POPULAR WIRELESS, November 6th, 1926. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

PERCY W. HARRIS WRITES IN THIS ISSUE

Popular Wireless

Every Thursday
PRICE
3d.

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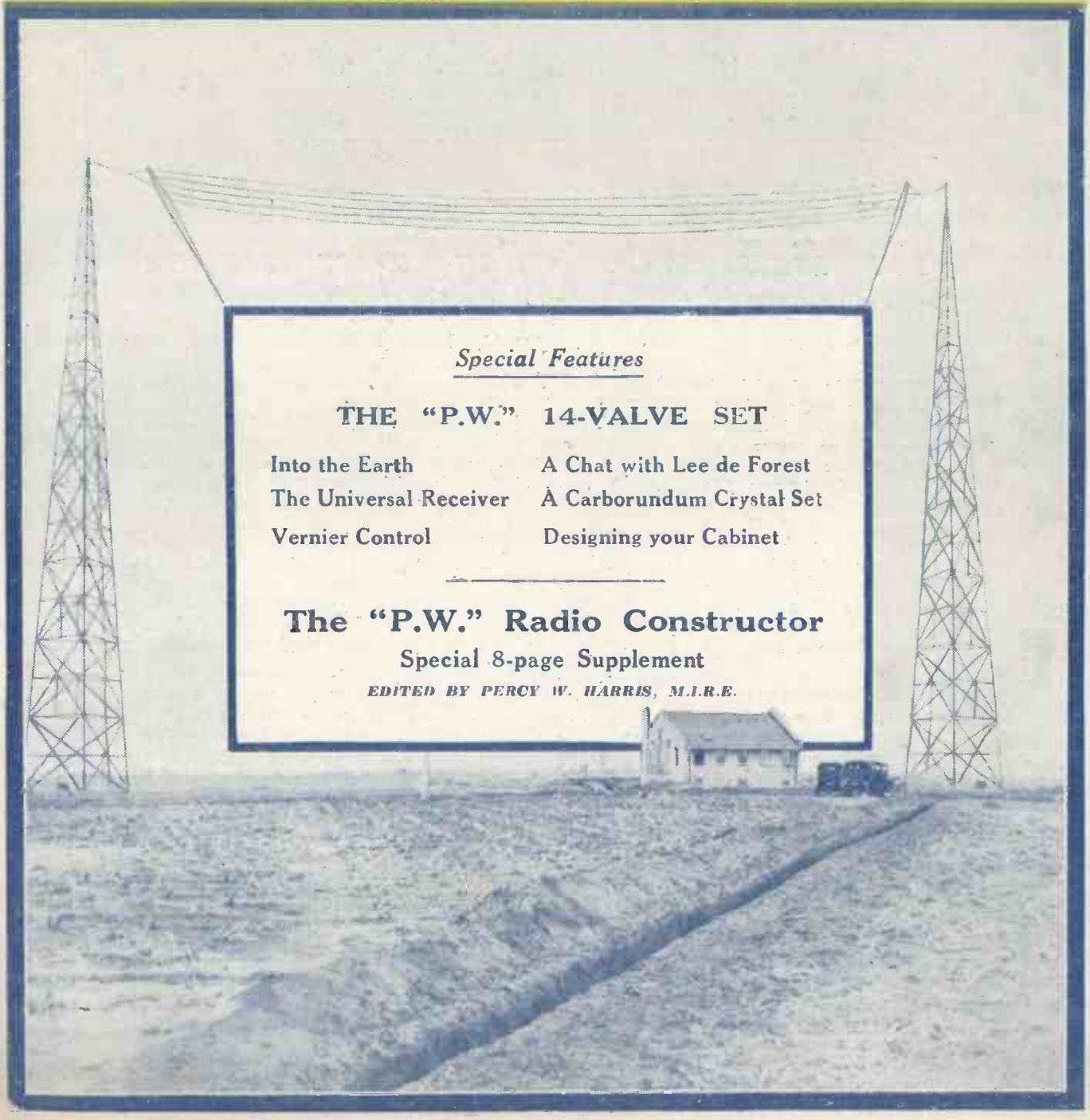


Special Features

THE "P.W." 14-VALVE SET

Into the Earth
The Universal Receiver
Vernier Control
A Chat with Lee de Forest
A Carborundum Crystal Set
Designing your Cabinet

The "P.W." Radio Constructor

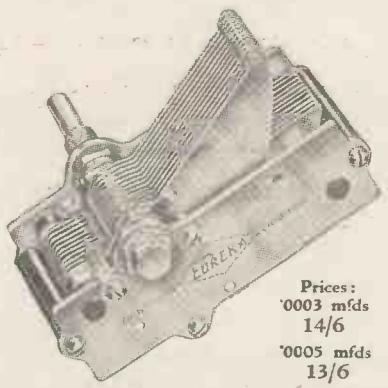
Special 8-page Supplement

EDITED BY PERCY W. HARRIS, M.I.R.E.

Just a smooth, regular movement of the dials and station after station wings its way in.

TRAFFIC tangles of the air are solved. Under Eureka Ortho-cyclic principles, stations—instead of being jumbled together—are evenly separated, no matter whether they are at the commencement or end of the dial. Compare this simple test. An ordinary condenser crowds 51 Geneva wavelengths within its first fifteen degrees on the dial. More than 3 wavelengths—each of 10 kilocycles separation—to each degree. No wonder accurate tuning is impossible!

The Eureka Ortho-cyclic, on the other hand, under identical circumstances shows only 15 wavelengths. But even more important, the same precise separation is shown all the way up the dial. One wavelength to each degree—no more and no less. Think of it. No more complicated wave traps — no more irritating jamming. Under the Geneva wave plan each station will be separated from its neighbour by ten kilocycles. A smooth regular movement of the dials—degree by degree—and station after station wings its way in. Instead of being overworked at one end of the dial the Eureka Ortho-cyclic gives you precisely 10 wavelengths each of 10 kilocycles separation from one end of the scale to the other. As regular, in fact, as the rungs of a ladder.



Prices:
·0003 mfds 14/6
·0005 mfds 13/6

The New Eureka Dial
Engraved 0-100 right to left for kilocycles and 0-100 left to right for wavelengths Fits any condenser. Price 4/6

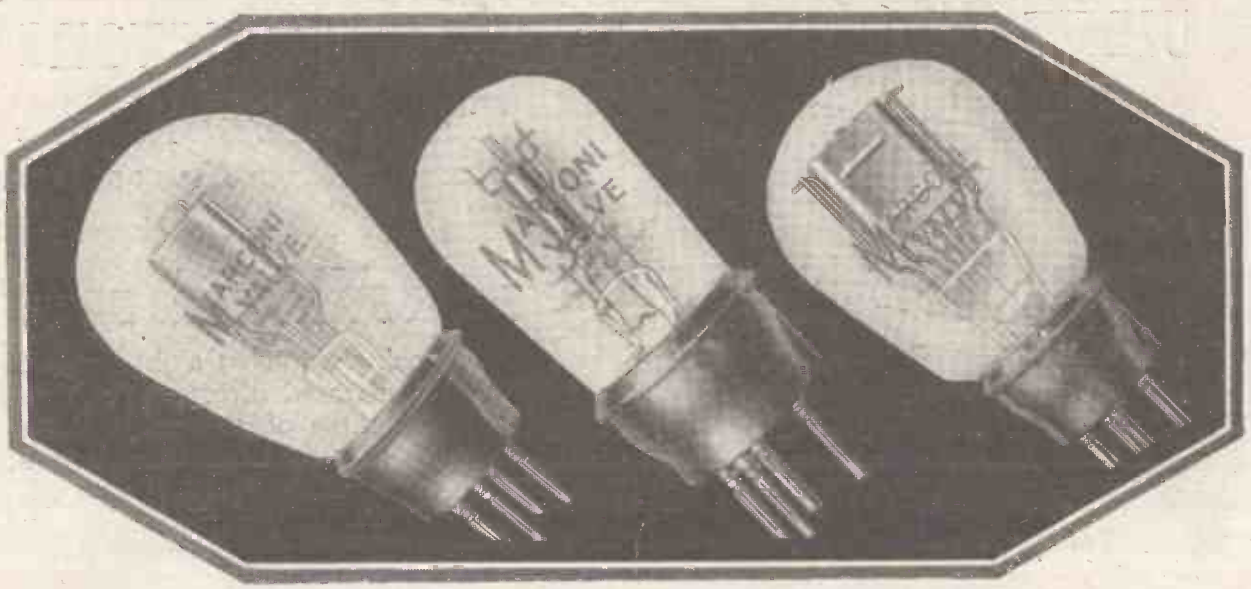
With its stout metal and plates—earthed rotor following latest low-loss practice—dual contacts, ball-bearing and self-centreing shaft, the new Eureka Ortho-cyclic is the most handsome Condenser on the market. It is a worthy "stable companion" of the famous Eureka Transformer and covered by the same generous guarantee. Your Set deserves them.

EUREKA ORTHO-CYCLIC CONDENSER

Advt. Postal Utilities Co., Ltd. (Eureka Radio Products), 8, Fisher Street W.C.1.

Gilbert Ad. 6232

MARCONI



VALVES

You will want Marconi Valves for the same reason that Radio Experts have chosen them for use in the principal Broadcasting Stations of the world—because they are the most efficient.

MARCONI TYPE D.E.2

L.F. for 2-volt Accumulator.

A New Valve for early stages of L.F. amplifier. Takes only about one-third the current of Type D.E.R. Can also be used as a rectifier with anode voltage 20-40. For final stages of L.F. amplifier a D.E.6 is recommended. Fil. volts 1·8. Fil. current amps 0·12. Anode volts 20-80. Impedance (ohms.) 22,000. Amp. factor 7 **14/-**

MARCONI TYPE D.E.3

For 4-volt Accumulator or 3 Dry Cells.

General Purpose Dull Emitter Valve. Current consumption is so low—0·06 amps.—that dry cells, three in series, can be used satisfactorily. For low frequency amplification the anode volts should be 60-80, with 3-5 volts negative grid bias. When used as a detector or H.F. amplifier the anode voltage should be of the order of 40. Fil. Volts 2·8. Fil. current amps. 0·06, anode volts 20-80. Impedance (ohms.) 22,000. Amp. factor 7 **14/-**

The NATIONAL WIRELESS WEEK
NOV. 7th.–13th.
'Let your Friends Listen'

Send for Marconi Valve Literature.

THE MARCONIPHONE COMPANY LIMITED,
Marconi House, Strand,
London, W.C.2

G. Marconi

MARCONI TYPE D.E.8

L.F. for 6-volt Accumulator.

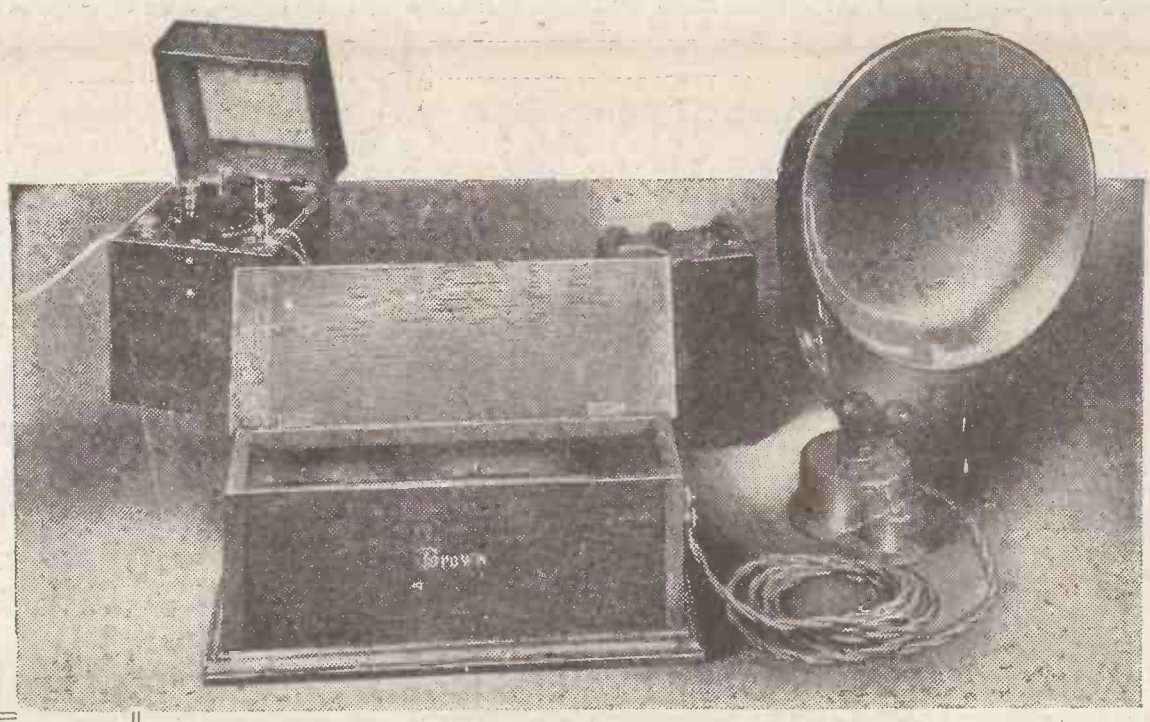
Recommended for L.F. amplification, when a steady negative grid bias of 6-7 volts is required, when using an anode voltage of 100. If a larger output is desired, a D.E.5 or D.E.5A may be used in the last stage of the amplifier. The D.E.8 L.F. may also be used as a general purpose valve. Fil. volts 5·6-6. Fil. current amps. 0·12. Anode volts 20-100. Impedance (ohms.) 8,000. Amp. factor 7 **18/6**

MARCONI TYPE D.E.6

For 2-volt Accumulator.

An improved design. Particularly suitable for use as the last stage of an L.F. amplifier using D.E.R. or D.E.2 in the initial stages. Suitable anode voltage 60-120 with 4½ to 10½ volts negative grid bias. Fil. volts 1·8-2. Fil. amps. 0·5. Impedance (ohms.) 10,000. Amp. factor 5·5 **18/6**

THE GREATEST NAME IN RADIO



Type A.2
4,000 ohms.
30/-

Brown
Q-type
120,2,000 or
4,000 ohms.
£15. 15s.

The Loud Speaker in the large photogr ph above is the Brown H.3 Q. 2,000ohms £3. 5s.

Brown H.3 Loud Speaker
2,000 ohms. only £3

Good news for Crystal Set users!

Now it is possible to work a Loud Speaker from your Crystal Set without Valves

Where is the Crystal Set user who has not longed for the day when he could put away his headphones and obtain loud speaker results without the use of a single valve? In the past this has been but an idle dream—to-day it is an actual fact. The makers of the world-famous Brown Loud Speaker have made it so, and this Winter you can dispense with Headphones and listen to a Loud Speaker whenever you wish—with not a valve or an accumulator in your home.

Behind the new Brown Crystal Amplifier there is a record of months spent in experiment and research. Months, however, that have been well-spent—for the perfected result brings to thousands of Crystal users, the long-desired boon of Loud Speaker reproduction.

Ask your Dealer to demonstrate the Brown Crystal Amplifier to you. You'll be amazed at its simplicity — the only accessory needed is an ordinary 4½-volt dry battery; you'll be delighted with the volume and the tone with which it enables the Loud Speaker to reproduce the broadcast.

£4 4s.

WHICH LOUD SPEAKER? Every purpose and every pocket is served by one of the nine Loud Speakers in the Brown range. Ask your Dealer for a Catalogue and get him to demonstrate the Crystal Amplifier on the one which suits your own requirements.

Brown

S. G. BROWN, LTD., Western Avenue, North Acton, W.1.

Retail Showrooms:—19, Mortimer Street, W.1.; 15, Moorfields, Liverpool; 67, High Street, Southampton. Wholesale Depots:—2, Lansdown Place, West Bath; 120, Wellington Street, Glasgow; 5-7, Godwin Street, Bradford; Cross House, Westgate Road, Newcastle; Howard S. Cooke & Co., 59, Caroline Street, Birmingham; Robert Garmany, Union Chambers, Union Street, Belfast, North Ireland.

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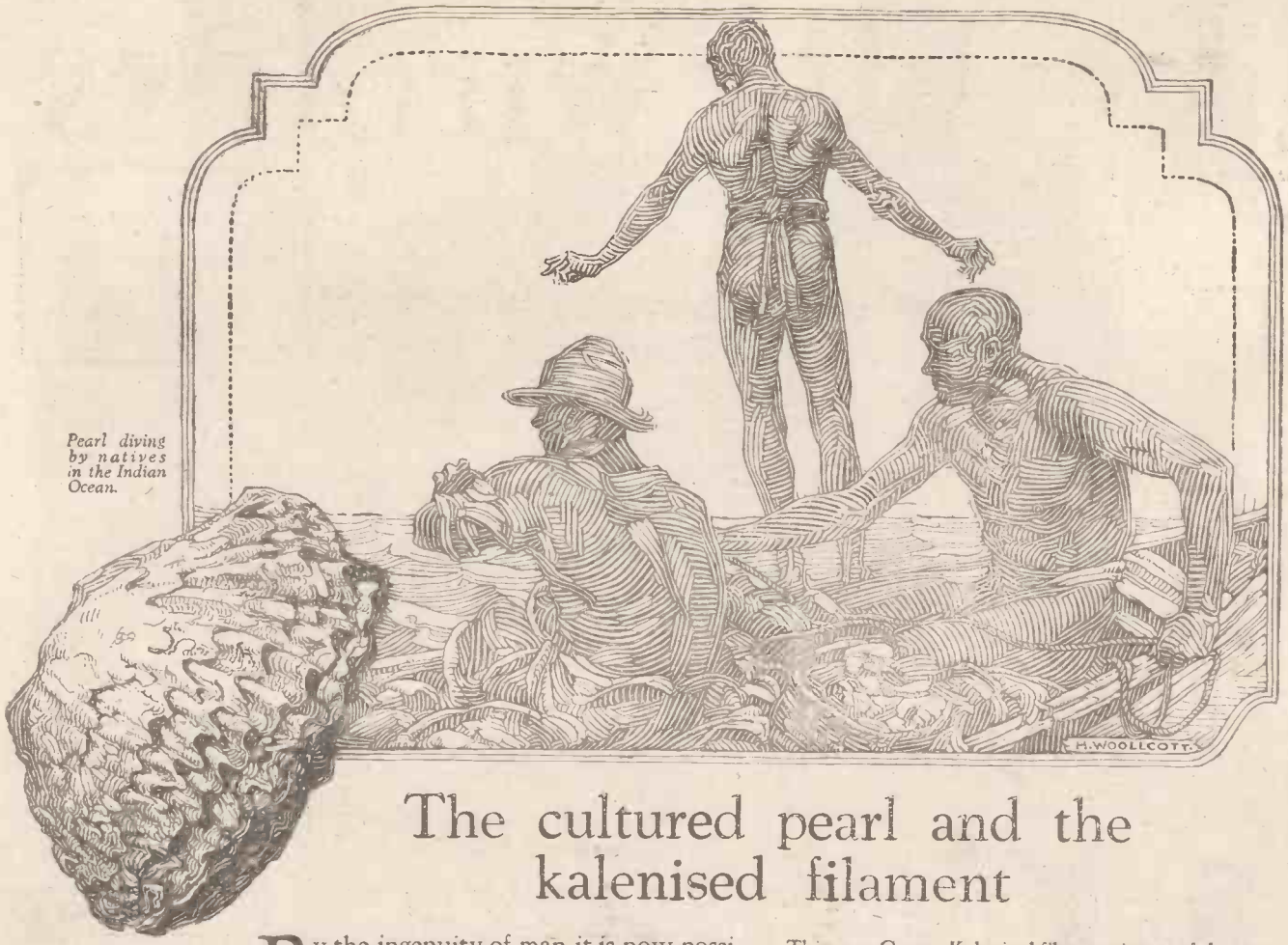

Pearl diving by natives in the Indian Ocean.

