig. 3.—Testing a condenser.

potentiometer. If the brilliance of the filament varies as the slider of the potentiometer is moved then there is contact between it and the grid. Two faults much more difficult to diagnose, and impossible to deal with arise, from a disconnection caused either by a breakage of a lead within the cap or by the loosening of one of the valve pins. If there is play in the cap itself or in the pins, the valve may always be suspected as the likely source of the trouble should the set break down. The best method of ascertaining whether it is at fault or not is to try the effect of substituting another known to be in good condition for it.

Lost Emission

It happens sometimes when a bright-emitter valve has been in use for some time that the emission from its filament falls off to such a marked degree that signals either fail to come in at all or are received with very poor strength indeed. With dull emitters this occurrence is not at all rare. These valves are of two kinds. Their filaments may be either thoriated or coated, but those of either type are easily injured by subjecting them to too high voltages. The effect of this upon a thoriated filament is to volatilise the layer of thoria which lies upon the outside of the tungsten. The valve thus ceases to function as a dull emitter, though it may work quite well with a brightly glowing filament and higher voltage. As a rule a valve with a thoriated filament which has suffered in this way will be of no further use as a dull emitter, though it is sometimes possible to bring more thoria to the surface of the tungsten by the process of "flashing," which means applying a voltage of 30 or more to the filament for a fraction of a second at a time. This can be done by using the high-tension battery, making one contact with the valve fixed and using a wander plug for the other. The plug must be brushed quickly against one of the sockets. In the case of a valve with a coated filament a cure can usually be effected by switching off the high-tension supply altogether and running the filament for an hour or so at a very low temperature.

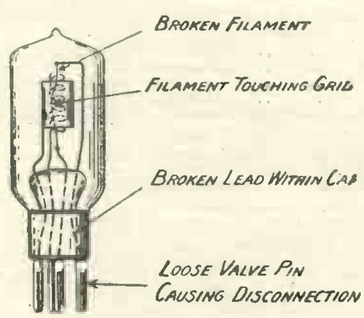

Fig. 4.—Where troubles may occur in a valve.

A Partial Remedy

The valve will in most cases function once more as a dull emitter, but it will seldom be as good as it was before it was subjected to ill-treatment. Falling emission is a very frequent source of misbehaviour on the part of a multi-valve set. Signals which were once quite good become gradually weaker and weaker on successive evenings and all remedies fail. The accumulator is recharged, the high-tension battery may be replaced. Inductances, transformers, condensers and telephones are suspected by turn and each is found to be quite up to the mark. The only components of the set which usually do not fall under suspicion are the valves which appear to be in good condition. When such a falling off occurs a valve known to be sound should be taken and the effect should be tried of substituting it for each valve in turn. In most cases it will be found that when this valve is used instead of one of the existing valves there is a sudden return of signal strength to its old volume. Of course, if a milliammeter is installed upon the set the falling emission can be detected at once, for one knows just what each valve passes under normal conditions, and if the reading is not up to the mark the culprit can be run down without any trouble.

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Variable Grid Leak	2/6
Anode Resistance..	2/6
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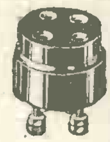

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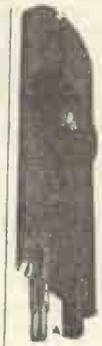

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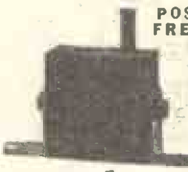

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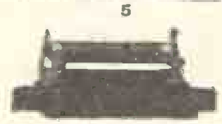

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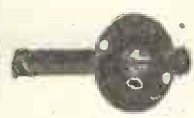

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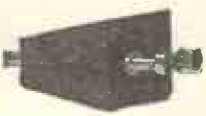

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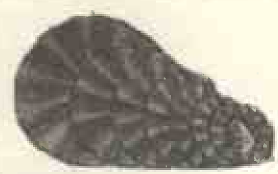

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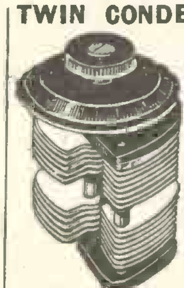

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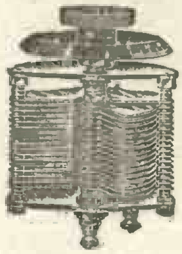

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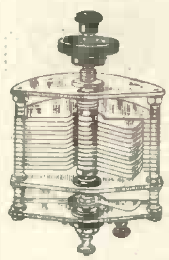

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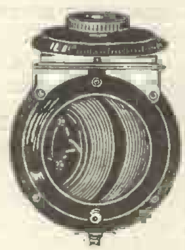

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(*Continued from p.* 381.)

then a 0.001 μF fixed condenser should be connected across the primary of the transformer.

Connecting the Unit to a Crystal Set

The method of adding the instrument to a crystal receiver valve chosen, otherwise distortion or damage to the valve is likely to result.

Grid Bias

Should the reader decide to use a dull emitter valve with this unit, then the incorporation of a grid biasing battery is recommended, and in order that such an addition

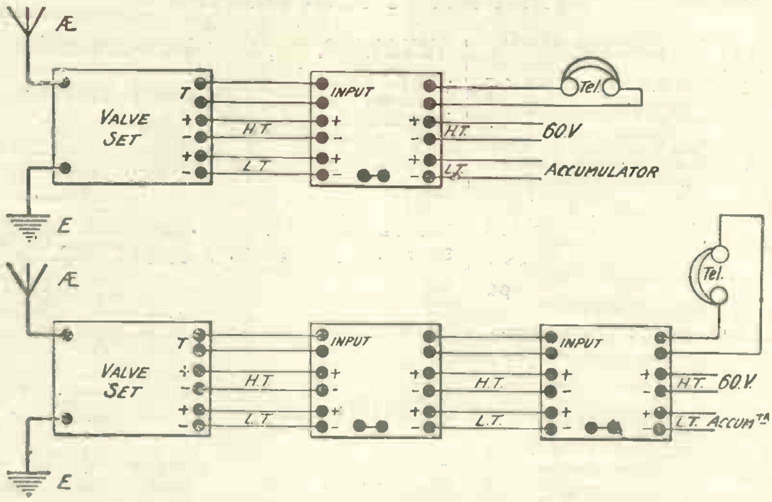


Fig. 8.—Showing how one or two units may be connected to a valve set. When using dull-emitter valves and H.T. over 60 volts, grid cells should be added.

is to connect the two "input" terminals of the unit to the two telephone terminals of the receiver, connect the batteries and telephones, light the valve to a suitable degree of brilliance, and after obtaining the best results, try reversing the connections to the "input" of the unit; this precaution very often affords better results both as regards distortion and volume.