The cultured pearl and the kalenised filament

By the ingenuity of man it is now possible to hoodwink our friend the Oyster and persuade it to produce pearls to order. This is the simple method employed in the East. An irritant is introduced into the shell. Almost immediately the creature begins to cover it with layers of a nacreous substance. Ultimately a pearl is the result.

Split a cultured pearl in half and you will find that the core and the surrounding layers are one homogeneous mass. It is quite impossible to separate either the layers or the core.

Thus from the bed of the sea comes an interesting parallel for every valve user.

The new Cossor Kalenised Filament is just as much a homogeneous mass as is the cultured pearl. In a similar manner it is formed layer upon layer. And just as the nacreous layers in the pearl cannot be separated from their centre, so the kalenised layers in the Cossor Filament cannot become detached in use from their metal core.

This new Cosso Kalenised filament is one of the outstanding contributions to Radio this season. At last there is available a complete range of 2-volt valves which function practical y without heat. Yet the elec ron emission is t rrif c—many hu dreds of times greater than the emi sion of the ordinary bright emitter. Because this kalenise filament never becomes hot it can never crysta lise. It always retains its pliability. Even after 2,000 hours use it is as supple as the day the valve wa made.

Remember, t o, that the process of kalenisation actually builds up layer upon layer until the cross section of the filament is exceptionally large. That fact—combined with its low specific resistance, which permits a considerable increase in length—shows why the new Cossor Dull Emitter has entirely recast popular ideas as to what a 2-volt valve can do.

No longer is it necessary to use 4-volt valves to obtain big volume—the new Cossor Point One will give better results—greater sensitivity—improved tone—and a l the volume your Loud Speaker can handle—with the miserly consumption of one-tenth of an ampere *and your accumulator will last twice as long as it would when using 4-volt valves,* with the consequent red ction in costs. Incidentally, too, a 2-volt accumulator costs only half the price of a 4-volt one. Finall , do not forget t e exclusive method of Co-axial Mounting which ensures a shock-proof filament support, and guarantees ab olute uniformity between all valves of the same class.

In three types

Red Band
For H.F. use
1·8 volts ·1 amp. **14/-**

Black Band
The Detector
1·8 volts ·1 amp. **14/-**

Stentor Two
Power Valve
1·8 volts ·15 amp. **18/6**

Cossor Point One

Issued by A. C. Cossor Ltd., Highbury Grove, N. 5.

Gilbert Ad. 6208.

Popular Wireless

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RADIO NOTES AND NEWS.

National Wireless Week—Peer's Brother as Announcer—De Groot Declines—The Third National Concert—500-Words-a-Minute Wireless—The Mars Mystery Message.

National Wireless Week.

NEXT week is the B.B.C.'s Birthday Week of special programmes that will start in right good style on Sunday. As all the programmes have been specially compiled, it will be an S.B. (simultaneous broadcast) week, but for once it will be difficult to grumble at this arrangement. A galaxy of favourite artistes has been secured, many of them world-famous, and it is very doubtful whether a better week's wireless has ever been served up in any part of the world.

"Let Your Friends Listen."

ALL the day-time programmes have been specially gingered up, too, so whenever you listen there will be something on that is worth while. Don't forget that it is National Wireless Week, and every listener is asked to let his non-wireless friends share his 'phones or loud speaker, just to show them what they're missing. "Permit your pals to participate" is good advice, for the programmes are always on the ether, and everyone should get his share.

Peer's Brother as Announcer.

"WHO is the nice announcer that reads even the most prosaic announcements as though they were poems?" asks a fair correspondent.

I think she must be referring to the Hon. David Tennant, who has just been appointed announcer at 2 L O. He is a nephew of Lady Oxford, and brother of Lord Glenconner.

Queen Marie's Microphone Engagement.

MILLIONS of American listeners were disappointed on October 24th, when the twenty-one wireless stations linked together to broadcast a speech by Queen Marie of Roumania announced that it was "off."

Apparently Queen Marie reached the studio half an hour too soon, and when informed that a little time must elapse before the arrangements could be completed she left to keep other engagements. This is one of the biggest radio disappointment ever known, for owing to Queen Marie's popularity many millions had arranged to listen in.

De Groot Declines.

THE B.B.C.'s contract with De Groot and the Piccadilly Orchestra is not to be renewed.

"I would have accepted any offer within reason," said Mr. de Groot recently, "but the B.B.C.'s offer was so inadequate that it would mean working for nothing, after all expenses were paid."

Whatever the cause, it seems a thousand pities that such an enjoyable feature of the programmes should be dropped.

M. Edouard Belin, the French Television expert, in his laboratory at Malmaison.

Exhibitions at 2 Z Y and Dublin.

THERE are only a few days left of Manchester's Wireless Exhibition that is now in full swing at the City Hall, Deansgate. The doors will close on Saturday, November 6th.

It has been suddenly announced from Dublin that a wireless exhibition will be held in that city this year, only a couple of weeks' notice being given that the show would take place "during the first week of November."

Making It Worse.

"MY set whistles, and groans, and howls, and chirps, and shrieks," writes a Scotch reader of "P.W.", "so I have been advised to get more H.T. What is likely to be the result?"

Hoots, mon!

B.B.C.'s Third National Concert.

THE third of the B.B.C.'s National Concerts will be held on Tuesday next (November 9th), with the famous composer, Dr. Richard Strauss, conducting. A first-class programme has been arranged, and there will probably be a big attendance at the Albert Hall to see the composer of "Der Rosenkavalier" conduct the huge National Orchestra.

Revolutionary Radio?

WRITING to the Editor of "The Times," a Reigate listener tells of picking up Communist propaganda recently, using a 4-valve set tuned to about 1,100 metres. After a talk in Russian there was a talk in English, and inquiry at the B.B.C. offices elicited the information that several listeners had heard the Communist speaker. Although it has often been predicted, this is, I believe, the first time that such a transmission has been picked up clearly in England.

Ex-Premier's Travel Talk.

THE Rt. Hon. J. Ramsay MacDonald, M.P., is due to give us a talk from the London studio on December 2nd. His subject will be "Forty Days and Forty Nights in the Sahara," and the ex-Prime Minister will recount the story of the holiday he is now enjoying in Northern Africa.

At present he is travelling by motor- and caterpillar-car in the desert, and he will not return to England until a few days before he faces the microphone.

London Wireless Lecture.

A MEETING of the Institute of Wireless Technology will take place at the Engineers' Club, Coventry Street, W., on Wednesday next (November 10th), at 7 p.m., when Mr. A. H. A. C. Cranmer will read a paper on "High Speed Automatic Transmission."

Britain's Radio Communications.

THE success of the Marconi Wireless Beam service to Canada, announced recently, gives Great Britain a

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

definite lead over all nations in the system of overseas communications. With Rugby for all-round communication, and the various beam services for direct communication between the Mother Country and the Dominions, the British is the most up-to-date and efficient system in the world to-day.

500-Words-a-Minute Wireless.

STRINGENT Post Office conditions laid it down that the stations must be capable of sending and receiving 500 letters per minute, in both directions. During the tests the speed of 500 whole *words* a minute was frequently attained, thus triumphantly vindicating Senatore Marconi's confidence in the new system.

Now that Canada is working, tests are to begin shortly with South Africa and Australia.

Can You Beat It?

A FRIEND of mine was staying at Eastbourne recently, where he heard a man grumbling about his 5-valve portable set.

"It's not half loud enough," he complained to a pal, who had a reputation as a wireless wizard.

"Well, you connect it all up ready for use next Sunday," said the wizard, "and we'll take it down to a shelter on the front. We can see the Grand Hotel from there, and Albert Sandler will be broadcasting that night, so we can test it out *on real loud signals!*"

"May Day."

"MAY-DAY" is the airman's "S.O.S." And it was a very thrilling "May-Day" message that Croydon aerodrome received recently, when a British aeroplane was forced to come down in the sea, near the French coast.

Within a few minutes of the message being broadcast, the plane was skilfully brought down to the water, the passengers clambering on to the tail and looking anxiously over the waves for assistance, whilst the machine started to sink slowly under them.

Fortunately, all were saved—a tribute to the skill of the pilot and a lesson on the value of the radio "May-Day."

Say it by 'Phone.

IT is reported from America that following the success of the Marconi Beam System of telegraphy, revolutionary developments in transatlantic *telephony* will take place shortly. Listeners will remember that many months ago ordinary telephone subscribers in this country were linked up by wireless with American subscribers, conversations being as clear as over the inland system. Now, we are told, the practical application is in sight.

Before the end of the year the giant Rugby stations may be handling a commercial telephone service, and any British subscriber will be able to "say it by telephone"—to New York!

Beam for Broadcasting.

"HALLO!" said a familiar voice to me over the telephone a few days ago—a voice that was once the most famous in Britain. It belonged to Mr. Burrows, now Director of Geneva's International Broadcasting Bureau, and formerly "Uncle Arthur" of the B.B.C. He was over in Britain for a few days on business, and was very interested in the possible application of the new "beam" wireless to broadcasting. Senatore Marconi himself thinks that eventually the wireless beam may link one broadcasting station to another, at long distances, so "Uncle Arthur" was already making allowances for this aid to the international interchange of programmes.

TECHNICAL TERMS ILLUSTRATED.

Resistance.

"I DON'T think I like your persistence,
Or your offer of two-fold subsistence,"
Said the saucy young miss.
But he gave her one kiss
Which overcame all her ~~~~

B.B.C.'s "Unfair Competition."

THE pessimistic statements of Mr. Wm. Boosey that the concert industry is being strangled by broadcasting, have not been taken very seriously. The B.B.C. made a statement on the subject in the course of which they said plainly: "The real trouble is that the concert industry has not tried to live side by side with broadcasting in this country, but has tried to stop broadcasting."

SHORT WAVES.

"Popular Wireless" is printed in black and white, but it is read with interest.

* * *

The latest DX record has been made by Mr. Spinks. His wife upset the frying pan over his set and he got grease. (Greece.) A Popular Weekly.

* * *

A loud speaker no bigger than a thimble has been suggested. We would suggest that these should be incorporated in umbrellas, books, collar-studs, etc.

* * *

A new degree. "Complete education courses are to be given by the B.B.C.," we read. Who, I wonder, will be the first B.B.A.?" ("Daily Herald.")

* * *

One of our readers writes to say that his wireless receiving set is not stable. Perhaps that is the reason why his loud speaker is a little "hoarse"!

* * *

We understand that radio scenes have been incorporated in a revue. We have, of course, also known this sort of thing to happen in many private houses.

* * *

B.B.C. Corporation. Fifteen people nominated for seven seats. (Headline in the "Manchester Evening Chronicle.")

This sounds to us more like the Underground Railway.

* * *

9.30. Topical Talk. S.B. from London.
Local News.
Cert. S.B. from London.
"Wireless Programme."

This last item will thoroughly annoy the bookmakers. ("Humorist.")

* * *

Extract from book: "He listened in with rapt interest."

Why didn't he use headphones?

* * *

Wireless Puff-Puff. "When you sneeze in front of the microphone you create enough power to drive a train," said Mr. J. H. Whitehouse, of the B.B.C. at Chelmsford. ("The Evening News.")

If the coal strike continues much longer, would this not be a very useful idea?

Perhaps "There's something in that"—as the experimenter said, when he touched two of the terminals of his H.T. Battery Eliminator (220 volts!).

New British Coast Station.

A NEW P.O. wireless station is to be erected at Mablethorpe, Lincolnshire. It will be used for messages to Northern Europe, and will also be available for the ordinary duties of land-station communication with ships at sea.

The Broadcasting Commission.

ACCORDING to the latest information, the new Commission to control broadcasting after December 31st, under the Chairmanship of Lord Clarendon, will be as follows: Lord Gainford, Mrs. Philip Snowden, Sir J. Gordon Nairn (late Comptroller of the Bank of England), and Mr. Montague Rendall, who two years ago was the Headmaster of Winchester.

The Wireless University.

JUST because the B.B.C. has announced the names of a committee to inquire into the idea of a wireless university, the talk-hating section of listeners has "got the wind up." There is no need, for on no account will the programmes be curtailed for the uplift stuff.

Sir Henry Hadow (Vice-Chancellor of Sheffield University) is to be Chairman, the other members being Mr. J. C. W. Reith and Mr. J. C. Stobart (B.B.C.), Hon. Oliver Stanley, D.S.O., M.P., Mr. W. Graham, M.P., Miss Grace Hadow, Prof. Peers, Mr. E. Salter-Davies, and Capt. L. F. Ellis, D.S.O., M.C.

Visual Wireless Compass.

A WONDERFUL new wireless direction-finder has just been demonstrated by Mr. R. A. Watson Watt, the inventor. It enables shore stations to *show* ships or aircraft their actual compass bearings. Attached to the receiver is a phosphorescent dial, from which the position can be seen at a glance.

Mars Mystery Message.

WHO sent the mysterious M's that were picked up on the P.W. 14-valve set, when listening-in for Mars?

As luck would have it, I was not in the room at the moment they were received, but was engaged at the 'phone checking up the Rugby transmission with half a dozen reporters; but unknown to the P.W. staff several expert telegraphists were amongst the company that actually heard the M's, and there is no doubt whatever of their mysterious nature.

The Unaccountable Hush.

THE coming of the two Morse letters, without any accompanying call-sign or means of identification, was in itself an extraordinary fact. But quite as inexplicable was the uncanny hush that preceded the call. The loud working of the various commercial stations suddenly faded and died down, and it was on a queerly quietened background that the "M M" came through.

The whole effect of the signals was very weird and mystifying, and it certainly created a sensation for the critical crowd of listeners that filled the room.

ARIEL.

The "UNIVERSAL" RECEIVER

A Description of a Four-valve Receiver which has become exceedingly popular in the United States.

By LAWRENCE W. CORBETT.

(Our Correspondent in New York.)

IN these days of the multi-valve receiver it is rare to hear of a receiver employing less than two stages of H.F. amplification becoming popular in the United States. In England, on the other hand, where the crystal receiver is still very much in evidence, there is very little demand for a receiver which makes use of more than a single stage of H.F. amplification. It must be remembered that the higher scale of wages which are prevalent in the United States enable the working-class radio "fan" to indulge in his favourite hobby much more liberally than do the wages of the Britisher. Crystal receivers are practically unknown in the United States.

Several Novel Features.

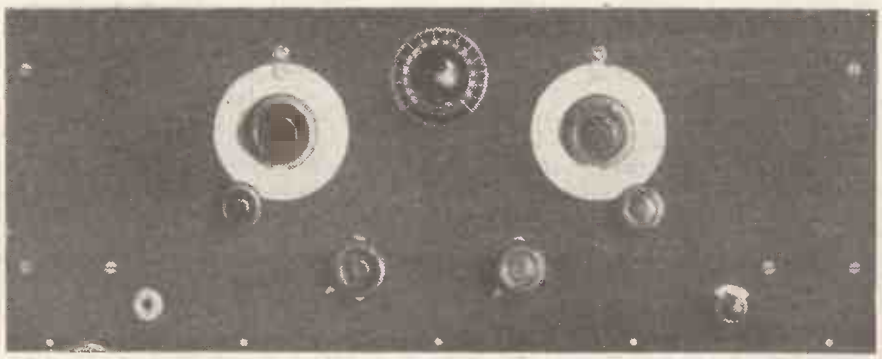
There is an exception to every rule, as is amply proved by the fact that the "Universal"—a receiver employing but a single stage of H.F. amplification—has met with the general approval of wireless "fans" in America. The "Universal" is a four-valve receiver with several novel features incorporated, and, providing ordinary care is taken, it may be built by the average "fan" without fear of the usual snags, characteristic of trick circuits, cropping up.

First described in "Radio Broadcast" some months ago, the circuit has met with such unqualified approval that many other papers in the States have reprinted the article for the benefit of their readers.

It has been said that it is impossible to include quality and sensitivity in one receiver, but this statement is often misconstrued. While a sensitive receiver will bring in local stations with perfect purity of tone, the quality of the distant stations will appear to be not so perfect. This shortcoming is due to the fact that so many extraneous noises are received while a receiver is set at its most sensitive point for distant reception, and these noises naturally do not enhance the quality. What should be said is that the quality of distant stations will not appear to be so good as the local ones, no matter how perfect is the set.

Good for DX Work.

The "Universal" combines sensitivity and quality. It will give well-nigh perfect quality on the locals (providing the audio-amplifier is built with meticulous care and with good transformers, chokes, or resistances) and is a good circuit for reaching out.



The panel lay-out while being neat, is almost severely symmetrical, but all the controls are very accessible.

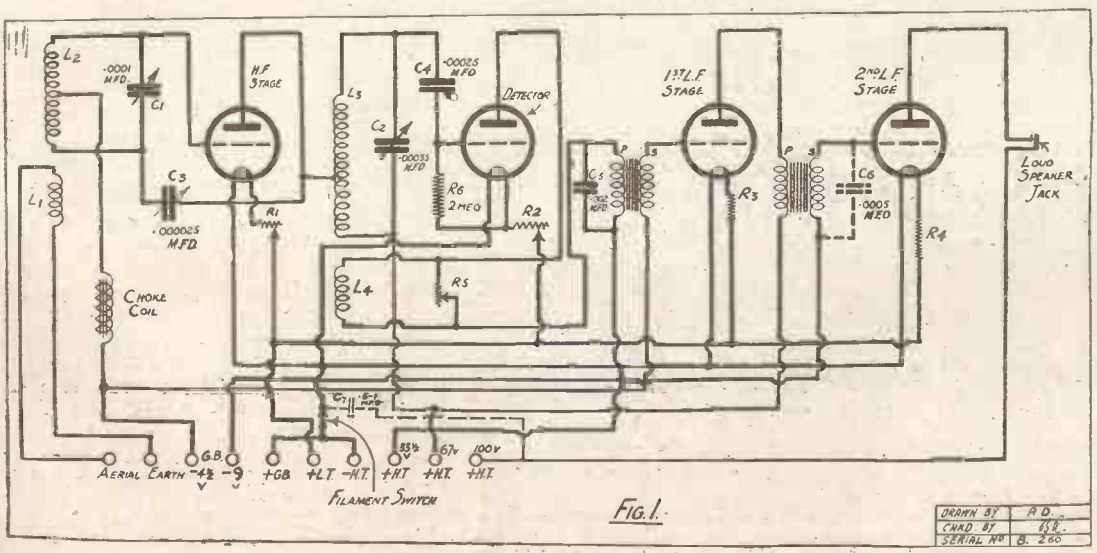


FIG. 1.

DRAWN BY	A.D.
CHKD BY	
SERIAL No	B. 260

Referring to the circuit diagram given herewith, it will be seen that the circuit consists of an H.F. amplifier auto-coupled to a regenerative detector, and the standard L.F. amplifier. The set will not radiate and cause interference for the H.F. valve is neutralised, the Rice system of neutralisation being incorporated.

In America, most H.F. amplifiers are transformer coupled, the tuned anode system being rarely, if ever, used. Transformers are used because of the voltage stepup obtained between stages. The "Universal" is, perhaps, the nearest

(Continued on next page.)

THE "UNIVERSAL" RECEIVER.

(Continued from previous page.)

approach to the British tuned anode system. A step-up effect is obtained as in the standard transformer system, and therefore this system should be more efficient than the tuned anode method of coupling, whereby no step-up is obtainable.

Referring again to the diagram, we note that the aerial tuning system consists of the usual primary and secondary circuits, the former being untuned. The single circuit aerial tuning receiver is practically obsolete in America, although the Ultra Audion is, unfortunately, still used a little. In the diagram, L1 represents the primary, while L2 is the secondary, the latter being tuned by C1, a variable condenser of approximately ·0005 mfd. C3, the neutralising condenser, is a neutrodyne condenser and has a capacity of about ·000025 mfd.

As we look to the right in the diagram, we come to L3 and L4. The first is the coupling coil, which has a tapping, and the second, L4, is the reaction or "tickler" coil. This latter is coupled to the coupling coil in a fixed position, and regeneration is controlled by the variable resistance, R5, across it. This resistance has a range of approximately from 500 to 50,000 ohms, and permits of very accurate adjustment.

Coil Winding Details.

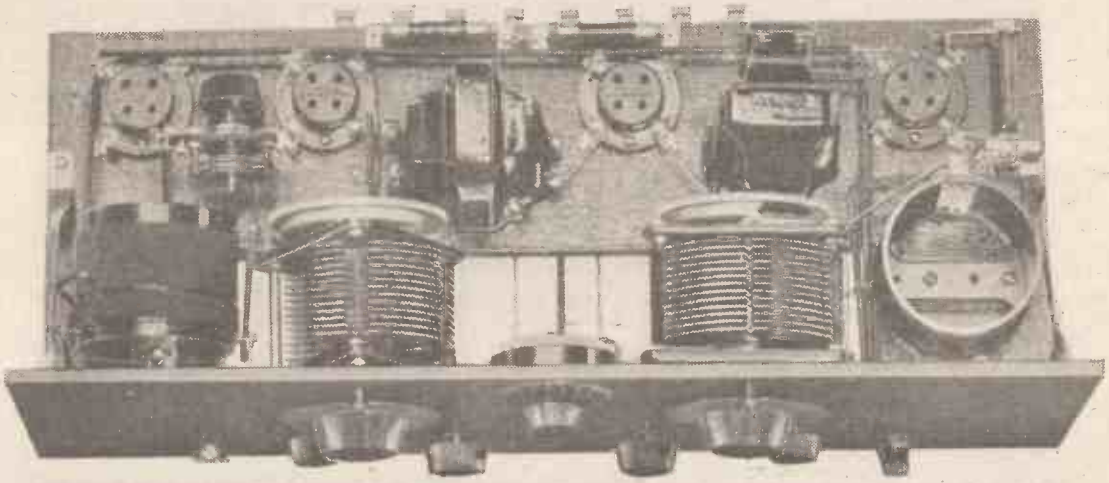
Both sets of coils are wound on cardboard or ebonite tubes of 2¾ in. diameter. In the first unit the secondary has 59 turns of No. 24 D.S.C. wire (this is the winding across which the variable condenser is connected). A centre tap in this coil connects to a choke coil and the other end of this latter connects to the — 4½ volt terminal of a grid battery. The centre of this coil is now covered with some material such as Empire cloth, and on top of this secondary are wound fifteen turns of the same wire, as specified above. These fifteen turns constitute the untuned primary which is connected to the aerial and earth terminals of the set. We have now completed L1, L2.

We next turn to the coil unit comprising L3 and L4. The coupling coil, L3, has the same number of turns as the secondary in the aerial circuit, namely, 59. The tap which connects to the plate of the preceding valve and to one side of the neutralising condenser, C3, is made 39 turns from the grid end of this coupling coil.

The filament end is covered with a small width of Empire cloth, and fifteen turns of the same wire are wound on top of it. These fifteen turns constitute the reaction coil, or "tickler," as it is termed in America.

R1, R2, R3, and R4 are filament rheostats, their value depending, of course, upon the tubes employed. Preferably a power valve should be employed in the last stage, otherwise if the L.F. amplifier is a good one, overloading is sure to occur. The 9-volt value of grid battery will not be necessary if an ordinary tube is employed in this last stage, but some grid bias is recommended to cut down the H.T. battery consumption. If only 4½ volts are used for grid bias, connect the terminal marked G.B. — 9 to that marked G.B. — 4½. Also in the diagram are shown three distinct terminals for H.T. These are approximately 33⅓ volts, 67 volts, and 100 volts. The values are definitely only approximate, and the tube manufacturers' values should be adhered to.

If a power valve is not used in the last stage, the third terminal may be omitted, the connection to the loud speaker going to the 67-volt terminal instead, which is also connected to one side of the transformer primary connected in the plate circuit of the detector valve.



When studying this photograph readers should remember that American components were used in the construction of the receiver.

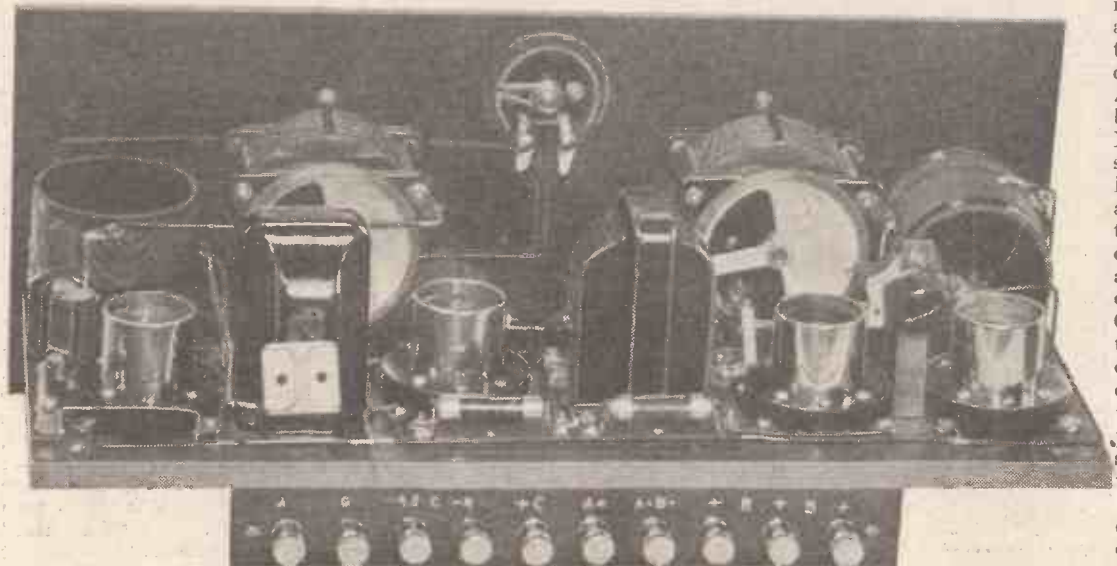
The Wiring Connections.

All the other lettered parts are given their values on the schematic diagram, such parts as the grid leak being apt to vary in value slightly depending upon the type of tube employed.

There are so many wireless enthusiasts these days who wish to build their receivers at home that it would not be out of place here to detail point-to-point connections for the "Universal," for the benefit of those readers who may not be able to follow clearly the technical diagram. The connections are as follows: Aerial terminal of set to beginning of primary coil, L1. Earth terminal of set to end of primary coil, L1. Beginning of secondary aerial coil, L2, to grid terminal of valve socket of first (H.F.) valve, and also to stationary plates of the variable condenser, C1. Mid tap of coil L2 to choke, and other end of choke to grid bias terminal of set — 4½ volts, and also, with as short a lead as possible, to one side of secondary of first L.F. transformer.

The bottom connection of the secondary coil, L2, connects to the other terminal of the variable

(Continued on next page.)



The lettering may confuse those readers unacquainted with American practice, so it should be noted that G is the earth terminal, and that A = L.T., B = H.T., and C = grid bias.

THE "UNIVERSAL" RECEIVER.

(Continued from previous page.)

condenser C1, and also to one terminal of the neutralising condenser, C3. The other side of the neutralising condenser goes to the plate terminal of the first (H.F.) valve, and also to the tap on the coupling coil, L3. The top of the coupling coil now connects to one side of the fixed grid condenser of about ·00025 mfd. marked C4, and also to stator plates of the variable condenser C2. The other side of C2 finds its way to the remaining connection of L3, to the H.T. + 67 terminal, and to one side of the primary of the second L.F. transformer.

The side of the fixed grid condenser which yet remains unconnected is connected to one end of the grid leak (which may be of the variable type) and to the grid of the second valve (the detector). The plate of this valve goes to one side of the 15-turn coil L4, and to the variable resistance R5, which controls regeneration. The remaining lead of L4 goes to the other connection of the variable resistance and to one of the primary connections of the first L.F. transformer, and to one connection of C5, a ·002 mfd. fixed condenser.

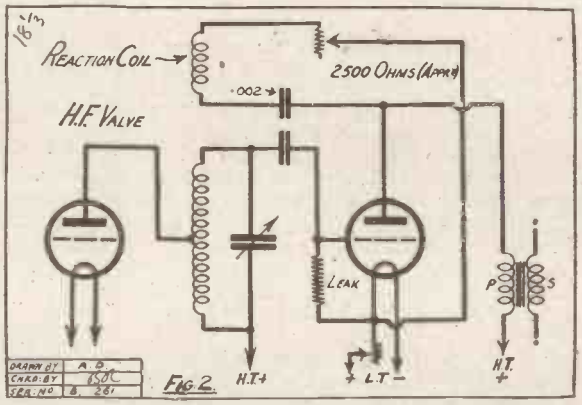


FIG. 2.

The Filament Wiring.

The remaining terminal of C5 is led to the remaining terminal of the primary of this first transformer, and thence to an H.T. terminal on the set for 33½ volts.

We still have one connection to make to the secondary of the first transformer, and another to the primary of the second transformer. These are connected to the grid and plate respectively of the third (first L.F.) valve. The grid of the last valve is now connected to one end of the secondary winding of the last transformer, the other end of this secondary winding going either to the grid bias terminal − 4½ (which also connects to the secondary of the first transformer) or to a second negative grid bias terminal if the tube requires a higher grid potential than the first, which will be the case if a power tube is used.

A fixed condenser, C6, of approximately ·0005 mfd., may be found useful across the secondary terminals of this second transformer. The plate of the last valve connects to one of the output (telephone) terminals, the other output terminal going to the H.T. +100 volt terminal if one is used, or to the already mentioned 90-volt positive H.T. terminal. A fixed condenser, shown dotted (C7), will often be found advantageous connected across the whole H.T. battery supply.

We next consider the filament wiring. Connect one filament terminal of each valve socket to a wire which, via a switch (if one is used), connects to the terminal of the set to which the L.T. minus, H.T. minus, and G.B. plus all connect. We now lead the remaining filament terminals on the valve sockets to one side of their respective rheostats, the other terminals on the rheostats combining and connecting to the accumulator terminal plus on the set. Connect the remaining grid-leak connection to L.T. plus, and we have finished.

Neutralising The Set.

If at first the set does not go as well as it should, the first steps we take are to try reversing the leads to the reaction coil, L4, afterwards doing the same with the L.F. transformer primary leads. These are rather obvious steps, one would think, but it is surprising how many people will consider them too obvious to try.

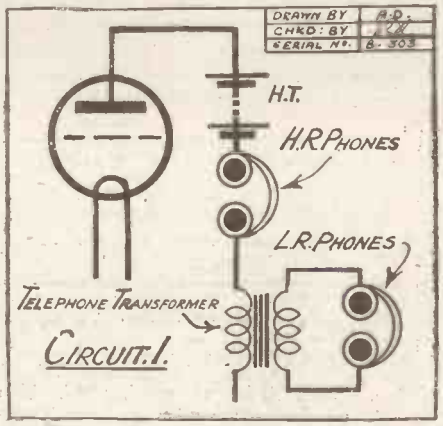
When the receiver is completed and apparently operating correctly, we set about the neutralisation process. Tune-in a station on about 300 metres whose signals are not too loud, with the detector oscillating. The condenser C2 should be tuned until the whistle is quite loud. Now the condenser C1 should be tuned, and it will be noticed that the whistle will vary in pitch as this condenser is turned. Adjust the neutralising condenser C3 until it is in such a position that when C1 is turned the whistle will vary in intensity only, not pitch. When this state is reached, the set can be said to be neutralised. Don't imagine that because the set is neutralised it will not squeal. It certainly will, but these squeals do not reach the antenna circuit with any degree of strength because the H.F. valve is neutralised and the detector valve is causing the squeals.

An alternative method of reaction control which has been found very successful in the "Universal," is shown in Fig. 2. Some may find that smoother control, with less critical adjustment, will result with this wiring.

HIGH AND LOW RESISTANCE 'PHONES.

FROM A CORRESPONDENT.

THERE is many a pair of low-resistance headphones of the 120 ohm. type hanging idly in the workrooms and dens of wireless amateurs on account of the prevailing belief that it is impracticable to employ them in conjunction with the more popular high-resistance type of 'phones.



CIRCUIT 1.

This is quite a mistaken idea, however, as the following circuits will show.

Circuit 1 indicates a method of employing a low-resistance headphone and a high-resistance one together. Of course, as will be noticed, a step-down telephone transformer is needed in the circuit, but such instruments are not difficult to procure, especially from dealers in surplus radio goods.

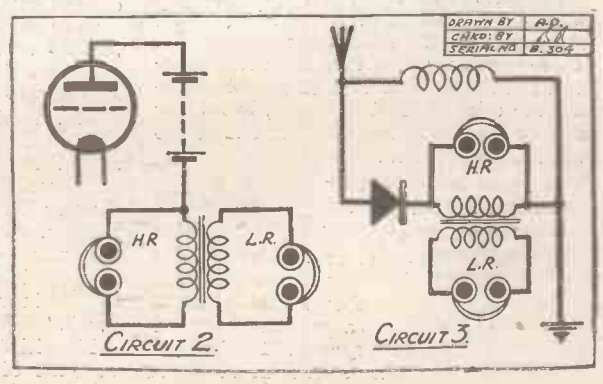
Circuit 1 is especially suitable for use in a valve set employing high impedance valves, whilst the alternative Circuit 2 is more especially of use for dealing with signals which are weak in intensity.

In a Crystal Circuit.

Circuit 3, which is really the same as Circuit 2, shows the method of utilising the high and low resistance 'phones in any ordinary crystal circuit.

After all, many of the low-resistance 'phones which are seen in a discarded condition nowadays are very efficient articles, and therefore there is no reason why they should not be given a new life of useful activity. The above methods show the means of bringing this about.

The use of low-resistance telephones is even advisable when extension leads are run and the transformer completely isolates them from the H.T. current.



CIRCUIT 2. CIRCUIT 3.

BROADCAST NOTES

BY OUR BROADCASTING CORRESPONDENTS.

The New Board—"Hassan"—The Concert Industry's S.O.S.—Uncertainty at Savoy Hill—A Suggested Labour Board.

The Corporation Stakes.

THESE have now been run and won. The announcement of the names by the P.M.G. has not been received with an excess of enthusiasm throughout the country. Those who take an intelligent interest in the future of broadcasting are almost unanimously of the opinion that the present Board of the B.B.C. is both more capable and representative than the new Board.

Lord Gainford, Sir William Noble, Sir William Bull, Mr. McKinstry, Major Basil Binyon, Mr. John Gray, Mr. Kellaway, Mr. H. M. Pease, Mr. Reith, and Mr. Burnham are regarded by the average listener as a much better "line-up" than Lord Clarendon, Mrs. Snowden, Mr. Rendall, Sir Gordon Nairne, and Lord Gainford.

The chief cause of alarm and despondency is the disappearance from the Board of Mr. Reith. It is contended in official circles, however, that as Director-General his power will be undiminished. This remains to be seen. Meanwhile, there is no doubt whatever from the changes in the Board that the "Man in-the-Street" is to have much more generous doses of education and uplift than at present. The only permanent curative will be a prompt slump in licences.

Wireless League Campaign.

The Wireless League, as the chief organisation of listeners, is appropriately tackling the question of broadcasting finance. A big campaign has been started throughout the country, and some newspapers are assisting. This move is analagous to that of the A.A. against the raid on the Road Fund.

The result of the Wireless League effort should be to stir up a considerable volume of discontent and alarm among private members of the House of Commons. There is a growing feeling of apprehension among listeners in the rural constituencies. There was already doubt about the change in control. Now suspicion about future financial restriction has changed the doubt to alarm.

A Radio "Hassan."

Listeners will recall with delight the B.B.C. performance at London last winter of "Hassan" with most of the original cast. There is to be a radio revival on November 21st; but this time it is proposed to use not the original theatre players, but a new cast of artistes more accustomed to studio work and conditions.

Permanent Concert Party.

The B.B.C. are considering the formation of a permanent concert party. The problem is regarded as entirely one of finance. Most outside critics of broadcast entertainment are of the opinion that a permanent concert party would not be a success. Particularly on the light side, it is of the utmost importance to "ring the changes" over the ether at least every six months however meritorious any performance may be.

The Concert Industry's S.O.S.

Readers of this page would have been prepared for the call for help that has gone up from the concert industry. But a carefully planned stunt to stampede public opinion completely failed.

The concert industry imagined that the threat of the transformation of the Queen's Hall into a cinema would so arouse popular consternation that the Government would be forced to exact a special levy on broadcasting funds without giving to the B.B.C. any compensating advantages whatever. This campaign has an eye to the £900,000 of licence money lying idle at the Post Office. But it is not coming off. The B.B.C. wisely held their hand until the concert people had shot their bolt.

Then Savoy Hill told the press that both in 1924 and in 1925 they had offered to guarantee the concert industry for a reasonable arrangement. In the latter year the B.B.C. went so far as to suggest to Mr. William Boosey, of Chappell's, that they should co-operate in the formation of a permanent trust for the maintenance of the Queen's Hall as the musical centre of London. The answer to each overture was the same—"there is no possibility of compromise between broadcasting and the concert industry; we must fight you to the death."