Where two units are used the connections are much the same and are illustrated in Fig. 6. The same precaution of reversing the "input" connections should also be tried with the second unit.

Connecting the Unit to a Valve Receiver

The adding of this unit to a valve receiver calls for the same operation as when a crystal receiver is used with the addition that the H.T. and L.T. connections are extended as shown in Fig. 8, illustrating the connections for either one or two units.

Valves

It may be understood that any general purpose receiving valve may be used with this unit, and, since a suitable filament resistance is fitted, these remarks may be taken to also cover the range of dull emitter valves. Care must be taken, however, to use the value of H.T. voltage as specified by the makers of the particular

may be made, two separate terminals are provided. A battery of about $4\frac{1}{2}$ volts made up from flash-lamp cells is sufficient in most cases, though with the valve chosen, instructions upon the wrapper of the valve are usually to be found. The inclusion of this battery of a suitable voltage will eliminate the "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 from use, then the two terminals across which the battery would normally be connected should be short circuited.

Test Report

The unit as illustrated, when connected to a crystal receiver in S.E. London, using 60 volts H.T., gives the standard volume for a crystal and note magnifier circuit. Connected to a single valve reaction receiver in the same district, with the same value of H.T. voltage, fair loud speaker strength can be obtained from 2LO, whilst all other stations within range are amplified to a standard consistent with that of any other low-frequency unit the writer has tried.

Throughout the tests the aerial used was a small indoor arrangement.

Test for Common L.T. Negative and H.T. Negative Connection.

In those cases where readers do not know whether their valve sets are connected L.T. positive to H.T. negative, or whether the two negatives are connected together, the following is an easy test:—

Take a pair of telephones and connect one pin to one side of a flash-lamp cell. The other telephone pin is now connected to the H.T. negative terminal, and the L.T. positive terminal is tapped with the free side of the flash-lamp battery.

If a loud click is heard in the telephones, then the L.T. positive is connected to the H.T. negative; if no click is heard, then the two negatives are connected together.

During this test both the H.T. battery and accumulator should be disconnected from the set.

THE JUNE SINGLE VALVE SET

To the Editor of MODERN WIRELESS.

SIR,—Saturday afternoon, July 19, being very wet, the writer and his friend decided that they would endeavour to build the single-valve receiver by H. K. Simpson as described in the June issue of MODERN WIRELESS with a few odd parts which had been discarded. Not having any ebonite or sufficient terminals, and all shops being closed, we decided to use an old gramophone record (without any treatment) for the panel, and to use valve legs and brass screws to make up for what we were short in terminals. The work was commenced at 3 p.m. and completed at 7.20 p.m., which included an interval for tea. After completion the high power station, 5XX, was received fairly clear with No. 200 Igranic coil in the aerial and 250 reaction—aerial is span of 2 wires, 5 ft. apart, about 25 ft. long by 40 ft. high. We then heard Manchester with 50 coil in aerial and 75 in reaction until 9.30 p.m., when we were switched on to London. I may mention I have built the S.T.100 as described in your journal, and can hear all B.B.C. stations with careful tuning, Manchester and Glasgow being very strong. I can also tune in Radiola, and on Saturday night last we heard the "time signal" from Eiffel Tower. My reason for sending you this letter is to tell you that I greatly appreciate the help I have received from both *Wireless Weekly* and MODERN WIRELESS.

Dublin. R. STEVENSON.

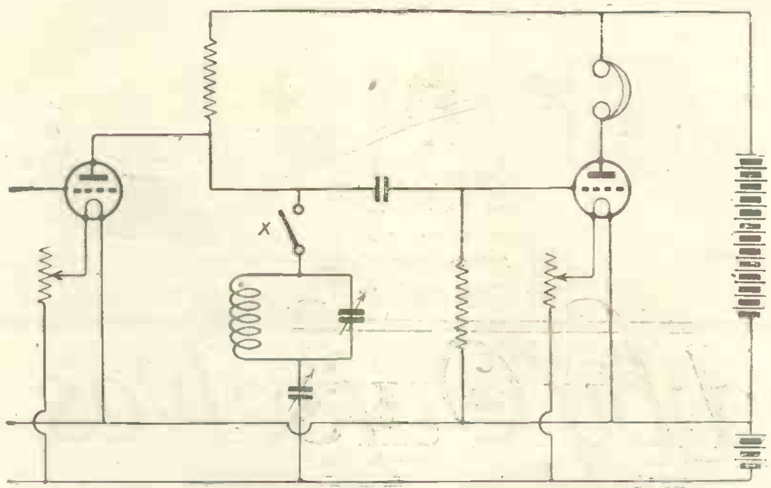


Fig. 5.—Changing over to long waves.

Continued from page 403.

of all one after the other in the same circuit and with the same tuning condenser. Unless the condenser readings are within one or two degrees of each other, pairs of inductances or of transformers will not work well together when tuned by a double condenser for short wave reception. It must be remembered that upon short waves the tiniest increase in capacity makes a comparatively enormous difference to the frequency. Hence, unless inductances or transformer primaries are perfectly matched one of them will probably always be slightly detuned. This obviously does not make for efficient working. On the longer waves such as those of our own broadcast-band, slight differences will not give rise to any noticeable ill effects, and when we tune up to 2,000 metres or more complete efficiency will be obtained. It is not really a difficult business to match the sub-panel wiring of two circuits if a little care is taken in the design. Provided that the components of both circuits are equally spaced leads can be made of exactly the same length, and if care is taken to arrange them the same distance apart in every case capacity differences should not be noticeable.