Notwithstanding the considerable provocation of such an attitude the B.B.C. refrained from declaring war. But when the concert industry definitely tried to prevent any artistes of distinction from broadcasting, the B.B.C. had to move, out of regard to its duty to listeners.

The series of National Concerts at the Albert Hall was a tremendous retort. They have still the alternative of negotiation and co-operation. But the maintenance of the attitude of hostility will be followed by the centralising in the hands of the B.B.C. of all the music interests of London.

This would be a good thing for music itself. Therefore it is profoundly to be hoped that the concert industry recognises its impotence in time to save something from the wreckage.

Mabel Constanduros at Christmas.

Many listeners, particularly the boys and girls, will be glad to hear that Miss Mabel Constanduros is to give this year a repeat performance of the Christmas party, which was so richly enjoyed last year.

"Pericles" for Armistice Day.

According to present plans at Savoy Hill, Professor Gilbert Murray will declaim the funeral oration of Pericles as part of the "In Memoriam" programme on Armistice Day. A suitable talk will be broadcast to schools at 11.15 on the morning of Armistice Day.

Uncertainty at Savoy Hill.

Visitors to Savoy Hill are being impressed by a decline of *morale*. There is a feeling of apprehension, jumpiness, and gloom in place of the old familiar buoyancy, enthusiasm, and optimism. The chief reason for this change is the prospect of financial starvation, and all that this will mean in the decline of programmes.

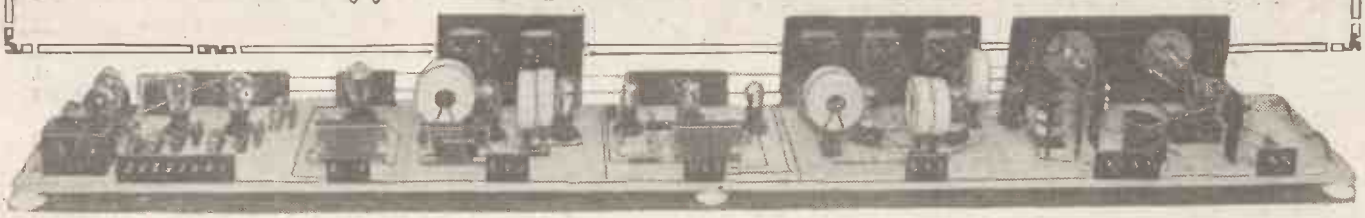
The second reason is uncertainty about the attitude of the new Board. The third reason is the consciousness that when the new system of distribution is introduced, the jobs of about two-thirds of the present staff will automatically vanish.

The position of ex-employees of the B.B.C. is peculiarly unfortunate. If they are on the dramatic or artistic side, they have no chance of employment on the stage or in the concert industry, because of the relentless hostility of the old rivals of broadcasting. If they are on the other sides of the work there are simply no jobs for them. It is to be hoped, therefore, that the Treasury will not be mean in its scale of compensation to the large band of broadcasters about to be turned loose on a cold and unsympathetic world.

A Labour Board of Broadcasting.

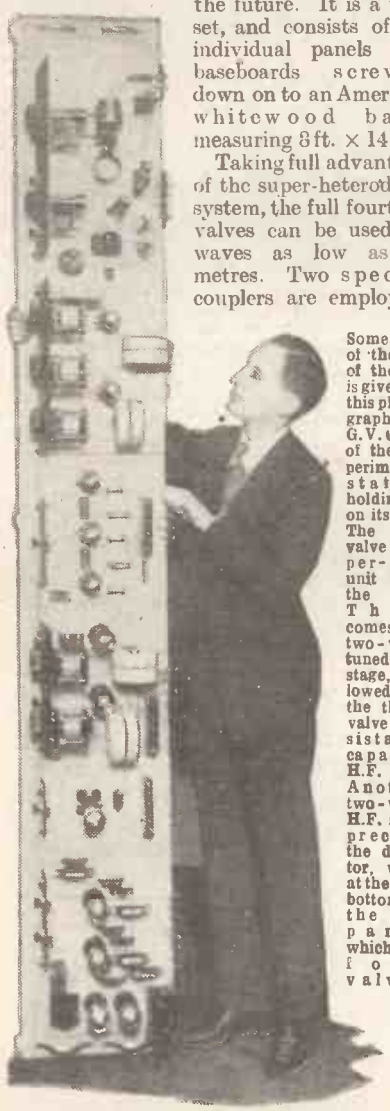
Further particulars are now available of the probable constitution of a Labour Board for Broadcasting in the event of a Labour Government succeeding to office before the end of the tenure of the first Board of the British Broadcasting Corporation. Mr. George Lansbury is to succeed Lord Clarendon, Mr. William Graham will replace Sir Gordon Nairne, Miss Helen Wilkinson will follow Mrs. Snowden, Mr. Hamilton Fyfe will replace Mr. Rendall, Mr. Frank Hodges will substitute Lord Gainford. There would appear to be little doubt that broadcasting, in the future, will be the prey of political fortune and misfortune. A Board such as this offers an excellent chance of rewarding hard political workers.

The "P.W." Fourteen Valver



OUR fourteen-valve set was not designed and built solely for the Martian experiment, and it will figure in some other very important experiments in the future. It is a unit set, and consists of six individual panels and baseboards screwed down on to an American whitewood base, measuring 8ft. × 14 in.

Taking full advantage of the super-heterodyne system, the full fourteen valves can be used on waves as low as 30 metres. Two special couplers are employed,



Some idea of the size of the set is given by this photograph. Mr. G. V. Colle, of the experimental staff, is holding it on its end. The two-valve super-het. unit is at the top. Then comes a two-valve tuned H.F. stage, followed by the three-valve resistance-capacity H.F. unit. Another two-valve H.F. stage precedes the detector, while at the very bottom is the L.F. panel which uses four valves.

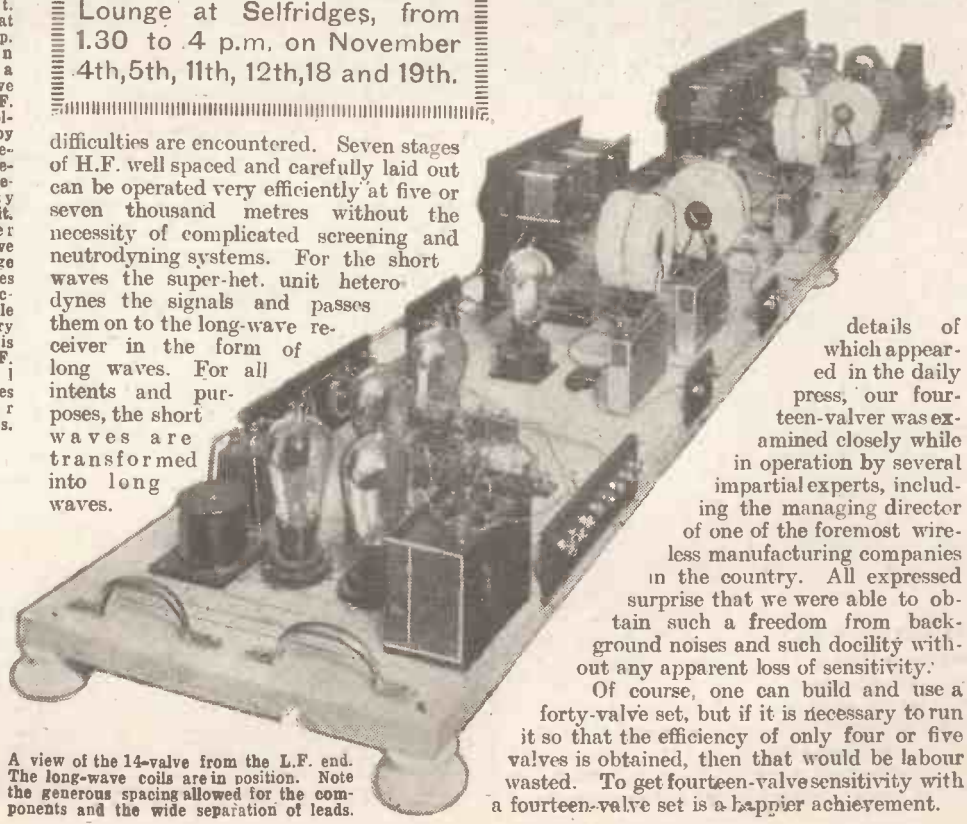
one for short waves and the other for the "broadcast band" (300 to 600 metres). Thus the whole set operates efficiently on the low waves with the super-het. unit in circuit, and, with this removed, the receiver is a long-wave twelve-valver, capable of handling wave-lengths between the hundreds and the tens of thousands.

We realised that there was only the one way to cover such an expansive range without carrying any passenger valves. Every one of the fourteen valves does useful work in our "multi-multi"-valver. As readers of "P.W." know, it is not a difficult matter to amplify long waves at H.F., but a very difficult problem to do this with short waves. In the latter case, all sorts of difficulties are encountered. Seven stages of H.F. well spaced and carefully laid out can be operated very efficiently at five or seven thousand metres without the necessity of complicated screening and neutrodyning systems. For the short waves the super-het. unit heterodynes the signals and passes them on to the long-wave receiver in the form of long waves. For all intents and purposes, the short waves are transformed into long waves.

SEE THE "P.W." 14-VALVER AT SELFRIDGES

The "Popular Wireless" 14-Valve Set, illustrated on this page, is now on view at Selfridges, Oxford Street, and may be seen by visitors.

Mr. P. R. Bird, Chief of the Queries Dept., will answer technical queries put to him by visitors carrying copies of "P.W." Mr. Bird will attend in the Wireless Demonstration Lounge at Selfridges, from 1.30 to 4 p.m. on November 4th, 5th, 11th, 12th, 18 and 19th.



A view of the 14-valve from the L.F. end. The long-wave coils are in position. Note the generous spacing allowed for the components and the wide separation of leads.

The detector stage is arranged to act as a limiter, so that there is no fear that powerful signals will fuse L.F. grids and leads! We can use the receiver on either a frame aerial or an ordinary antenna. Four of the H.F. stages can be tuned, so that very accurate balancing is possible. Four 60-volt and two 40-volt Oldham H.T. accumulators and two 6-volt and one 4-volt Oldham L.T. accumulators are used. The Osram valves were specially selected stage by stage in consultation with an Osram engineer. The special coils were wound for us by Mr. John T. Nichols, of Dalston, maker of the DX coils.

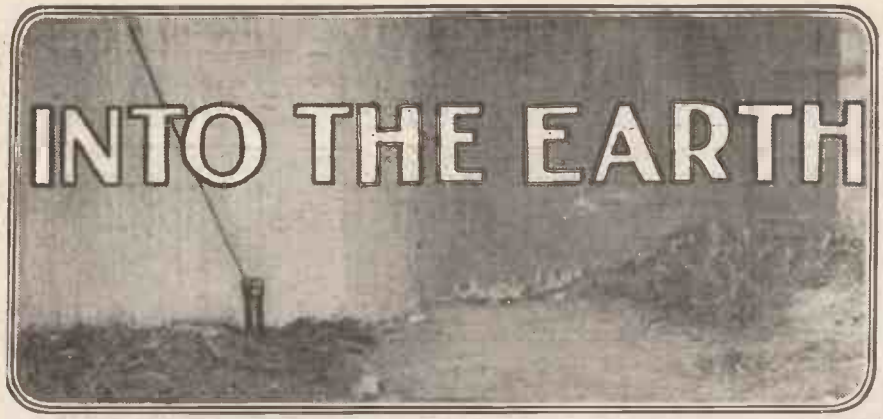
Easy to Handle.

Great care was taken in the assembly and wiring, and this part of the work and much of the calibration and preliminary testing was carried out with great success under the direction of Mr. G. V. Colle of our experimental staff.

Despite the extraordinary sensitivity of this set, it is, comparatively speaking, quite easy to handle and is as stable and "quiet" as a straight two or three valve of efficient design.

During the recent press demonstration, details of which appeared in the daily press, our fourteen-valver was examined closely while in operation by several impartial experts, including the managing director of one of the foremost wireless manufacturing companies in the country. All expressed surprise that we were able to obtain such a freedom from background noises and such docility without any apparent loss of sensitivity.

Of course, one can build and use a forty-valve set, but if it is necessary to run it so that the efficiency of only four or five valves is obtained, then that would be labour wasted. To get fourteen-valve sensitivity with a fourteen-valve set is a happier achievement.



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

WHETHER one resides in the town or country, it will be found that in many back gardens there are aerials erected which defy description. They appear a mixture of wires, stays, and masts set at all angles, nearly always at the mercy of the weather and disregarding all the accepted canons and laws which must be followed if the reception of wireless signals is to be at all efficient. Now, if the visible portions of the aerial system are bad, we may rest assured that the part not visible to the outside observer—i.e. the earth lead and earth itself, can be classed in the same category.

Now, while it is possible to receive signals on a poor aerial, the selectivity, for one thing, will be at a premium, and the broad tuning so often found is, in a large number of cases, traceable to the imperfect aerial system. To deal with all the salient features of an aerial system in one article in a thorough manner would make the article unduly long, so I have singled out on this occasion one particular portion —i.e. the earth lead, for a short discussion.

Let us, first of all, turn our attention to the wire itself. It is a subject of much controversy as to the type of wire to employ, whether a single strand or multi-stranded, insulated or uninsulated, and so on. So we will dwell for a moment on this point and review the facts which must be borne in mind. Should it not be more or less a natural sequence to make the cross section of the earth wire the same as the aerial wire and down lead? For example, if a single 18 is used, make the earth lead a single 18, or if a twin aerial of 7/22's is employed, the earth lead should be a pair of 7/22's.

Stranded Wire.

There are many people who advocate the use of thick wire for the aerial, down lead, and earth lead, especially the last-named. They bear in mind the fact that it has a low resistance, but this low resistance is only to the passage of what we call direct current, such as we draw from our batteries or accumulators. In the aerial and its associated leads there exists, during signal reception, a pulsating or alternating current which surges first in one direction and then in another at an enormous frequency, this frequency, of course, depending upon the wave-length of the received station (e.g. if the station transmits on 300 metres, the frequency will be one million).

If such is the case the current has not got time to sink right into the wire, but takes the easier path provided by the surface, and only penetrates a very minute amount into the conductor itself. Consequently, if we provide plenty of surface the resistance to the flow of this high-frequency current is considerably reduced. That is why it is preferable to employ multi-stranded wire, since the individual wires, consisting of nearly all surface, will then be in parallel, and hence reduce the resistance.

The Earth Lead.

For the maximum efficiency—and, after all, is that not our aim—each strand should be separately insulated from its neighbours, say, with a fine coating of enamel, and added to that it is preferable to separately join each one of these strands where the junctions are to be made to the set and earth plate. This is not a pandering to fancy, for, on actual measurements, the resistance under such circumstances is found to be less than when the strands are just soldered in one solid joint. Of course, if the conductor consists of many strands of fine wire the task becomes somewhat tedious, and a compromise may be effected.

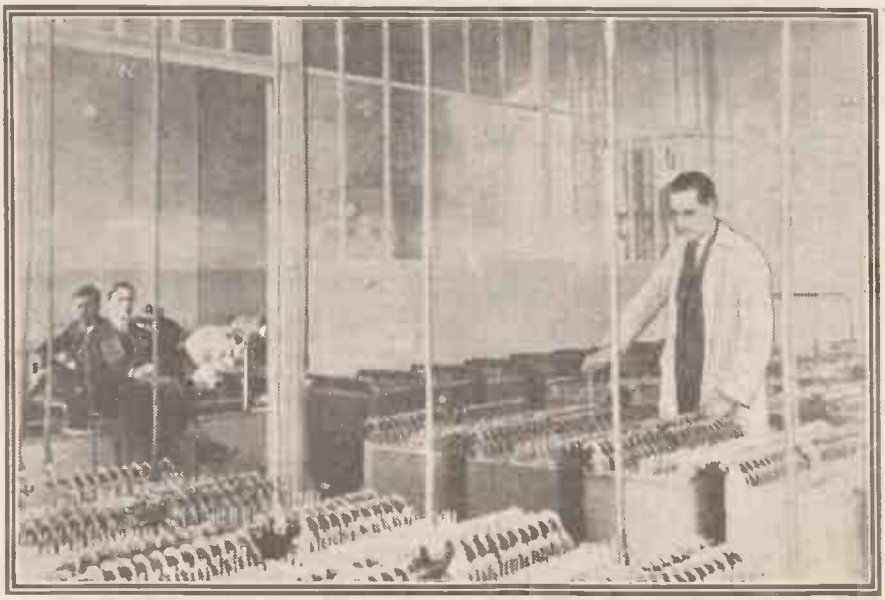
No doubt most of my readers realise that the earth merely acts as one plate of the condenser formed between the elevated aerial wires and the earth; consequently, without going into any theories of voltage distribution, it should be appreciated that if we have a long earth lead there will be a comparatively large drop of voltage along its length. This means that the "earth point" on our receiver is not at "earth potential," but at some value above it, and hence that is why we see the oft-repeated statement, "Make the earth lead *short and straight.*"

Loss of Energy.

With a long earth lead in use the reception of wireless signals is possible on this lead alone, the aerial itself being disconnected, the tuning, of course, differing from the normal dial settings. Now while this may be useful in an emergency such as a destroyed or temporarily incapacitated aerial, it is not an efficient arrangement, and the combination of the aerial and long earth lead will not give such strong and selective signals as is the case with the short earth lead. If it becomes necessary to choose between a short earth lead and a "fair" earth and a long lead and a good earth, the best solution will be found by experiment, and it is most probable that the former method will be preferable.

The question also arises as to whether the earth lead should be insulated throughout its length. We frequently find that this lead is nailed to the wall or brickwork, or otherwise left to its own devices, while extreme care is taken to insulate the aerial wires and down lead. The function of the earth lead is to provide a connection between the receiver and the earth proper, consequently if uninsulated or bare wire is employed, partial or inefficient earths are made along its length. The tuning of the set is not as sharp, while certain losses are introduced owing to the close proximity of brickwork, cement, metal pipes, etc. This loss of energy is to be deprecated, for it means that the resultant energy passed to the receiver is reduced. If the situation chosen for the earth lead is such that a length greater than about 8 to 10 ft. is required, then it must be properly supported on reel or similar insulators, and kept away from "foreign" material.

If the one or two points emphasised in this article are put into practice, an improvement in reception will be found to take place, and attention can then be turned to the aerial and earth.



Part of the laboratory belonging to Edouard Belin, the famous French scientist, who is working on the various problems of television.

Vernier Control

Vernier Control is essential to fine tuning and the following ideas will prove of considerable interest to wireless Constructors.

By O. J. RANKIN.

MUCH has been written on the subject of selectivity; how it is possible to cut out the local station and tune in a distant one by using a frame aerial, a wave-trap, or other device, and in a good many instances such devices have been more or less successful. There are cases, however, where such methods constitute a waste of time and money; where the problem is best solved by the application of a little patience and the use of a slow-motion attachment for the tuning condenser. This is the age of "knife-edge" tuning, of micrometer dial adjustments which separate stations of close wavelength, and those who cannot afford to purchase the ready-made slow-motion dial may be interested in the following hints on making an efficient substitute.

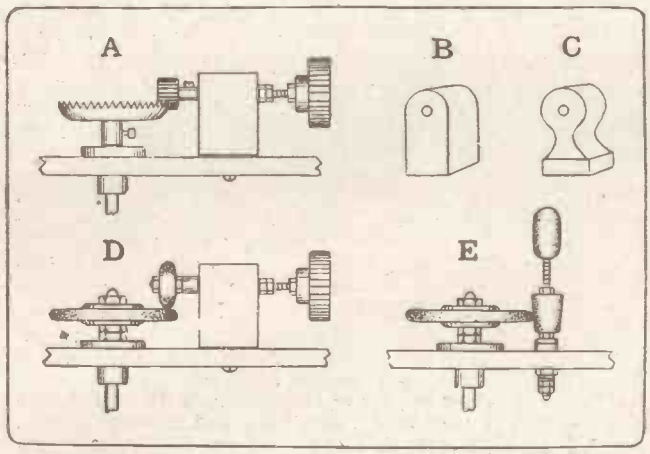


Fig. 1. Some simple methods of obtaining Vernier control.

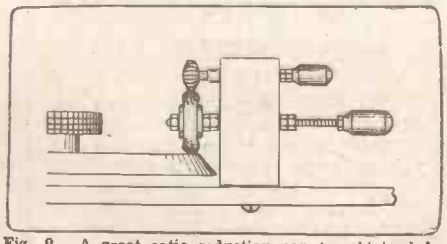


Fig. 2. A great ratio reduction can be obtained by the above.

The arrangement shown at A in Fig. 1 consists of a Meccano crown gear and pinion, a short spindle with knob, and a block of fibre or hardwood which forms the support for the spindle and pinion. The crown gear is attached to the top of the condenser spindle, which is reduced in diameter if necessary, the block then being fitted in position and screwed firmly to the panel. The block may be shaped as indicated at B or C, and the ratio of the gearing should not be less than 8 to 1.

With this it is possible to obtain fairly fine adjustments. The one great drawback, however, is the backlash or "play" between the teeth of the gears, and better results may be obtained by using a well-adjusted friction gear as shown at D, where a large typewriter eraser and a small rubber disc replace the crown gear and pinion in the previous example. Here one obtains a smooth and more definite movement, providing the condenser spindle turns freely. This, of course, is most important, for if the friction offered by the spindle is greater than or equal to the frictional power of the gear combination, the device will not function satisfactorily. The condenser spindle must turn easily, and for this reason a condenser fitted with such a device could only be mounted in a vertical position—i.e. on a horizontal panel.

The arrangement shown at E constitutes a general improvement. Here we have the same typewriter eraser, clamped between two nuts to the top of the condenser spindle, but the driving pinion is in the form of a round, tapered rubber cork which engages the edge of the eraser in the manner shown. The pinion is clamped by means of small nuts to the centre of a short-threaded brass rod, the lower half of which is made to turn accurately in a small brass bush mounted on the panel.

Adjustable Pinion.

Several thin washers are placed between the lower clamping nut and the face of the bush, these being removed, one at a time, whenever it becomes necessary to adjust the pinion. At the same time the lock nuts on the lower end of the spindle are taken up. Thus we have an adjustable pinion, and, by using the same eraser as at D, we also obtain a slightly larger gear ratio. Devices of this nature function quite well if properly arranged.

A much larger gear ratio (and consequently a much finer adjustment) is obtained when the driving pinion is made to engage the edge of a standard 3-inch ebonite dial attached to the condenser spindle, and it is quite a simple matter to arrange the pinions shown at D and E

(*Continued on next page.*)

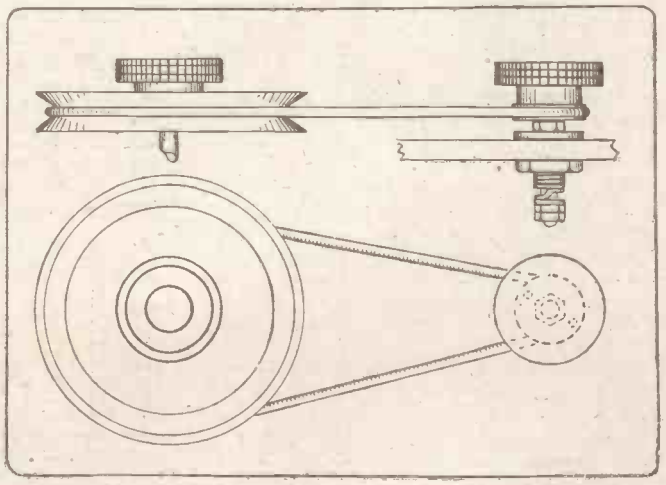


Fig. 3. Another form of control that is very satisfactory.

VERNIER CONTROL

(Continued from previous page.)

(Fig. 1) in this manner. A still finer adjustment is made possible by employing an intermediate pinion which is placed between the small driving pinion and the edge of the dial. Such a device is shown in Fig. 2. The small driving pinion consists of a knurled winding knob taken from an old watch, the small steel spindle being removed and a short length of threaded brass rod soldered in its place. This pinion engages the top of the driven pinion as shown.

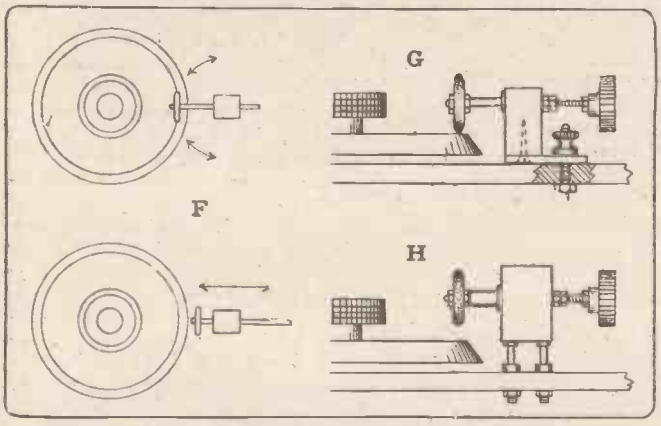


Fig. 4. A system of removable vernier controls.

The latter consists of a small rubber umbrella ring which is clamped between two washers to one end of the lower spindle, and so arranged to engage the edge of the dial. The support is made from a block of fibre, accurately drilled to take the two spindles, and attached in the usual way by means of a single screw driven in from the under side of the panel. The spindles are adjusted and set by means of lock nuts. The lower spindle serves for making fine adjustments, the final "knife-edge" settings being obtained by revolving the upper spindle.

Fig. 3 shows another very efficient form of reduction gear which is easily made up at home. This is arranged on the belt and pulley principle, the small driving pulley consisting of a Meccano pulley attached to the lug of an ordinary ebonite knob, and the driven pulley being made from two 3-inch ebonite dials which are clamped together in the manner shown. The belt is a round-section rubber band taken from an airtight jar, or purchased from a firm dealing in rubber goods. Alternatively, a special belt may be made from a length of flexible metal belting used in conjunction with Meccano mechanisms.

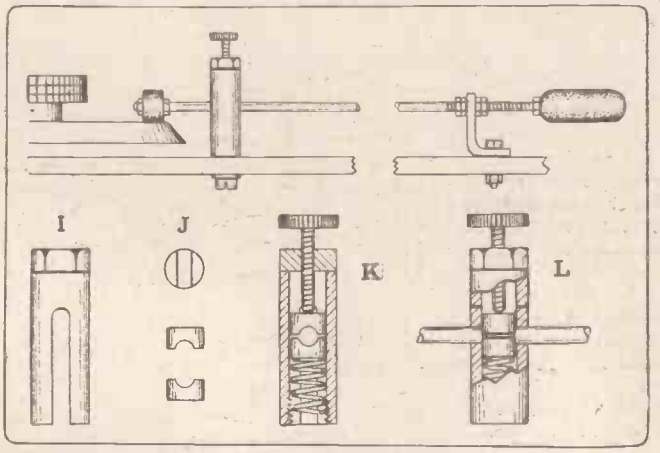


Fig. 5. A simple arrangement that is an improvement on Fig. 4.

The knob carrying the driving pulley is provided with a short spindle which turns in a brass bush fitted to the panel; the height of the pulley is adjusted by means of nuts or washers placed between the bush and the pulley, and a spring washer with locknuts is fitted to the lower end of the spindle. The distance between the centres of the two pulleys should not exceed 4 in.

Removable Controls.

For sake of appearance a disc of cardboard, metal, or ebonite might be fitted over the upturned base of the top dial; or, if the spindle is sufficiently long, a third dial might be used. In the former instance the indicating pointer should be placed between the pulleys, inside the belt, and set to read the lower dial; in the latter case a special pointer might be made to read the upper dial, and placed at any convenient point.

So far we have dealt only with the fixed or permanent forms of slow-motion attachments. It is, of course, often advantageous to be able to disengage the gearing at any time in order to operate the condenser in the usual manner when rough tuning is desirable, and bring it into use again when making final adjustments. Fortunately, such refinements call for no drastic modifications in the designs of the various devices described; it will be seen by the diagrams F (Fig. 4) that the most simple method of disengaging the device is to provide a means of swivelling same on the panel, or to employ a simple sliding movement. Either arrangement may be effected by screwing a strip of fairly stout sheet brass to the base of the supporting pillar and securing this to the panel in the manner shown at G (Fig. 4). The projection or foot thus formed is drilled and slipped over a stud which is screwed into the panel and locked by means of a nut; thus the device may be swivelled to right or left in order to engage or disengage the dial, and held firmly in any position by tightening the milled nut fitted to the top of the stud. If a straight sliding movement is preferred it is only necessary to extend the brass foot and cut a slot in place of the hole.

Diagram H (Fig. 4) shows how a support may be fitted with two valve pins which engage two flush-type valve sockets on the panel. When the device is not required it may be raised slightly so as to clear the dial, or it may be entirely removed.

Similarly the spindle shown at E (Fig. 1) might be arranged to plug into a socket which would also act as a bearing when revolving same.

Fig. 5 shows an extremely simple arrangement embodying the suggested improvements set out in the foregoing examples—i.e. it is adjustable, it engages or disengages the dial in a most convenient manner, and as an additional feature the spindle is arranged as an anti-capacity handle. The supporting pillar consists of a short length of heavy gauge brass tubing which is threaded internally at one end to take a screw which holds same to the panel.

The tube is then slotted as shown at I, to pass the spindle.

A nut, soldered to the top of the tube, accommodates a milled headed screw which engages a small brass plunger, J, arranged as a half-bearing for the spindle.

A second plunger acts as the other half-bearing, the grooves being cut so that both plungers meet when closed over the spindle, which should then revolve freely. The plungers should slide freely inside the tube.

Easy Adjustments.

A glance at the sectional sketches K and L should now make the idea quite clear; the spindle is adjusted by means of the milled screw, the small compression spring, placed between the lower plunger and the end of the fixing screw, lifting the rubber pinion completely off the dial when the milled screw is slackened a few turns.

If a fairly short spindle is used the angle piece supporting the outer end of the spindle should be slightly pliable in order to take up the movement when making adjustments. In such an instance it might be made from thin sheet ebonite or fibre; but if the spindle is 8 in. or more in length, and not more than $\frac{1}{8}$ in. in diameter, this is a matter of little importance, and a metal support may be fitted in the usual way. It will be found best to fit the lock nuts to the spindle on each side of this support, as shown; thus the bearing blocks in the tube may be made to engage an unthreaded portion of the spindle.

£200

IN CASH PRIZES FOR "P.W." READERS

A

GREAT CHANCE FOR AMATEUR CONSTRUCTORS

WHAT YOU HAVE TO DO—

The Editor of POPULAR WIRELESS is offering 5 prizes of £25 each and 5 of £15 each to readers of POPULAR WIRELESS who enter the "P.W." Constructors' Competition by filling up the coupon on this page. There is no entrance fee.

The prizes will be awarded under the following categories:

A. A prize of **£25** for the best home-made L.F. amplifier unit. Second Prize **£15.**

B. A prize of **£25** for the best home-made Variable Condenser, approx. capacity ·001 mfd. Second Prize **£15.**

C. A prize of **£25** for the best original wireless receiving set component. Second Prize **£15.**

D. A prize of **£25** for the best home-made Variometer for B.B.C. wave-lengths. Second Prize **£15.**

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The First Prize of £25 in each class will be awarded by the Editor of POPULAR WIRELESS for what he considers the best constructive effort within the terms laid down for the respective classes. In all cases workmanship and design and the amount of actual "home made" apparatus will be primarily considered in the judging. The second prizes will follow according to merit.

The Editor may divide any of the prizes, at his discretion. The Editor's decision will be absolutely final and binding in all respects.

Any number of entries may be sent, but each entry must be separate and distinct in itself and must be accompanied by a separate signed coupon (as given here). Thus, if you want to enter two of the classes, just buy another copy of "P.W." which will give you the necessary coupon.

All apparatus must be addressed to:

"Amateurs' Radio" Competition,
The POPULAR WIRELESS,
7/9, Pilgrim Street, Ludgate Hill,
London, E.C.4 (Comp.)

and it must reach that address not later than TUESDAY, November 16th. Nothing arriving thereafter will be admitted for adjudication.

When packing your apparatus, pack carefully and make sure that you enclose stamps to cover the cost of its being sent back to you, otherwise its return cannot be guaranteed.

And when sending up your apparatus it will help us if you use on the parcel a label (according to the class you are entering), as given in the 16th Oct. issue of "P.W." Every care will be taken of entries, but no responsibility can be undertaken in this respect. This contest is only open to *bona fide* wireless amateurs.

Any apparatus of professional make (other than the smaller component parts and accessories) will be disqualified.

No one connected in any way with POPULAR WIRELESS is eligible to compete.

Apparatus will be returned as soon as possible after the adjudication.

ENTRANCE FORM.

I (Signature).....

of (Address).....

.....

an amateur in wireless construction, wish to enter the "P.W." Constructors' Competition Class.....(write "A," "B," "C," "D" or "E," as the case may be) and hereby agree to abide by the Editor's decision. I declare that the entry herewith submitted, is of my own construction. (If under 16 years, please state age.)

To the Editor ("Amateurs' Radio" Competition Dept.), POPULAR WIRELESS, 7/9, Pilgrim St., Ludgate Hill, London, E.C.4 (Comp.)

TECHNICAL NOTES.

A Weekly Feature Conducted by

Dr. J. H. T. ROBERTS, F.Inst.P.
(*Staff Consultant.*)

ONE of the most important of radio components, and one which seems to have taken the longest time to perfect, is the variable grid leak. It might at first seem a very simple matter to design what is, after all, merely a variable resistance with a very high resistance value. The fact that it is, however, a difficult problem, is proved by the comparative scarcity of really reliable variable grid leaks.

It is not a matter of any great trouble to make a suitable fixed grid leak, although here there is a certain amount of care necessary in arranging for the contacts at the extremities of the resistance element, but when it comes to making a variable grid leak there are several other points to be considered.

Poor Contact.

For one thing, the nature of the resistance material is usually such that when metallic contact is made with it the resistance in the contact is comparable with the body resistance of the resistance element. This might seem to be a matter of no importance; it is, however, a matter of considerable importance for two reasons. In the first place, it means that the total resistance of the component (which, of course, includes the contact resistance) is liable to vary in accordance with the fluctuating character of the contact, whilst in the second place the contact resistance has always to be added to the amount of element resistance in circuit, and consequently the resistance which is in circuit is not proportional to the length of the resistance element which is in circuit.

A New Leak.

A well-known grid leak which contains a slightly conducting fluid in an insulating tube gets over these contact difficulties to a large extent by reason of the fact that the resistance element, being a fluid, makes automatic contact with a considerable surface of metal. The liquid grid leak, although it has many important advantages, is not entirely free from drawbacks; for one thing, its value is liable to change very considerably for some minutes or even hours after an adjustment of the screw control has been made, owing to a change in the disposition of the viscous liquid.

In the new Dubilier grid leak the resistance element consists of a special metallic substance which is laid in a groove in the "former," and contact is established by means of a ball-tipped contact arm. This has the advantage that practically no rubbing contact is introduced against the surface of the resistance element. It is claimed that with this type of leak the resistance is almost entirely in the resistance element, the contact resistance being inappreciable. In consequence of this, the resistance in circuit is approximately proportional to the length of the resistance element which is in circuit, or, in other words, the component gives what might be termed a straight-line reading. It certainly appears to be an important step forward in grid leak design and brings the grid leak out of the "hit or miss" category and more into line with other standard radio components.

Lightning Safeguards.

Although lightning precautions are not so important at this time of the year as in the summer, it is interesting to note some of the new devices which have lately been brought forward for simplifying the safeguarding of the set from this particular danger. One of the neatest earth switches which I have seen has a moulded insulating case to which the aerial and earth are connected. Spring contacts within this case make connection between the aerial and earth, so that in the ordinary way the aerial is to earth. The aerial and earth leads from the set are connected to a two-point plug adapted to plug into two sockets in the moulded case referred to. When the plug is inserted in position, the spring contacts are lifted and the aerial makes contact with the aerial lead from the set and the earth with the earth lead from the set. In order to ensure complete protection of the set it is only necessary to withdraw the two-point plug from the socket; this has the effect of detaching the set completely from aerial and earth, and of leaving the aerial automatically connected to earth. The particular device which I have described above, and which seems to me to be one of the simplest and most satisfactory for this purpose which I have yet seen, is made by the Athol Engineering Company.

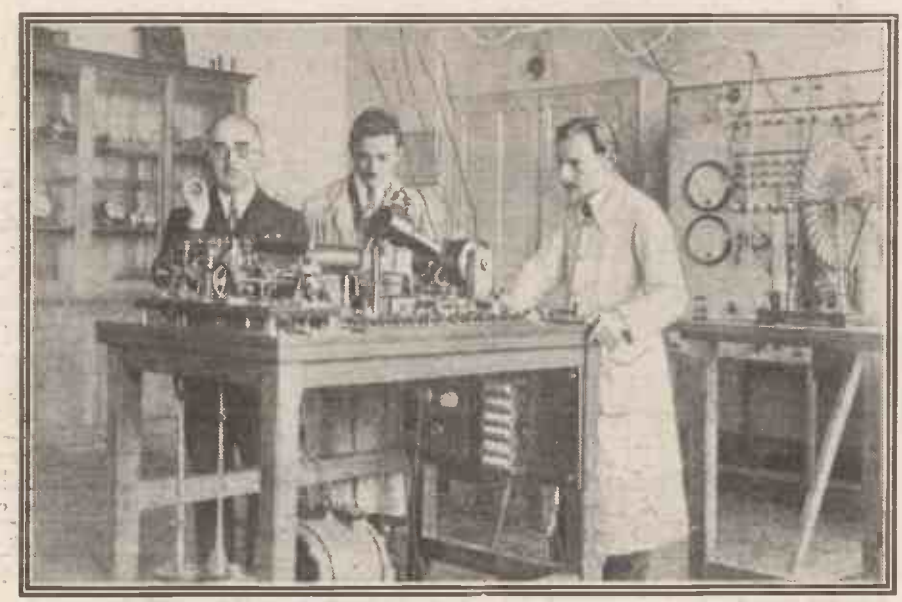
Petroleum Jelly.