The Long and Short of It

For very short wave work, then, I am disposed to recommend that two separate condensers should be used for tuning the plate circuits of high-frequency valves. The main objection to the use of a pair of condensers so far as I can see is that it does rather complicate the question of searching. If a double circuit tuner is employed one has four variable condensers — the A.T.I., C.C.I. and the two anode condensers —all of which should really be moved simultaneously. Not being gifted with prehensile toes I have not so far been able to discover any ready method of doing this! In practice it is a good deal more simple than it will appear on paper. One knows the approximate tuning of both A.T.I. and C.C.I. for any wavelength, especially if square law condensers (I cannot refrain from mentioning these again, since I am so delighted with their performance) are used, and even if no wavemeter is available one can usually set these two at something approaching the required adjustment. Now with two stages of high-frequency it is not essential, unless signals are so weak as to be hardly detectable that both should be sharply tuned. It suffices, therefore, to set the second tuned anode condenser at approximately the right setting and to use the first for searching. Again, if the coupling is kept not too loose, the adjustment of the aerial tuning condenser is not over critical. This again can be placed at approximately the right setting. One can now use one's two hands for operating the closed circuit condenser and that tuning the first anode, and in most cases even the weak signals of a distant short wave station will be picked up in this way. Once found they can be tuned to their maximum strength by adjusting the other condensers. For medium and long-wave work the double condenser is entirely satisfactory; it saves one any amount of trouble, and if due care is taken in matching the two circuits and their components it will be as efficient as can be desired, even by the most critical of amateurs.

A Condenser Point

A very important point in the reception of either very short or very long waves is that the condenser should be up to its stated maximum capacity, and that it should have a very low minimum capacity. If the maximum capacity is much below what it ought to be, or if the minimum capacity is high, the waveband covered by any particular coil used in conjunction with the condenser will be a comparatively narrow one. The effects of small maximum capacity are obvious. Those who care to do so can easily prove to their own satisfaction that the waveband covered by a condenser whose maximum capacity is .0005 μF with a minimum of .00005 μF is very much smaller than one which ranges from .0005 μF down to .00002 μF. Using the ordinary formula 1885 $\sqrt{L \times C}$, and allowing .00003 μF for the distributed capacity of the coil, a simple calculation will show you how much is lost if the minimum capacity of the condenser is large.

LAMBDA.

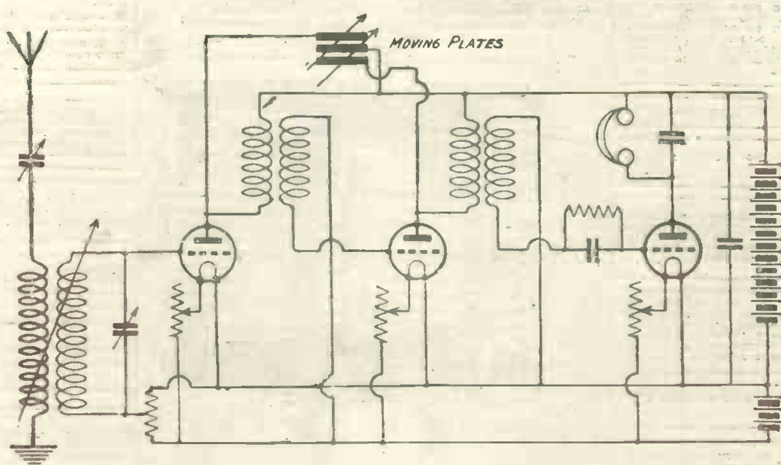
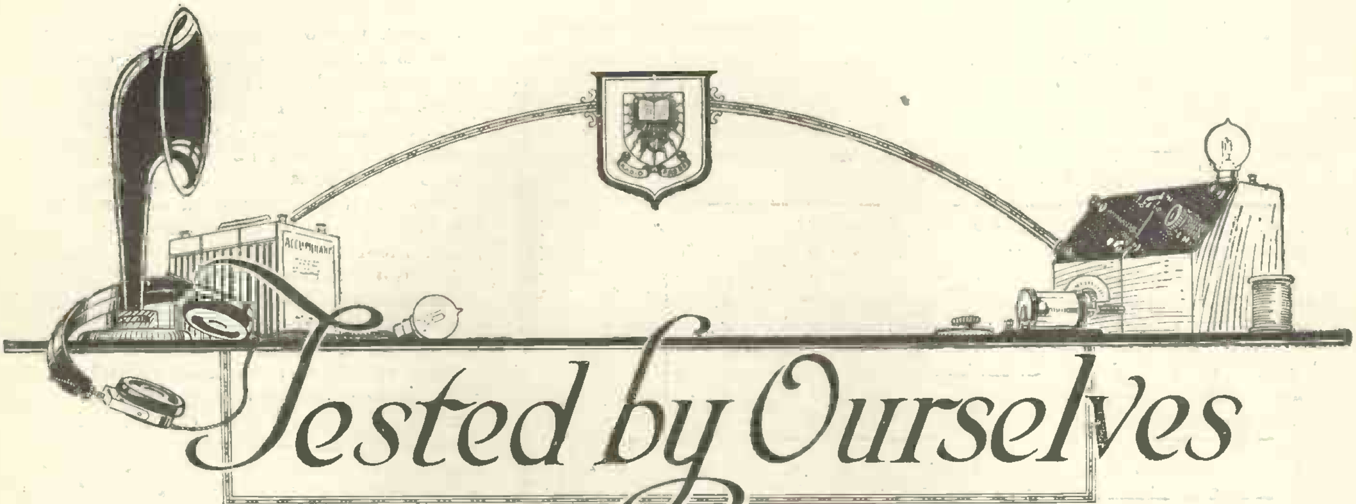


Fig. 6.—Showing how a double condenser is wired in circuit.



Tested by Ourselves

New R.I. Transformer

Messrs. Radio Instruments, Ltd., have submitted for test a sample of their new pattern of the well-known R.I. intervalve L.F. transformer.