"Vaseline" petroleum jelly is capable of helping the listener and experimenter in many ways. Trouble with accumulator connections, for instance, can be prevented by a smear of "Vaseline" jelly over the terminals; and in many charging stations where accumulators are scientifically cared for, this smearing of the terminals with a trace of "Vaseline" jelly is as much a part of the maintenance-routine as the voltmeter and the hydrometer tests.

If the metal to be protected is thinly coated with "Vaseline" jelly the creeping of the acid will not result in "seized" terminals, or in bad contact due to the surface becoming rough and irregular. (There is no need for the protective coating to be a thick one, for so long as the "Vaseline" jelly covers the metal surface completely it will afford all the protection that is necessary.)

A Peculiar Use.

Another use to which "Vaseline" petroleum jelly can be put will surprise most crystal-set owners, especially those who handle their crystals with tweezers to protect them from grease. A well-known expert on crystals has disclosed that in order to prevent the cat's-whisker from getting shaken off a sensitive point on the crystal, he smears the latter with a good coating of "Vaseline" jelly! The cat's-whisker, when adjusted upon a sensitive spot, is held there by the surrounding jelly, and the minor vibrations that formerly would have upset it are then powerless to interfere with reception.



M. Edouard Belin, the well-known French inventor, in his laboratory at Malmaison.

In the "Journal of Scientific Instruments" is a very interesting account of a new type of magnetic shield, made up from the proprietary alloy known as "mu-metal." This is a metal of a specially high magnetic permeability and is manufactured by the Gutta Percha Company. The paper referred to is by Professor A. V. Hill, of University College, London, and refers more particularly to a shield which he constructed from this metal for the purpose of shielding a sensitive galvanometer. The mu-metal in this case was used in the form of strip and was wound upon a copper cylinder alternately with copper strip, so as to introduce in this way a non-magnetic gap between each pair of mu-metal turns, by which it was hoped to divert the lines of magnetic force as completely as possible into the mu-metal. In constructing a shield of mu-metal, one of the essential conditions to remember is that the material must be annealed at 900 degrees centigrade in an

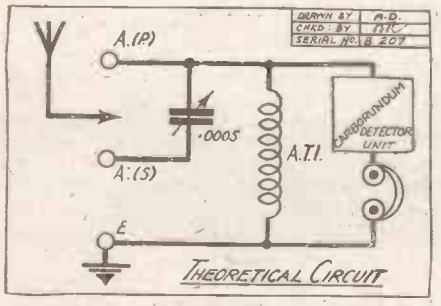
(*Continued on page 584.*)

A Carborundum Crystal Set

No cat's-whisker or other fiddling contact adjustments are necessary with this little set, and once it is tuned it will remain "set" on the local station for very long periods.

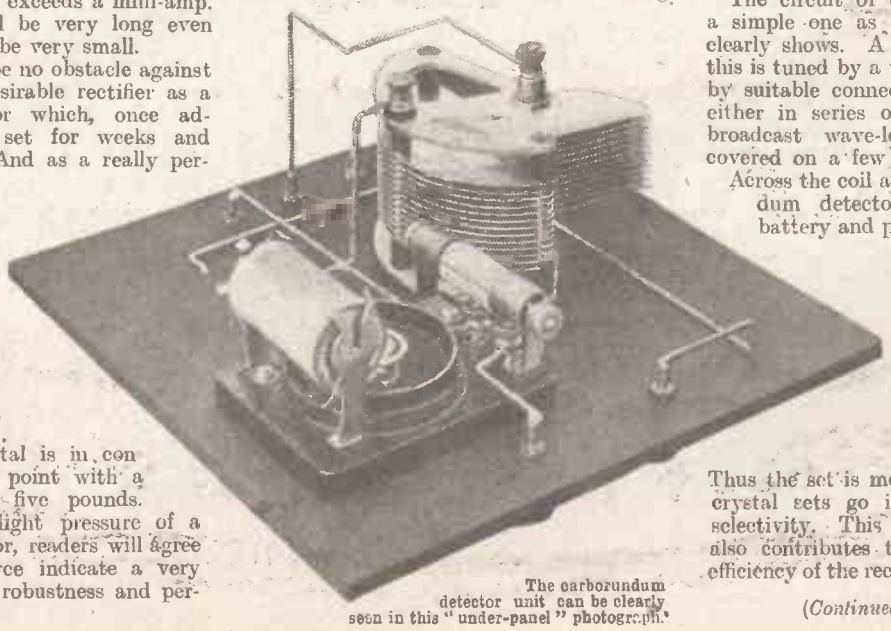
The Set Designed and Described by
G. V. DOWDING, Grad.I.E.E.
(Technical Editor).
Constructional Work by
G. V. COLLE
(Technical Staff).

AS one of the most important requirements of an efficient broadcast receiver is stability, it is rather surprising that the carborundum crystal detector has not acquired greater popularity among broadcast enthusiasts. The father of all crystals, it is still able to hold its own in point of sensitivity against any other type. But (and it is probably this *but* that is at the bottom of it) a tiny battery is required to operate a carborundum detector. Advisably we say tiny, for it cannot be compared in any way to a battery as used with a valve set. It is only required to supply a small potential, and the drain of current from it rarely exceeds a milli-amp. Therefore its life will be very long even although its capacity be very small.



This, then, should be no obstacle against the use of such a desirable rectifier as a carborundum detector which, once adjusted, will remain set for weeks and months at a time. And as a really permanent type of carborundum detector is now available, it will be surprising if this crystal does not regain some of its lost popularity. This new detector used in the set we are about to describe has more title to the name of permanent than many other types in that its crystal is in contact with a metallic point with a pressure of at least five pounds. Compared with the light pressure of a galena type of detector, readers will agree that this must perforce indicate a very considerable degree of robustness and permanency.

A carborundum detector by itself is still very stable, but not sensitive. By applying a very small potential to it by means of a small battery it can be brought to an exceedingly sensitive condition. In some cases only ½ a volt is necessary, and in others nearly 1½ volts; it all depends upon the characteristics of the individual crystal used. In order to arrive at the exact voltage a potentiometer is used. This will allow a very fine graduation of voltages between zero and the maximum of the battery to be obtained. This operation can, in some ways, be compared to the adjustment of grid bias on a valve set, except that a slightly keener variation is demanded in the case of the carborundum arrangement. Once this potential is adjusted, however, it seldom requires to be altered. Only as the battery starts to run down after a very lengthy period of service does this control need handling.



The carborundum detector unit can be clearly seen in this "under-panel" photograph.

In the meantime there are no fiddling cat's-whisker adjustments needed before or after transmissions or, more important still, during transmissions.

The Detector Unit.

Constructors should not anticipate superior results in point of sensitivity with this crystal set to those given by any ordinary type, but where it will excel is in stability. Heavy atmospherics or mechanical vibration will not impair reception, and the sensitivity of the detector will be retained, even although the receiver be subjected to very rough handling.

LIST OF COMPONENTS.

1 Red Triangle panel, 8 in. x 8 in. x ¼ in. (with box to fit, 9½" deep) (Peto-Scott)	10	6
1 Atlas ·0005 variable condenser	11	6
1 Carborundum detector unit (Carborundum Co., Ltd.) ..	12	6
1 Single coil holder	1	0
5 Terminals		7½
Wire, transfers, etc.	1	6

The circuit of this crystal set is quite a simple one as the theoretical diagram clearly shows. A plug-in coil is used and this is tuned by a variable condenser which, by suitable connections, can be employed either in series or in parallel. Thus all broadcast wave-lengths can readily be covered on a few coils.

Across the coil are connected a carborundum detector unit, complete with battery and potentiometer, and a pair of telephone receivers. Now the carborundum crystal has a very high resistance in comparison with many of the other types, so that this detector circuit will impose comparatively little damping on the aerial tuning circuit. Thus the set is moderately selective, or as crystal sets go it has a high order of selectivity. This freedom from damping also contributes to the general all-round efficiency of the receiver.

(Continued on next page.)

A CARBORUNDUM CRYSTAL SET.

(*Continued from previous page.*)

Nevertheless, it must not be forgotten that, as previously stated, it should not be regarded as a "super," and its range of reception and aerial and earth requirements will be similar to the average crystal set. Notwithstanding the fact that a special detector unit with a battery is incorporated, a valve amplifier can be added if desired in quite a normal manner.

Panel Drilling Hints.

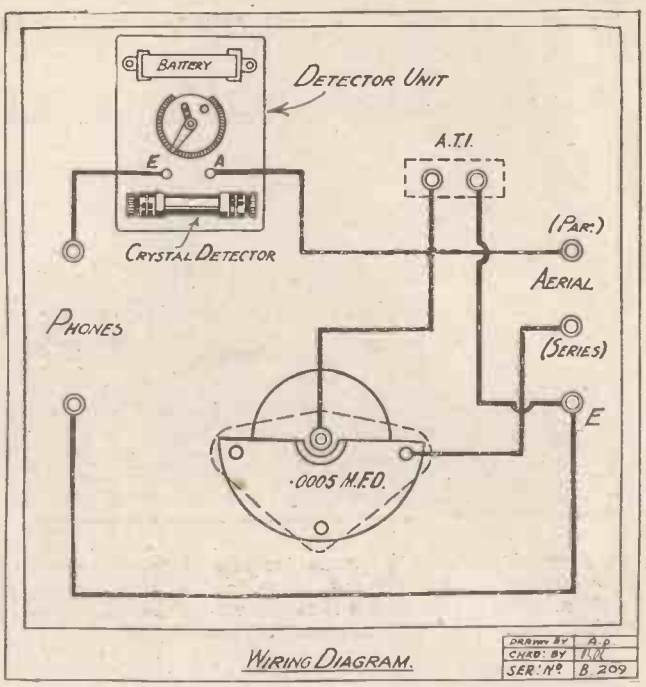
A list of the necessary parts and components is given, and from this it will be seen that no great initial outlay confronts the intending constructor. The little dry battery will last for months without replacement.

Having assembled all the necessary gear, not forgetting the tools that will be needed, a commencement can be made by drilling the panel. The size of this is a perfectly standard one and, therefore, should be readily obtainable cut and polished to shape. Constructors are advised that to save a few pence and purchase a sheet of this black insulating material backed roughly to the desired dimensions from a large sheet by a local dealer is decidedly not worth while. It takes a long time to square up a roughly cut panel, longer than those who haven't tried it may imagine.

The panel must be drilled with metal working drills, not those used for piercing wood and other such comparatively soft materials. The drill should be rotated rapidly, but with a fairly light application of pressure, more especially when breaking through. Drilling should be carried out from the front of the panel, and the marking out should be done by making tiny crosses with a sharp instrument such as a large needle. The holes can then be accurately centred with a centre punch, or with a keen-pointed bradawl.

The coil-holder holes must be very carefully made; none of the others needs such a degree of accuracy, and that which is needed is mostly required for the sake of symmetry and neatness of appearance. The holes required for mounting the variable condenser and the detector unit are rather large ones, and it may happen that the contructor's drill is not capable of carrying suitable drills for them. If this is the case the largest available drill should be used and the holes enlarged with a reamer, or the end of a file.

As everything connected with this set is "one-hole" fixing with the exception of the coil holder, mounting the components should not occupy much time. The wiring, too, is quite a simple proposition and, with diagrams, photographs and check list to guide him, the constructor should meet with no difficulties whatever.



WIRING DIAGRAM.

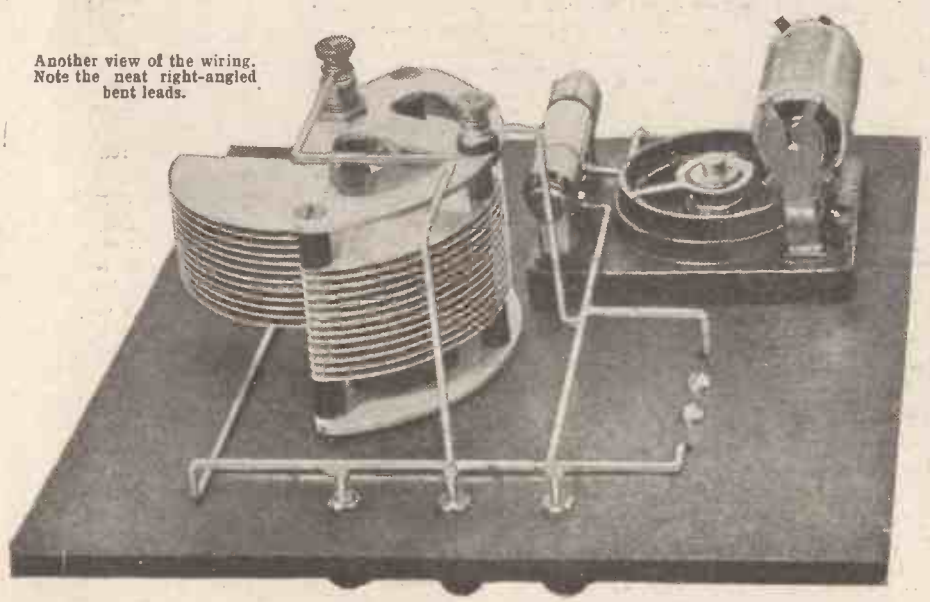
Square section tinned copper wire should be used, and each lead should be carefully cut and bent into its final exact shape before even one end is soldered. It takes a trifle longer to get all the wiring paralleled and with right-angle bends, but the extra trouble is well worth while. Leads should also be well spaced and kept decent distances apart from each other.

Soldering is Quite Easy.

Soldering is not the mysterious art some endeavour to make out, and if the constructor has not done any before he should make a start right away with this set. He will be surprised to learn how easy and free from subtle complications it is, providing he exercises reasonable care. A non-acid flux, such as Fluxite, must be used, and a fairly light iron. The ends of the leads, the points to which these are to be joined and the faces of the copper bit on the soldering should be thoroughly cleaned with emery paper, or a fine file. Then the iron should be heated, and while it is getting hot Fluxite can be smeared on the points to be soldered. Just a thin film is all that is necessary. The lid of a tin should then be placed ready with a little Fluxite in it.

When the flame around the iron begins to flicker with a greenish blue colour it can be removed from the gas flame and swiftly wiped with a piece of cloth. Then it can be dipped momentarily in the tin lid and the stick of solder held against its copper bit. The solder should run evenly over this and leave it "tinned." Containing a globule of molten solder, it should be placed for a second in contact with the prepared work, and a film of solder should settle on this latter with but little manipulation.

The end of the lead and the point to which it is to be fixed can then be held together, and with another tiny globule of solder the iron should be applied and the joint completed. A nice hot (but not red hot) iron, well cleaned, and well cleaned and fluxed surfaces to leads and terminals are the rules to observe.



Another view of the wiring. Note the neat right-angled bent leads.

The Coils to Use.

After soldering, every joint should be tested for mechanical strength, and every scrap of surplus Fluxite carefully removed.

It is not difficult to construct a case for this little set if it is desired so to economise. But a modicum of carpentering skill is called for. Any good wood can be utilised, even ordinary pine, providing it is nicely planed up and polished.

The case of such a set is asked only to support the panel and protect the components against dust; it plays no electrical part in the receiver and is not demanded to do insulating work.

Three-eighth inch timber (mahogany or oak for preference, of course), seasoned and "prepared," or even three ply, can be employed. The cabinet should be 4½ in. in depth. It will be unnecessary to give further dimensions or to say anything about dove-tailing, etc.; and, anyway, that is

(*Continued on page 549.*)

The Duvolcon

Control the volume of your loud speaker without altering the tuning of your set by fitting a Duvolcon.

AN APOLOGY

Our first advertisements announcing the Duvarileak and the Duvolcon met with such eager response on all hands as to swamp even the extensive production arrangements which we had made.

We wish to apologise for any delays experienced, and to say that since we have promptly arranged to increase the production several fold, normal supplies will again be available by the time this announcement appears.

THE DUVARILEAK

By evolving, after three years of laboratory experiments, a special resistance material of great hardness and by arranging a frictionless ball-contact (see cut-away view) we have succeeded at last in producing the perfect Variable Grid Leak—the Duvarileak. This Grid Leak has no granules to cohere, its velvet control makes it silent in action, and the elimination of wear and friction means that it will retain indefinitely its variable properties. You can set the resistance value by the scale, and in two, four, six, eight months the Duvarileak will still give the same resistance for that particular setting.

THE DUVOLCON

Control the volume of your loud speaker without altering the tuning of your set.

Frequently your loud speaker may be at some distance from the set, you do not wish to upset your tuning, yet you wish to have perfect control over the volume.

The Duvolcon will give you this whatever the type of your loud speaker. You can also employ the Duvolcon as a Reaction Control in the manner shown on the leaflet which accompanies each instrument.

BOTH

the Duvarileak and the Duvolcon—they are similar in appearance—have one-hole fixing, they carry our full guarantee, are obtainable of all dealers, and cost

7/6 each

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MODEL H.T.4 ... 30 VOLTS ... 30/-
MODEL H.T.5 ... 90 VOLTS ... 90/-

Have you considered the advantages of C.A.V. H.T. Accumulators as compared with dry batteries for your H.T. Supply?

Do you know that your radio reception can be vastly improved by using the C.A.V. 1927 Model H.T. Accumulator, and that your H.T. Supply will then actually cost less?

Study the following points, and get your local Radio Dealer to demonstrate what a difference they make to reception, and you will not only be convinced that they satisfy in every way, but you will also wonder why you did not use one before.

WHY YOU SHOULD CHOOSE C.A.V. H.T. ACCUMULATORS

1. C.A.V. H.T. Accumulators will last for years, and only require recharging every four to six months. (Any C.A.V. Service Station will recharge a 60-Volt Assembly for 2/6 or less.)
2. They are cheaper in the long run than continually buying new dry batteries.
3. The chemical action of dry batteries causes crackling background noises with reception. C.A.V. H.T. Accumulators are absolutely silent in operation.
4. C.A.V. H.T. Accumulators give a constant voltage pressure, not varying as with dry batteries, a consistent signal strength is therefore maintained during reception.
5. They have no shelf life (it is possible to lose a considerable part of the useful life of a dry battery if it is kept standing idle for any length of time). Although H.T. Accumulators will discharge in the same way but to a much lesser degree, this loss can be replenished by a freshening charge.
6. This is a super-charged battery, it being given several cycles of charge and discharge during the initial charging process. By this method retention of charge over a long period is obtained.
7. Used by the majority of leading experimenters, C.A.V. H.T. Accumulators have also been supplied to over 100 of the London Hospitals in which Receiving Apparatus has been installed for the benefit of the patients.

COMPETITION OPEN TO USERS OF THIS ACCUMULATOR

Owing to the various special features of our H.T. Accumulator we desire to give it a distinctive name, and invite suggestions. Prizes will be awarded as follows:

1st PRIZE—75 GUINEAS.

To the entrant of name adiudged the best.

2nd PRIZE—25 GUINEAS.

To the Trader from whom the First Prize Winner purchased his Accumulator.

Full particulars including conditions of competition will be forwarded on application.

SALES DEPOTS.

BIRMINGHAM.—Great Hampton Street.
BRISTOL.—7-25, Temple Street.
DUBLIN.—Taylor Bros., 41, Middle Abbey Street.
GLASGOW.—227-229, St. George's Road.
LEEDS.—117, Park Lane.
LONDON.—224, Shaftesbury Avenue, W.C.2.
LONDON.—90, High Street, Camden Town, N.W.1.
MANCHESTER.—191-3 and 277, Deansgate.
NEWCASTLE-ON-TYNE.—68, St. Mary Place.

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Telephone: Chiswick 3801. (Private Branch Exchange).
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A CARBORUNDUM CRYSTAL SET.

(Continued from page 546.)

rather without the scope of this article. Woodwork enthusiasts will know how to handle a simple job of this nature without detailed instructions and drawings.

The set is now complete, and nothing remains but to test it and then place it in operation.

For 2 L O and such-like stations a 75-turn plug-in coil should be used, the aerial being connected to the (S) series aerial terminal.

POINT-TO-POINT CONNECTIONS.

Aerial parallel terminal to fixed plates of variable condenser, socket of fixed coil holder and to the "A" terminal of detector unit.

Aerial series terminal to moving plates of variable condenser.

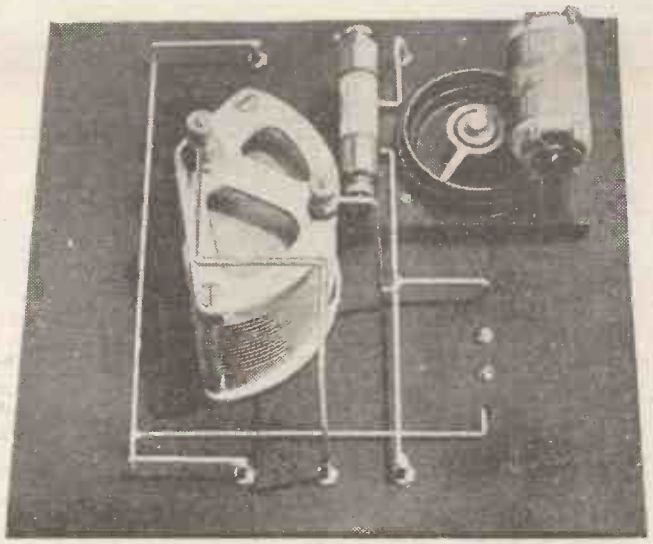
Earth terminal to plug of coil holder and to bottom 'phone terminal.

Top 'phone terminal to "E" terminal of detector unit.

5 X X needs a 200-turn coil with parallel condenser tuning, the aerial lead being taken to the (P) aerial terminal, the (S) terminal being connected to the earth terminal by means of a short length of wire or a metal bar or strap. 2 L O and other stations can also be heard in this parallel condenser position providing a 35 or 40 turn coil is used, but we prefer the series method and a larger coil for the shorter-waved stations. Likewise 5 X X can be heard in the series condenser arrangement with a 300-turn coil, but a 300 coil is more expensive than one of 200 turns, and it will not give better results.

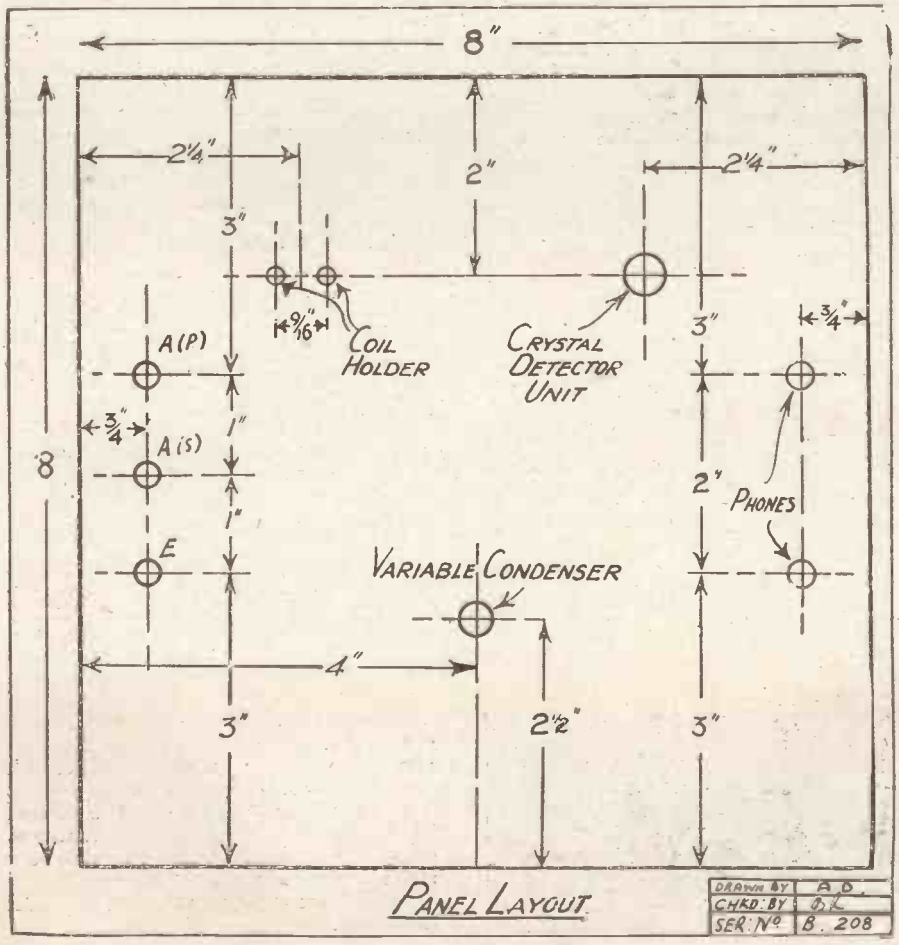
Adjusting the carborundum detector calls for just a little care if best results are to be obtained. First of all, the little battery must be inserted the right way round in its holder. Then the potentiometer knob must be slowly rotated first one way and then the other until the loudest signals result. It can then be left for lengthy periods before it needs readjustment. This operation must be carried out more or less simultaneously with that of tuning the set with the variable condenser.

The little battery should be removed when the set is not in use. Although the detector unit takes but little current, it must not be forgotten that there is a constant drain on the battery when it is in circuit. Some constructors may consider it well worth while to incorporate a switch on the panel working through short flexes joined to the battery clips on the unit and to a small dry battery standing inside the case.



This photograph should be compared with the wiring diagram.

In conclusion, this carborundum detector crystal set should come as quite a boon to many listeners, especially those who have relations who are unable, or who have insufficient patience, to operate a "cat's-whisker."



IMPEDANCE.

IMPEDANCE is influenced by frequency, as is reactance, and concerns direct as well as alternating currents, as does resistance. Like resistance, it is measured in ohms, the number of ohms being the number of volts required per ampere of current.

For example, the resistance of a pair of headphones is very often 4,000 ohms. The *impedance* of such a pair to a current at a frequency of 800 cycles per second may be about 30,000 ohms, whereas to a current at 400 cycles it would be a little more than half that amount. We may summarise these results as follows:

Resistance is opposition offered to the flow of a current, and is a property of the circuit or apparatus concerned, being independent of the nature or frequency of the current.

Reactance is the opposition offered by an inductance or capacity to an alternating current. Only alternating or changing currents encounter reactance, the magnitude of which depends upon the frequency of the current.

Impedance is the total opposition offered by a circuit, and is made up of resistance and reactance. Where direct current is concerned, the impedance is the same as the resistance, for there is no reactance.

CURRENT TOPICS.

BY THE EDITOR.

Members of the New Corporation—An Unsatisfactory List—Mr. Reith's Future—Mr. De Groot—The Publicity Claim—B.B.C. and the Concert Industry

AT last the Government have officially announced the names of the members of the new British Broadcasting Corporation. We will state them here: The Earl of Clarendon (Chairman), Lord Gainford (Vice Chairman), Sir Gordon Nairne, Mr. Montague Rendall, and Mrs. Philip Snowden. Mr. J. C. W. Reith, the present Managing Director of the B.B.C., will, it is stated, be a Director-General of the Corporation, although he will not have a seat on the Board.

Although we have previously exclusively given the names of the Earl of Clarendon and Mrs. Snowden to our readers, the names of Sir Gordon Nairne and Mr. Montague Rendall are new to us, as they will doubtless be to many of our readers.

Disappointing List.

Looking at this list, the average amateur will feel very disappointed indeed. It is not an inspiring list. The first question which jumps to one's mind is, no doubt, that these people are very eminent, but what do they know about broadcasting? Have they any sympathy with it, and have they the slightest knowledge of what the public wants? The list gives one the impression that the Government has selected a most "highbrow" list of members for the Corporation, and there is no doubt that the Postmaster-General's statement regarding this Corporation is regarded as most unsatisfactory in many quarters, for the composition of the new Board is a long way from being convincing.

We are curious to know whether it is the intention of the Government that the Board shall exercise effective control or whether it has been constituted on the grounds that the real control shall remain in the hands of the present competent broadcasting authorities. If this new Board is to exercise the real direction and control of broadcasting, then its personnel is singularly lacking in those qualifications which are necessary for interpreting popular needs, for developing a new service of entertainment, and for inspiring confidence in a new and promising industry.

Parliamentary Discussion.

Parliamentary discussion on this new Corporation has been evaded by the Government, and there is no likelihood of the matter being thrashed out in Parliament until the supplementary estimate regarding the new Board is introduced next year. This probably means the end of February or March.

Nevertheless, this new Corporation will come into power on January 1st next, which means that Parliament is not to be given an opportunity of discussing the new broadcasting policy until after the new Board has come into office and has thoroughly taken charge of the new broadcasting arrangements. The probable result will be a very depressing effect on the sale of licences.

* * *

It is not yet too late, however, for the Government to review the situation. Seeing that large salaries go with the appointments to this governing Board of the new B.B.C., the public are entitled to the appointment of competent authorities who thoroughly understand the psychology of the business.

The fact that Mr. J. C. W. Reith's name has not been included in the Royal Charter and that he has not been given a seat on the Board can only be described as scandalous. He, above all other men, knows the business of running a broadcasting service from A to Z, and although it is certainly the brightest news in connection with the new Corporation that he will be a Director General and, we hope, will retain the authority he holds at this time, it does seem a most extraordinary thing that this man, who has built up broadcasting, should not be included in the new Board.

* * *

Further discussion on the subject at the moment is futile and in many ways depressing; but we can only hope that members of Parliament will insist on this matter being thrashed out thoroughly, for it is not yet too late for the Government to revise their ideas about broadcasting and to drop the idea that it can be used for political purposes.

* * *

An unfortunate misunderstanding and disagreement between the B.B.C. and Mr. De Groot has, as most of our readers know, arisen owing to the fact that the B.B.C. will not pay Mr. De Groot certain fees for future broadcasting. Mr. De Groot has named a sum which he considers he is entitled to, if he is to renew his contract for broadcasting, but the B.B.C. refuse to pay this amount and again bring up the question of publicity value of broadcasting.

* * *

We have every sympathy with Mr. De Groot and also with the B.B.C. Mr. De Groot is naturally a business man, and he is quite entitled to get the best terms he can. On the other hand, the B.B.C. are very seriously hampered these days by the lack of money owing to the retention of large sums of licence money by the Post Office, and they naturally have to watch with the greatest care their expenditure on programmes.

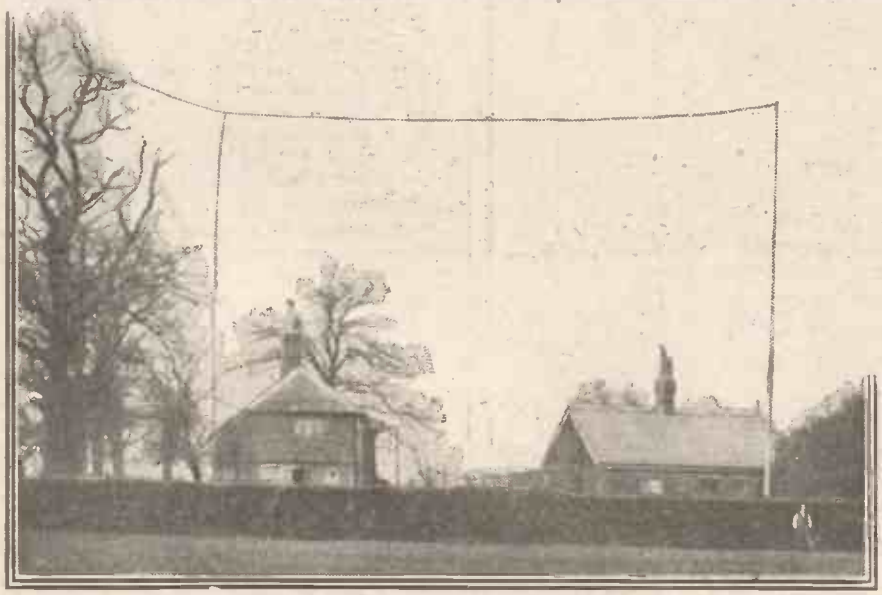
It is, however, about time they forgot all about the publicity value of broadcasting. Undoubtedly there is a great publicity value in connection with broadcasting, but it is hardly policy these days to keep on dragging it up as an excuse for not paying certain artists adequate fees for their services.

Another important development in connection with broadcasting has been the threat of Mr. William Boosey, of Chappells, in connection with turning the Queen's Hall into a cinema unless greater support is given to the concerts held there from time to time.

The National Concerts.

Mr. Boosey has very ingenuously backed up this announcement by stating that broadcasting has consistently injured the concert business. In his opinion, the B.B.C.'s National Concerts at the Albert Hall have been very injurious to the concert industry, but the fact remains that concerts very seldom pay in this country, and long before the B.B.C. started to broadcast these questions of: "Can music pay?" and the like cropped up from time to time in the newspapers.

There is no doubt that certain kinds of concerts do pay very well in this country. The truth of the matter is that certain classes of concerts, such as high-class Symphony Concerts, only have a limited appeal, and whether broadcasting continues or not we do not think it will make very much difference to the success or failure of some of the concerts given in the big halls in London.



An exceptionally efficient aerial erected by a "P.W." reader, Mr. H. Day, of 2, Woodside, Cockfosters Road, Barnet.

The RADIO CONSTRUCTOR

Edited by PERCY W. HARRIS, M.I.R.E.

This valuable eight-page supplement, devoted to the interests of amateur wireless constructors, appears every week in "Popular Wireless." Tell your friends about it, for it is only in "P.W." that they will find radio articles by the leading constructor's expert, Mr. Percy W. Harris.

IT is one of the greatest fascinations of experimental radio that so many combinations are possible with apparatus you already possess. Given one or two valve holders, a couple of rheostats, a few odd valves, grid leaks, condensers, home-made or bought tuning coils—in all, two or three pounds' worth of odd apparatus and you have at once the key to weeks or months of enjoyable entertainment. Thousands of readers of POPULAR WIRELESS are already acquainted with the joy of home construction, and I hope this supplement will be the means not only of adding to this enjoyment, but of bringing many new recruits to the noble order of the soldering iron and kitchen table.

Problems Still with Us.

With so many keen brains throughout the world devoting their attention to the evolution of new and improved circuits, you may be sure that there will be a regular supply of fascinating material in this direction. At the same time, the problem of what are generally termed "accessories" is always with us.

We have, for example, the question of filament current supply. Accumulators have to be charged, and dry cells—if you do not use accumulators—have an irritating habit of running out just when you want to hear that programme to which the whole family have been looking forward. The valve makers, fortunately for us, have done a great deal in the last year or two in reducing the demands made upon our L.T. supply, and indeed we have the promise ultimately of being able to get all the power we require from the mains (if we are so fortunate as to have electric light in our homes).

The H.T. Question.

The H.T. problem is even more pressing. While valves have greatly improved in their filament consumption (on the bench alongside me as I write I have an eight-valve set which consumes only half an ampere) it is an unpleasant fact, that while the L.T. consumption has gone down, the H.T. demands have gone up!

Before sitting down to write this page, I took from my shelf two valves (both of the same make) one of which was very popular a year or two ago and the other equally popular at the present time. The filament *power* expressed in watts is just ten times less in the new valve than it was in the old. Used in the same circuit, however, the H.T. current demand is just twice as great. You will thus see that the H.T. problem is not to be ignored.

In order that the readers of the "Radio Constructor" may be fully acquainted with the vital facts concerning H.T., I have devoted an article to the subject in this issue, on the principle that it is little practical use pointing out a trouble unless you can indicate a cure. Next week in an article, "The Assault on your Battery," some facts, figures and tests will be expressed in a very graphic way. A constructional article in the present issue gives you details of a simple, safe and efficient little piece of apparatus which, used in conjunction with any H.T. accumulator, will relieve you once and for all of any worries caused by the big demands of the modern valve.

More About the "Hale."

Since describing the Hale circuit last week I have carried out many further experiments, and extended the list of valves which will work satisfactorily in this circuit. Although practically any valve will give satisfactory results, when you are near a broadcasting station you will not obtain the full undistorted volume of music which the Hale receiver is capable of giving if you do not use a valve with a big enough emission to handle the energy.

For this reason the best results are given by the special L.F. valves, which every maker now sells.

A Lunch Time Experiment.