This exactly resembles in external appearance and finish the old pattern instrument; but has a sectional winding, both primary and secondary coils being divided into six portions, each in a separate compartment in the insulating bobbin, and with the primary winding now arranged outside the secondary. The effect of this is claimed to be a considerable reduction of self-capacity (distributed capacity) in the windings, with resulting greater and more uniform amplification at high audio-frequencies. A larger gauge of wire is also used than heretofore. The same type of liberal iron core, with thin laminations which are not short-circuited for eddy-currents by bolts through them, is adopted. The turns ratio is given as 4 : 1, with a primary inductance of 11 Henries. The makers actually offer a twelve-months guarantee with this instrument.

It will give the experienced investigator considerable confidence to learn of the ample use made by the manufacturers of the unrivalled facilities of the National Physical Laboratory for accurate scientific standardisation, in the development of this instrument. The curve showing the actual voltage amplification (A.C. voltage across unloaded secondary of transformer following an amplifying valve: A.C. voltage applied on the grid of that valve) at different frequencies from 300 to 4,000 cycles, as determined by the N.P.L., indicates a flat characteristic from 4,000 down to 2,000 cycles audio-frequency; falling to about 50 per cent. of the average amplification at 500 cycles; and to about 38 per cent. at the lowest frequency measured of 300 cycles—a fairly low note. Accordingly it was to be expected that there would be but little distortion noticeable in operation, in amplifying speech and music; but a slight loss in the low bass notes: giving what is sometimes loosely termed a rather "high-pitched" effect.

On actual trial, in conjunction with a loud-speaker equipment as nearly above suspicion as appears to be possible at the moment, in comparison with the standard L.F. amplifier this new pattern of the R.I. showed noticeable improvement over the old pattern, in the matter of distortion, the tone being rounder and fuller, due to the inclusion of more of the low frequencies: this was particularly noticeable on organ music. The degree of amplification on an average was about the same as with the old pattern, and approached closely to the standard. Compared with standards in the matter of tone, except for the slight raising of the "pitch" (or selective amplification of that particular portion of the scale), the performance was good, and markedly superior to the average run of even high-priced transformers. Comparative tests with approximately pure notes of different pitches substantiated the claims for fairly uniform amplification over a large range, the typical resonance peaks of poor L.F. transformers being absent.

The customary routine tests of insulation proved satisfactory. The workmanship and finish of the instrument were up to the usual high standard of the makers.

Vanicon Variable Condenser

With reference to the Vanicon variable condenser reported on in Vol. 3, No. 2, of MODERN WIRELESS, Messrs. Dubilier Condenser Co. have drawn our attention to the provision made in this instrument for panel mounting. By removing the knob and scale from the spindle it becomes an easy matter to take off a circular false panel on the top of the condenser, which carries the stops and zero-mark of the scale: this is then placed *outside* the panel (where it affords an attractive finish), and the condenser proper is secured by small screws below the panel. The terminals are then behind and clear of the panel, and easily accessible. We understand that instructions for this operation are to be attached to instruments supplied to the public. It is evident that considerable thought has been given to the matter of providing an effective and extremely neat mode of mounting this condenser.

M.L. Anode Converter

Messrs. M.L. Magneto Syndicate, Ltd., have submitted for practical trial a sample of their "Anode Converter," for providing a reliable H.T. supply to replace the customary H.T. battery. This consists of a small motor-generator, working off an ordinary 6- or 12-volt accumulator, and mounted on supports inside a metal case so as to minimise vibration and noise and to reduce direct interference. It is particularly suggested for use in power-amplification work where H.T. batteries are rapidly exhausted by the large demands made for plate current. Several types are made, each of which is rated at 20-milliamperes continuous load, but of voltage ranging from 70 volts to 500 volts.

A filament-rheostat type of resistance-controller is fitted in the L.T. side, which gives a narrow and convenient control over the output.

The current demand is from around 1 ampere for no load to $1\frac{1}{2}$ or 2 amperes full load, at 6 or 12 volts according to size. The 12-volt unit, which was given an extensive test, operated quite well on 6 volts, with proportionately lower output.

A smoothing device is provided, consisting of the usual iron-core inductance and smoothing condensers, which has alternative modes of connection. Extra smoothing units, for use in special cases, are also supplied.

On practical trial it was found that a distinct hum was noticeable when the generator was used to supply H.T. for both detector and power-amplifier valves, and was run off the same L.T. battery. With a separate battery to run the unit the hum was quite inaudible at any distance from the loud-speaker, and extremely powerful loud-speaking results were obtained. The best mode of operation appeared to be to use a separate small H.T. battery for the detector-valve, and separate L.T. battery for valves and generator, using the latter exclusively for supplying the 20-milliamperes or more of plate current at 150 to 300 volts for power-amplification.

The generator ran steadily and silently, and was readily controlled. The general workmanship and finish were of the highest order.

Dull-Emitter Dextraudion Valve

A sample of the new one-volt Dextraudion valve has been submitted for test by Messrs. Economic Electric Co., Ltd.

This is similar in general appearance and design to the bright-emitter Dextraudion valve, having the same type of rectangular trough-shaped anode; but has a dull-emitter filament rated at the unusually low figure of $\frac{1}{10}$ watt —*i.e.*, .1 ampere at 1 volt.

On trial the sample valve took .12 amperes at 1 volt on the filament, for satisfactory operation, the saturation plate-current being 2 milliamperes: the filament is just visibly red under these circumstances. The valve will operate both as detector and amplifier with considerably less than 1 volt on the filament, and with the latter at so low a temperature that it is almost invisible even in a carefully darkened room. It is, however, not advisable to use the valve in this condition. With the filament at a bright red heat the filament current rose to .15 amperes.

Tested at .12 amperes in the filament the characteristic curves showed that on 50 or 70 volts H.T. and with a negative grid-bias of a few volts, the desirable long straight portion for distortionless amplification was obtainable. On 70 volts H.T. over half-a-milliampere plate-current was available for modulation under these circumstances: it is not surprising therefore that on practical trial in reception most excellent distortionless loud-speaking was obtained on a two-valve set at short range, using this valve as a note-magnifier. With up to 150 volts H.T. and grid-bias of 5 volts maximum a large volume of sound was obtained, without signs of the distortion due to partial rectification, and somewhat impressive in view of the small amount of energy consumed in the filament.

In high-frequency amplification using 50 volts H.T., the valve replaced a standard bright-emitter R valve effectively, and gave a degree of amplification which reached the usual standard obtainable, by actual measurement.

As a detector the results obtained fell a little short of those given by the pea-nut type of valve; consuming over twice the current; the valve oscillated readily, and operated best on moderate H.T. of about 30 volts. Microphonic effects were not noticeable.

(Continued on page 469.)

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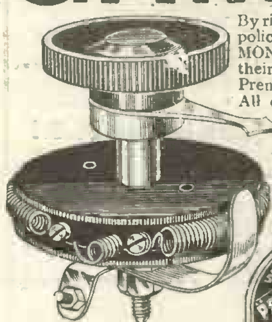

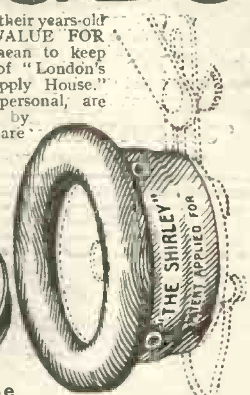

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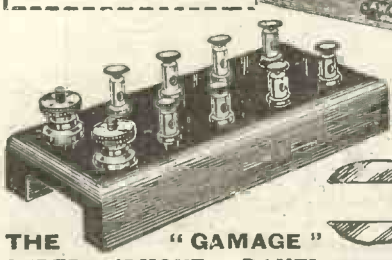

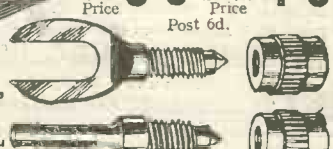

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A beautifully finished component with lacquered terminals. TO TAKE 4 PAIRS OF 'PHONES. Size 5 in. x 2 in. x 1½ in. high. Post 4d. Price **3/6**
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Very handy for Aerial, Earth and Battery Wires, etc. Beautifully made and finished. Per doz. either type **1/6** Post 2d.

COIL HOLDERS
For Honeycomb and Burndept Coils. Best ebonite with all brass parts finished dull nickel. Perfect movement which can be tightened when using large coils. For Two Coils. Post 6d. Reduced Price **4/-** For 3 Coils Post 6d. Reduced Price **6/-**

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SIEMENS HEADPHONES.

Unsurpassed for clearness and purity of tone.

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Obtainable from all dealers.

SIEMENS BROTHERS & CO., LTD.
WOOLWICH, LONDON, S.E. 18.

In general, we can certainly recommend this valve for use where L.T. supply is a serious consideration, as a single moderate-sized dry cell for each valve is all that is required. With proper adjustment of H.T. supply, and in particular ample H.T. on the L.F. stages and from 1.4 to 5 volts grid-bias in the latter case, results can be obtained that compare well with those given by R valves.

Marconiphone "Ideal" Distortionless Transformer

Messrs. Marconiphone, Ltd., have sent for test a sample of the new "Ideal" L.F. intervalve transformer, that submitted being the 2.7 : 1 ratio type, designed for use in particular immediately *after* a valve of high impedance such as the R., D.E.R., V.24, etc., and in general as the first stage of L.F. amplification after rectification.

This is a very large, heavy instrument, the circular iron casing enclosing it being 3 in. diameter by about 2¾ in. high, small terminals being mounted on ebonite strips on the top. Drilled lugs are provided for fixing in the set.

The design of this transformer is particularly interesting, the coils being divided into sections which are interleaved, and suitably spaced, whilst the iron circuit is exceptionally liberal. The makers describe elaborate tests which are carried out during the assembling of each instrument, and have the notable courage to give a printed guarantee of performance — amplification to be within 5 per cent. of that shown in characteristic curves given for each type with standard types of valves; and replacement free of charge within six months if a break occurs in the winding, subject to reasonable usage.

The curves give for the theoretical voltage amplification, measured in a somewhat arbitrary manner as the ratio of the A.C. voltage across the unloaded secondary of the transformer, used *after* an amplifying valve, to the A.C. voltage of the particular frequency applied to the grid of this same valve (and therefore making full use of the amplification of the valve) show a very high and uniform amplification over an unusually long range of audio-frequencies. With the 2.7 : 1 ratio instrument, and an R valve (M = 10), this "voltage amplification" is given as about 33 : 1 over the whole range from 4,000 down to about 700 cycles audio-frequency, and only dropping to 28 : 1 at 300 cycles—an extraordinary performance.

The actual amplification of signals, though related to this theoretical "voltage amplification" is naturally much less: by actual measurement with this instrument and an R valve used before the transformer, with a small power-valve and 170 volts H.T., with proper grid-bias for the second stage, the amplification was sensibly less than that given by the standard, which gives a pretty uniform average of 7 : 1 *actual* measured signal-strength. The comparative low ratio of this transformer, while it makes possible a high-impedance primary (and accordingly more uniform amplification of the lower notes), had cut down the available amplification in comparison. It will be interesting to test the higher-ratio patterns of the "Ideal" transformer in this connection. The makers give particulars of a 4 : 1 type, for use with low-impedance valves, or to get maximum results from an R valve and a special 6 : 1 ratio type for use in the last stage of power amplification with power valves.

It would be a revelation to many of those who tolerate present-day loud-speaker performances to note

the difference between this type of uniformly amplifying L.F. transformer, when used in a properly adjusted circuit, with ample H.T. and optimum grid-bias, with the valves chosen to carry the load; and the more usual types of transformers with low impedance, overloaded iron circuits, and pronounced resonance peaks. With the best available loud-speaking equipment this 2.7 : 1 instrument gave as natural a reproduction as one could desire, even Big Ben being reproduced in all his dignity and sonority. Contralto and soprano kept their natural "pitch"; piccolo and organ both were faithfully rendered. The fullness and roundness of tone (without the dulling of the sparkling upper notes and overtones which sometimes accompanies loud speaker reproduction was notably better than that of our previous standard, though, as stated, the amplification fell sensibly short. Critical tests at different audio-frequencies failed to bring out any resonance effects.

Qualitative tests in actual reception showed very satisfactory results: on a good aerial in a remote corner of Essex with an R and a small-power valve and moderate H.T., London came in with a merry shout; Bournemouth, Manchester, Newcastle, Glasgow, Birmingham (the latter little inferior to 2LO.) all comfortably audible on the L.S. in a large room; two German stations tuned in (as with the others) directly on the loud-speaker, the Frankfort announcer being readable across the room; finally Madrid, after the B.B.C. stations had ceased, came in loud enough to follow the music (a guitar solo) in another room across a large hall—on the two valves arranged as detector and note-magnifier. The transmission from London at about 40 miles was exceptionally natural and clear, as well as almost overoweringly loud indoors.

We can with the utmost confidence recommend this very fine instrument. Whilst the price is not low, it should be borne in mind that the amplification attained with proper equipment is nearly twice that with inferior types of the so-called "cheap" order, so that the cost of another valve and of a cheap transformer, or of another stage of resistance-coupled amplification, must be offset against this. Of the workmanship, finish, and insulation it is unnecessary to speak.

Radio Press Service Department Notes

THE Radio Press Service Dept., Ltd., requests us to give prominence to the following notes, due observance of which will greatly facilitate the work of the department.

Packing of Sets.

Experience shows that when sets are to travel by post or rail the greatest care must be taken in packing. Please use strong wooden crates or boxes, and surround the set with paper or straw: on no account screw the panel rigidly into the crate. Cardboard boxes are quite useless for the purpose.

Exhibition of Sets.

The exhibition of "WIRELESS WEEKLY," "MODERN WIRELESS" and Radio Press Envelope sets has now been transferred to a room in the main Radio Press building (3rd floor) where they can be inspected by interested readers. It will be remembered that the W.W. and M.W. sets are on view for a period of three weeks following publication.

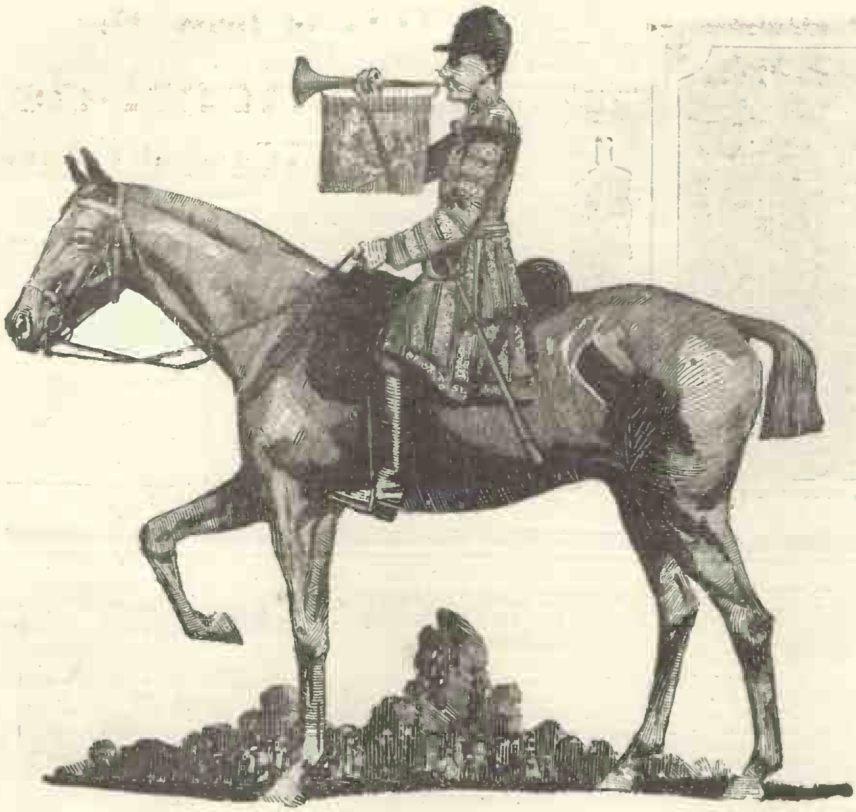
Labelling of Sets.

Readers are particularly requested to put *their own* name in some prominent position on the *outside* of the package, in order that sets can be identified easily and promptly acknowledged.

Something for the Constructor. "That Professional Look"

EVERYONE who builds a wireless set must, at heart, rather wish he could make it look as handsome and imposing as some of the polished and lacquered productions of the best manufacturers, and one of his greatest difficulties is in the matter of engraving. He can, no doubt, have the panel properly engraved after drilling, but it is a somewhat expensive business, and entails a delay at the very stage whereat the constructor is most anxious to get a move on.

Radio Press, Ltd., ever on the watch for opportunities of helping the home constructors, is about to publish a set of special "Panel Transfers" which will entirely overcome the difficulty, and enable a really handsome appearance to be obtained. These transfers have been specially manufactured to suit the Radio Press sets, and are of the "hot pad" type. They are to be sold for the modest sum of 6d. per set, enclosed in a large *sealed* envelope, consist of nearly 100 different labels, and are specially easy to affix.



Marvellously fine tone

—without a trace of blast or blare

RADIO enthusiasts are gradually appreciating the fact that 75 per cent. of the responsibility for poor tone rendering is due to the Transformer, with the remaining 25 per cent. divided between the Valves and the Loud-Speaker.

It has been a common fallacy to believe that the L.F. Transformer merely amplifies, and for this reason many of them are badly designed. Amplification in a Transformer for Loud-Speaker use must always be considered in relationship to tone purity. Any Transformer can be made with a high amplification factor—that means merely a mathematical calculation as to the ratio between the number of turns on the primary winding and those on the secondary. But to eliminate distortion and yet retain the volume is entirely another matter.

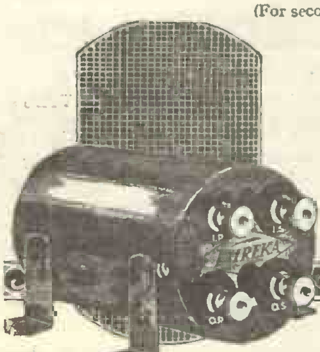
The Eureka Concert Grand is such an exceptional Transformer because no money has been spared on its construction. For instance, it is the only L.F. Transformer in the world that contains 2¼ miles of wire. It is the only one that will stand a 14-day total immersion in water test. It is the only one that can be bolted together in pairs without interaction.

In face of these outstanding advantages it is not surprising that our output has had to be trebled in an endeavour to keep pace with the demand.

Made in two types

Concert Grand	30/-
Eureka No. 2	22/6 (For second stage)

Sold by all Dealers and manufactured only by
Portable Utilities Co., Ltd.,
7 & 8, Fisher Street, London, W.C.1.
Scottish Agents: FULLER, BLACKIE & RUSSELL. Ltd., 30, Gordon St., Glasgow.



EUREKA Transformer

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Wireless Vacuum Tubes

—an elementary Text-book written by John Scott-Taggart
F.Inst.P., A.M.I.E.E.

FOR less than the cost of a Valve the keen experimenter can obtain a Text-book—the only one of its kind—on the complete working of the Thermionic Valve. Carefully printed and well bound in full cloth, this book should be on the bookshelf of everyone who is out of the novice stage and who aspires to some sound theoretical knowledge of Radio.

Its wide scope, coupled with the fact that its contents are arranged in a progressive and logical order, render it ideal as a work of reference rather than a book that one would attempt to assimilate at a sitting.

With its 250 pages and more than 130 diagrams and illustrations, it represents remarkable value for money and is a book that would be gladly appreciated as a birthday or other gift by any wireless enthusiast.

10/- *from all Booksellers, or sent direct by the Publishers (postage 6d.).*

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PUBLISHERS OF AUTHORITATIVE WIRELESS LITERATURE
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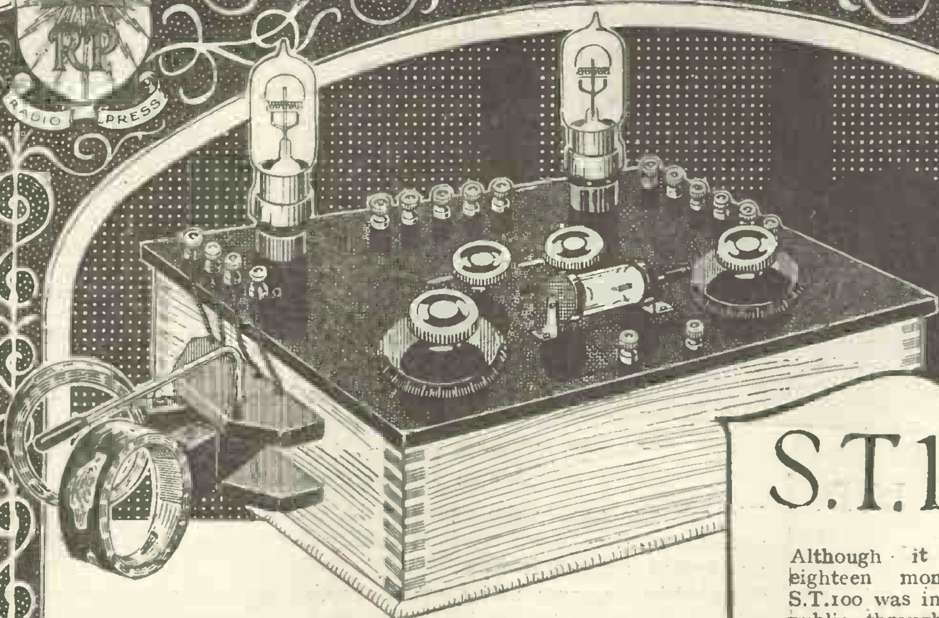


S.T.100

Although it is less than eighteen months since the S.T.100 was introduced to the public through the pages of MODERN WIRELESS, yet scores of thousands of Receiving Sets incorporating it are giving complete satisfaction in all parts of the country. For a general purposes, economical Set the S.T.100 would be hard to beat. On an average Aerial all B.B.C. stations can be heard at good strength, while it has a Loud-Speaker range of 30 to 40 miles.

It is particularly economical because it only uses two Valves (a Crystal acting as Rectifier), yet immense amplification is obtained because the first valve acts as a high-frequency and low-frequency amplifier simultaneously.

To build such a Set is within the reach of anyone, the following being practically the only components required: Two variable condensers, two valve-holders, two rheostats, one fixed resistance, one coil-holder, one crystal detector, two L.F. transformers, the necessary terminals, panel and cabinet.

¶ **Why not rebuild your present Set into an S.T.100?**

1/6

A new system simplifies the home construction of this fine Reflex Set.

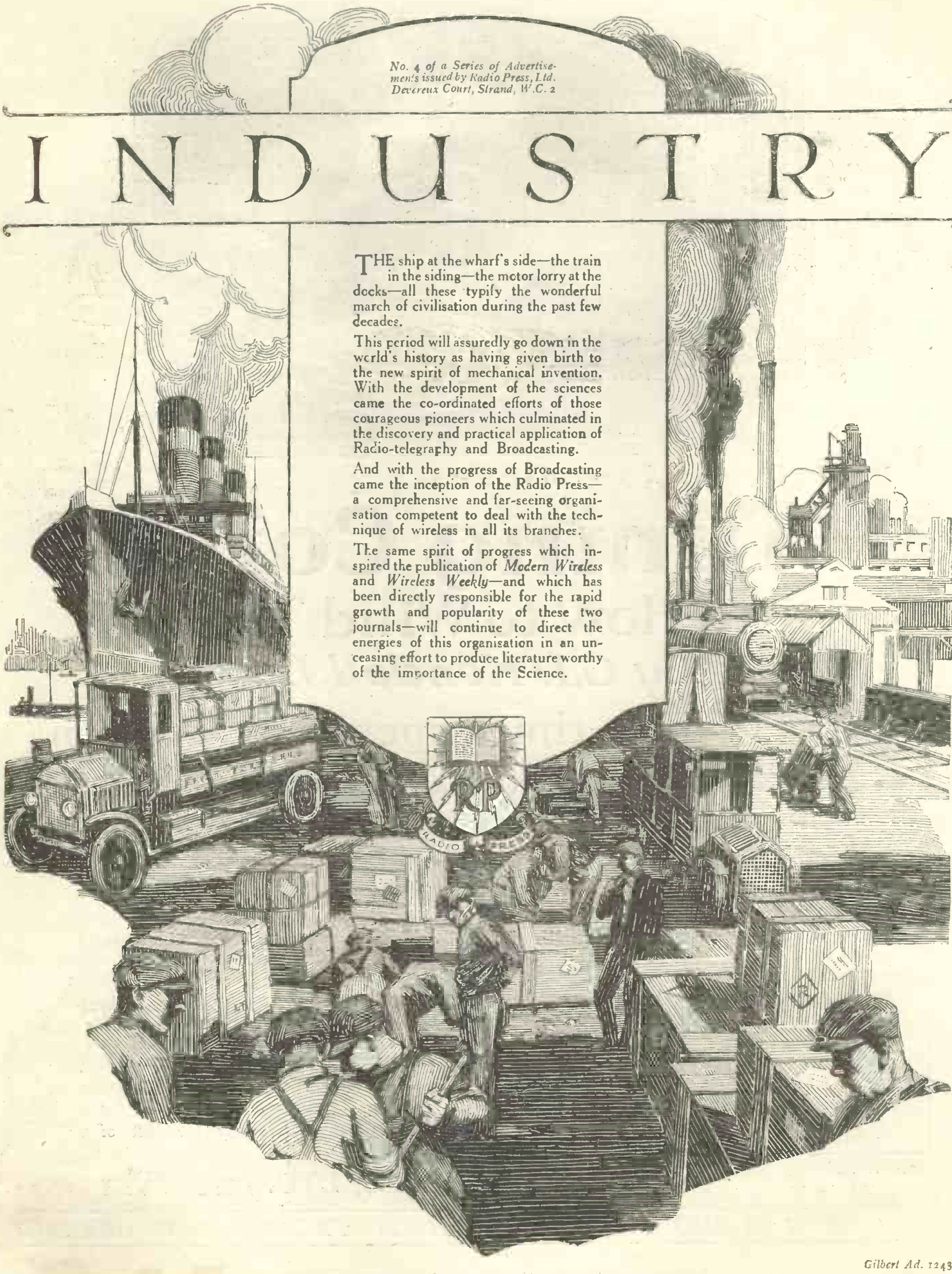
WHILE to many enthusiasts who already have some knowledge of Radio the constructional articles in MODERN WIRELESS and *Wireless Weekly* are quite sufficient, yet to some beginners and others the elementary details of construction may have been omitted. Obviously exigencies of space in a magazine often render it necessary for an article to be kept brief.

In order to assist the novice and the man who has never built a Set before, however, we have produced a special Series of Envelopes, each dealing with one particular type of Set in a most comprehensive manner.

The first one of the series is devoted to building up the S.T.100 shown above and contains blue prints, wiring diagrams, illustrations of finished instruments taken in various positions, complete working instructions, etc., etc. Absolutely every possible assistance is given so that the novice can follow the instructions and build a first-class Set without possibility of error. **1/9 post free.**

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

Radio Press Envelope No. 1



Gilbert Ad. 1243

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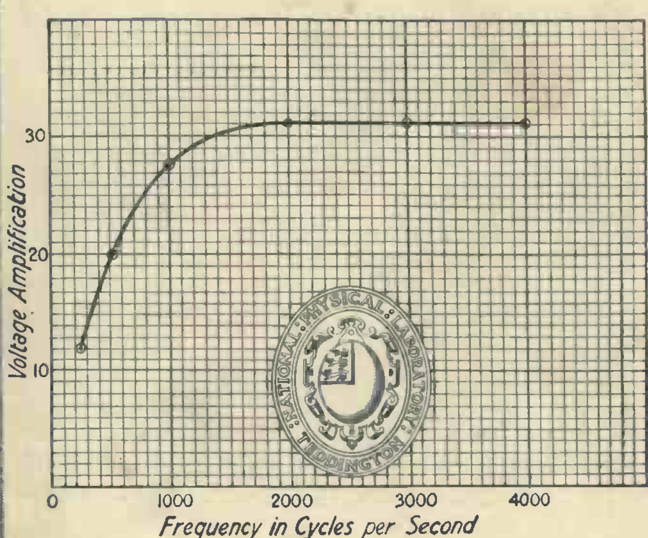
"MODERN WIRELESS" September, 1924

THE NEW RI



IN many transformers at present on the market, particularly when a large amount of wire is used, the coil is wound higgledy-piggledy over the whole length of the core, The self capacity is consequently extremely large, and limits amplification at the higher frequencies, while the only insulation is that provided by the wire itself.

The original R.I. Transformer had a self-capacity of 63 micro-microfarads. The new R.I. has a self capacity of 18 micro-microfarads.

The primary and secondary are wound in twelve sections, the six sections of the primary being wound on the outside of the secondary sections.

A year's guarantee, and one R.I. Transformer Booklet with distortionless circuit diagrams supplied with each instrument.

Recognise the New R.I. by the provisional patent number on label. Write for leaflet N1 free on application

ONE of the finest things we can say about the R.I. Transformer is that over a quarter of a million are now in use, but the finest thing we can say about the new R.I. is that it is better in every respect than the original type and in one fundamental detail, it has a low self capacity which we maintain is superior to any of its competitors. Behind the scenes for two years at our great wireless factory have been ceaseless experiments and practical tests. We now offer the radio public a still further improved transformer backed by a year's guarantee. But more important still, we want to remove all possible doubt and enable the public to judge for itself by publishing for the first time the results of searching tests carried out by

"The National Physical Laboratory."

Extract from Report on Audio/Frequency Intervalve Transformer for Messrs. Radio Instruments, Ltd.

April 7th, 1924.

The self-capacity of the secondary winding of the transformer was measured, using alternating voltage of sine wave form and was found to be

18 Micro-microfarads.

The attached blue print shows the curve of the voltage amplification plotted against frequency for a stage comprising the transformer and a standard type R valve.

25/-

Telephone: Regent 6214-5-6

Telegrams: "Instradio London"

Radio Instruments Ltd.

12 Hyde Street, Oxford Street W. I.

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