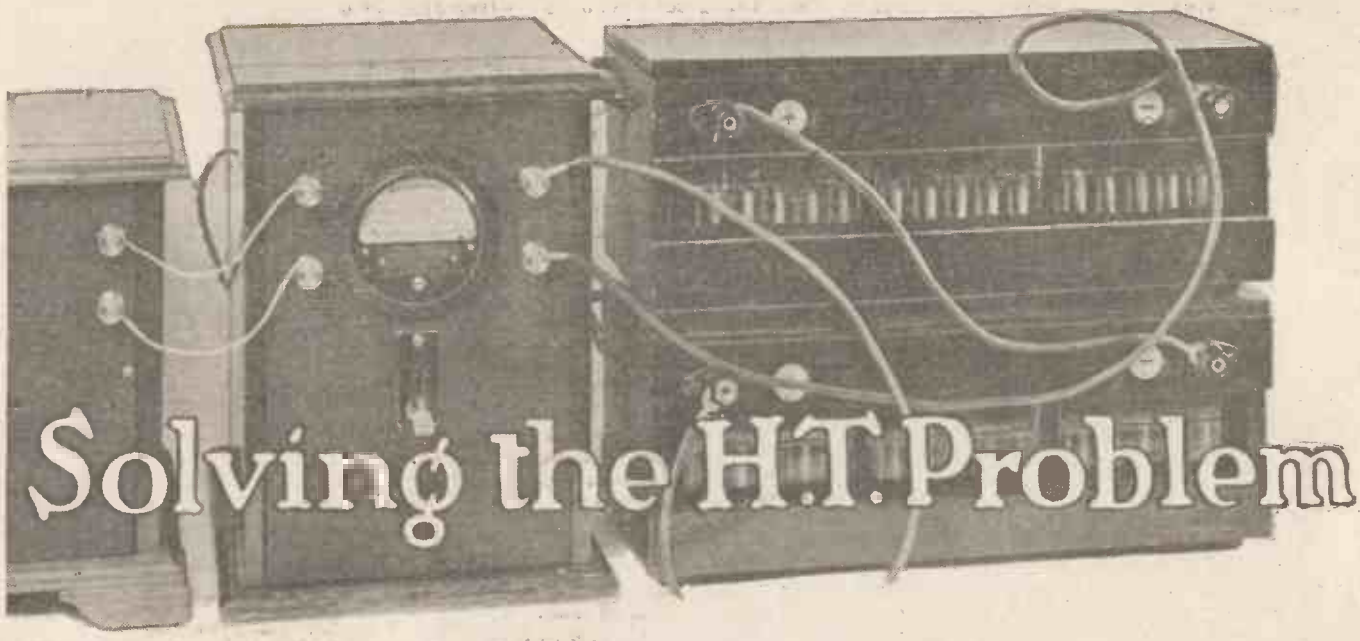
When Mr. Hale, the inventor of the circuit, visited my laboratory the other day and tried the single valve set described last week, we left the loud speaker operating on the lunch hour programme from 2 L O, and could still distinctly hear the music after we had left the room, gone downstairs and passed out of the garden gate. By this time I am sure numerous readers of the "Radio Constructor" will be obtaining equally good results, and I hope that they will not fail to write and tell me their experiences.

Next week I shall show you how to make a very inexpensive two-valve Hale receiver, which will be very useful if you are too far away from a broadcasting station to obtain all the strength you want with one valve.

Possessing all the virtues of the single valve Hale receiver, it has just that additional "kick" that comes so useful to the indoor aerial user.

Percy W. Harris

Preparing data for next week's article, "The Assault on your Battery."



Solving the H.T. Problem

By PERCY W. HARRIS, M.I.R.E.

How to Build a Unit which Makes Home-Charging Practical.

WITH the increase in the number of multi-valve sets, and perhaps more particularly with the increased use of what are generally called "power" valves, the high-tension supply problem is becoming increasingly acute. The ordinary small-size H.T. dry battery, giving 60 or 72 volts, obtainable from any wireless dealer, is an excellent little device, and can be relied on to give satisfactory service with a one, two or three valve set, using valves which have no great appetite for H.T. current.

A Practical Example.

For example, a modern set with one stage of high frequency, detector, and one note amplifier, using a modern valve designed for H.F. amplification, a detector, and a good L.F. valve (not a special power valve for L.F.), can be run very efficiently on not more than four or five milliamps. and, indeed, many sets with suitable valves consume less than this.

Any maker of H.T. dry batteries will tell you that this figure is the maximum economical load that can be placed on such batteries and for anything greater than this the larger type of cell should be purchased. As the larger types are considerably more expensive, many people have fought shy of purchasing them in the past.

H.T. accumulators have now reached a degree of perfection which makes them a practical proposition for almost any user, and now that prices have fallen to a reasonable figure, many people would like to purchase these useful accessories. The problem immediately arises of how they shall be charged, and unfortunately the service offered by the average battery charging station—none too good in the case of the L.T. accumulator, is shown by painful experience to be even worse for H.T. accumulators. If only one could conveniently charge the H.T. accumulators at home—and I say "conveniently" advisedly—I am convinced that many more H.T. accumulators would be purchased and used with satisfaction.

I have experimented with all kinds and ways of charging H.T. accumulators, and have quite a formidable array of apparatus for this purpose, including a special motor generator which will give a pure H.T. direct current for charging accumulators up to any voltage I am likely to use. Again, I have a vibratory rectifier for the purpose, and also an ingenious Neon tube rectifier and charger which has given particularly satisfactory results.

While I have nothing whatever against the commercial forms of H.T. charger, and have obtained satisfaction with most of them, they lack certain conveniences which I have sought to overcome. The result of experiments in the last few weeks has been that I have been able to design what I think will be a welcome addition to many homes—the "Radio Constructor" H.T. battery charger and control unit. It consists, as you will see from the photographs, of a neat case which can be stood immediately alongside your receiving set. It possesses the following advantages:

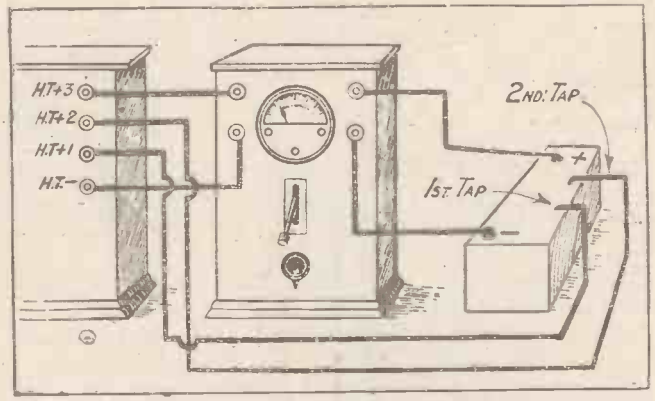


Fig. 1. The H.T. accumulator charging unit described stands permanently by your set. Charging is effected by throwing over a switch.

1. The unit is permanently installed by the set.
2. Your H.T. accumulator and the unit are permanently wired to your receiver.
3. A change-over switch enables you *immediately on switching off your set at night*, to place the H.T. accumulators on charge until the next time you use the set.
4. The rate of charging is controllable and *visibly indicated*.

No More Tedious Changes.

You will thus have no mess and inconvenience, no tedious undoing of terminals for the purpose of disconnecting H.T. accumulators, and carting them off to a service station, no worry about whether or not your accumulators will be properly attended to, and no doubt as to the proper charging rate. In fact, if you make a habit of throwing up the switch, say, every Friday night until the time you switch on the set on Saturday, your batteries will always be kept in the pink of condition. All you then need to do is to have a look at them every two or three months to see whether the electrolyte has evaporated sufficiently to need a few drops of distilled water so as to bring up the level.

When I add that the set is perfectly silent in operation, quite safe, with not the slightest risk of getting electric shocks, any possible doubt in your mind as to its desirability will be removed. The set is very easy to make up and doubtless you already have a number of parts by you which can be utilised. The most expensive portion is the milliammeter, but this, I think, is essential, for it is most desirable that you should be able to see and adjust the rate of charge at all times.

Fig. 2 shows the theoretical circuit of the charger. The instrument is made possible by the introduction by the leading valve makers of special two-electrode rectifying valves, made to fit into ordinary valve sockets, which will pass sufficient current to charge your H.T. accumulators

(*Continued on next page.*)

SOLVING THE H.T. PROBLEM.

(*Continued from previous page.*)

adequately. On the left we have a twin flexible lead going to a lamp socket (the present unit is devised to operate from alternating current mains and a separate article later will show you how to make a unit for direct current mains). These leads are taken to a transformer which steps down the current to 6 volts for lighting the rectifying valve filament. The current through the filament is controlled by the filament resistance.

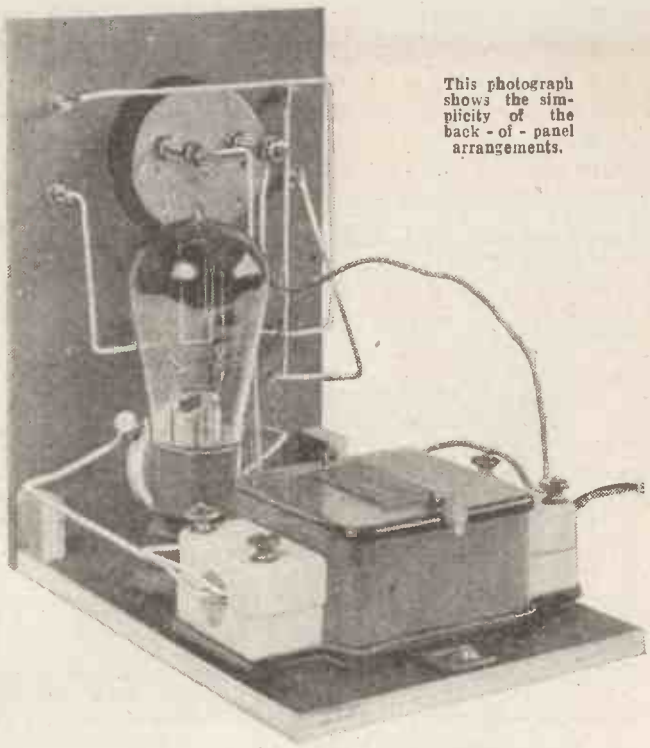
Change-over Arrangements.

From one side of the electric light mains a lead is taken to one contact of a double-pole double-throw switch. When the switch is on the "charge" side the current from the mains proceeds through this switch to the positive of the H.T. accumulator, out from the negative terminal, to the switch again, thence to the milliammeter, from this to the plate of the rectifying valve and across the vacuous space of the valve to the filament, from which it returns to the mains. The rectifying valve has the peculiar property of allowing the current to pass in one direction only through the valve, and therefore we use but one half of the alternating current.

When we change over the switch the mains and charging unit are completely disconnected from the accumulator and the accumulator is then directly connected to the set.

In practice and looking at the front of the unit, when the switch is "up" the accumulators are connected directly to your set, and when it is "down" the charging side is connected to your accumulator. If, as is frequently the case, you take several tappings from your accumulator they are made as is shown in Fig. 1, for the charging unit is only concerned with the whole H.T. accumulator, which is charged as one complete unit.

The transformer I have used is what is known as a "bell-ringing" transformer, designed to operate electric bells from the alternating current house mains. However, these are not very readily obtainable in all parts of the country in a size sufficient to pass one ampere (the size of transformer I am using), and I have, therefore, arranged with several firms to market a suitable step-down transformer for this purpose.



This photograph shows the simplicity of the back-of-panel arrangements.

Two firms who have already begun production are Messrs. Radio Instruments, Ltd., and Messrs. Peto-Scott, Ltd., and others will doubtless be able to market suitable transformers at an early date. The actual unit can be made up in any suitable cabinet and the reader need not necessarily adhere to the dimensions given in this article. However, in order that you may see how this unit can be made up in a convenient form, I am giving a detailed description of that on which my own tests have actually been conducted.

Components Needed.

The following components are required:

One polished mahogany cabinet to take an ebonite panel, measuring 9 in. × 6 in. The cabinet should be about 9 in. deep internally, and should have a lift-up lid (Camco, Peto-Scott, Coxton, etc.).

Ebonite Panel, 9 in. × 6 in. × ¼ in. (any good guaranteed make).

Four terminals.

One milliammeter to read to 100 milliamps. (Weston, Turner, Sifam, or other suitable make).

One plated double-pole double-throw switch (Utility).

One filament resistance. Care must be taken in choosing this, as it has to carry a heavier current than normal. I have used the Cosmos filament rheostat (double-wound) designed to have a resistance in one half of 18 ohms and in the other 2 ohms. The 18-ohm side will carry ·4 of an ampere and the 2 ohm up to 1½ ampere without overheating.

A Warning.

Do not purchase the ordinary type of filament rheostat which, however good it may be for normal purposes, is not suitable for a rectifying valve carrying heavy current. While it is not necessary to adhere to the particular make indicated, it is necessary that any other substituted make should be able to carry a similar current without overheating.

One special transformer, the input side suitable for your local alternating current voltage and periodicity, and the output side able to supply not less than one ampere at 6 volts.

One anti-vibratory valve socket (Burndept, Benjamin, Lotus, etc.).

Suitable baseboard (which will probably be supplied with cabinet). Suitable length

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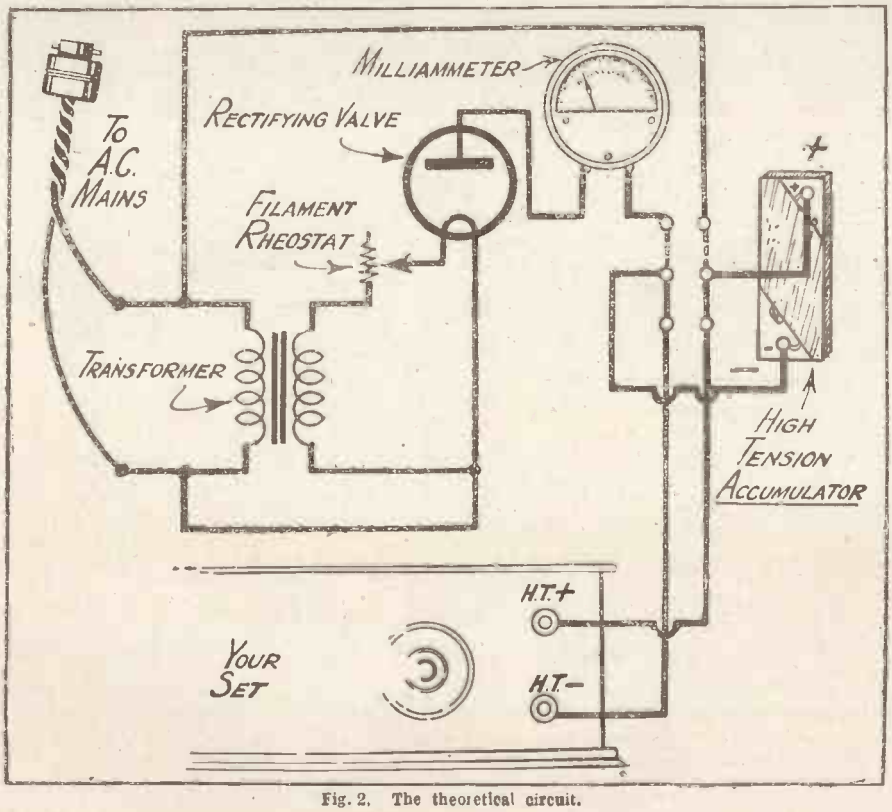


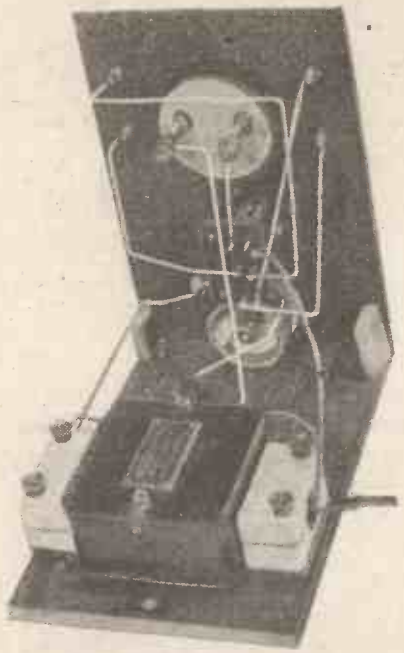
Fig. 2. The theoretical circuit.

SOLVING THE H.T. PROBLEM.

(*Continued from previous page.*)

of electric-lighting flex with adapter for lamp socket. Wire for wiring up (Glazite may be used, or, if you prefer bare wire, use sistoflex sleeving for insulation. Where high voltages are used, it is wise to take all precautions against your hand coming in contact with the live wire).

Suitable rectifying valve, regarding which further notes will be given.



This view will help you in wiring.

As we are not dealing with high-frequency currents here, the exact lay-out of the set is not an important matter. It is only necessary to examine the photographs and drawings to see a general and suitable lay-out for the wiring of the instrument.

I would again draw your attention to the importance of keeping your wires insulated.

If you should happen to use the particular type of bell-ringing transformer that I have adopted, you will find three terminals on the low voltage side. These are designed to give a choice of voltages. Use those I have shown.

You will also notice that one side of the low-tension winding is taken to one side of the high-tension winding. If this were not done the current from the mains through the high-tension accumulator would have no return path. You will observe, too, that I have passed the flexible leads to the lamp socket through a small hole in the box. This is a necessary precaution, as in this way any possible contact with the mains when operating this set is avoided. Do not bring out the transformer windings to terminals on the panel.

This would be a dangerous procedure, and would involve serious risk of injury if your body came into contact with high voltage terminals. As the set is made up it is quite safe, and there is no more risk of shock than with your present high-tension battery.

Most of the leading valve makers now make special rectifying valves capable of passing current of 50 milliamps. or more, and this set was made up and first used with the Burndept rectifying valve called the U. 695, the price of which is 20s. It operates with 4½ to 6 volts on the filament,

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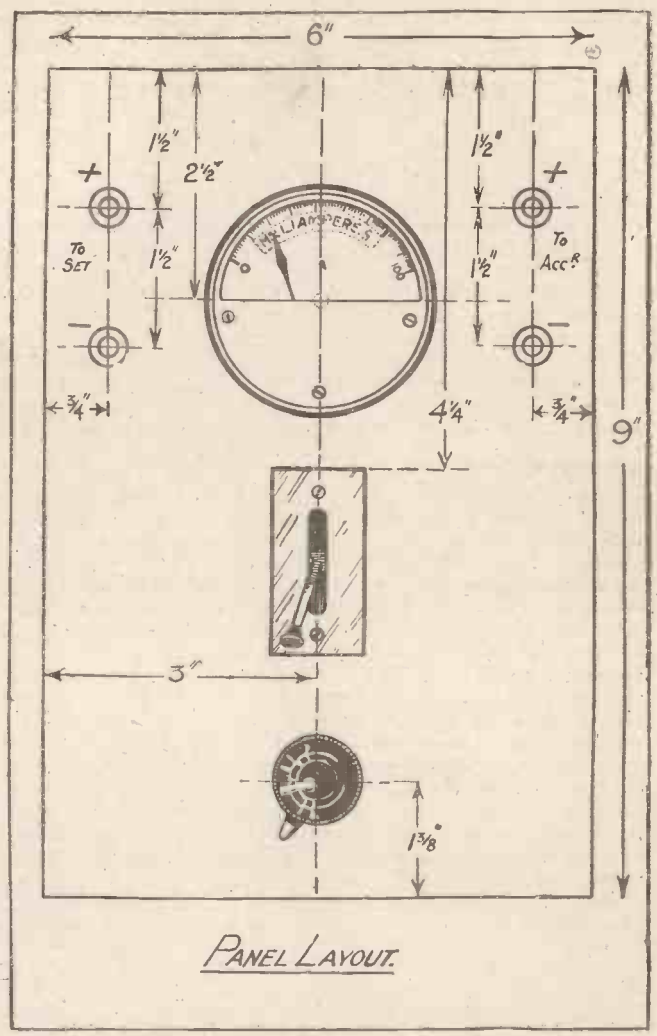
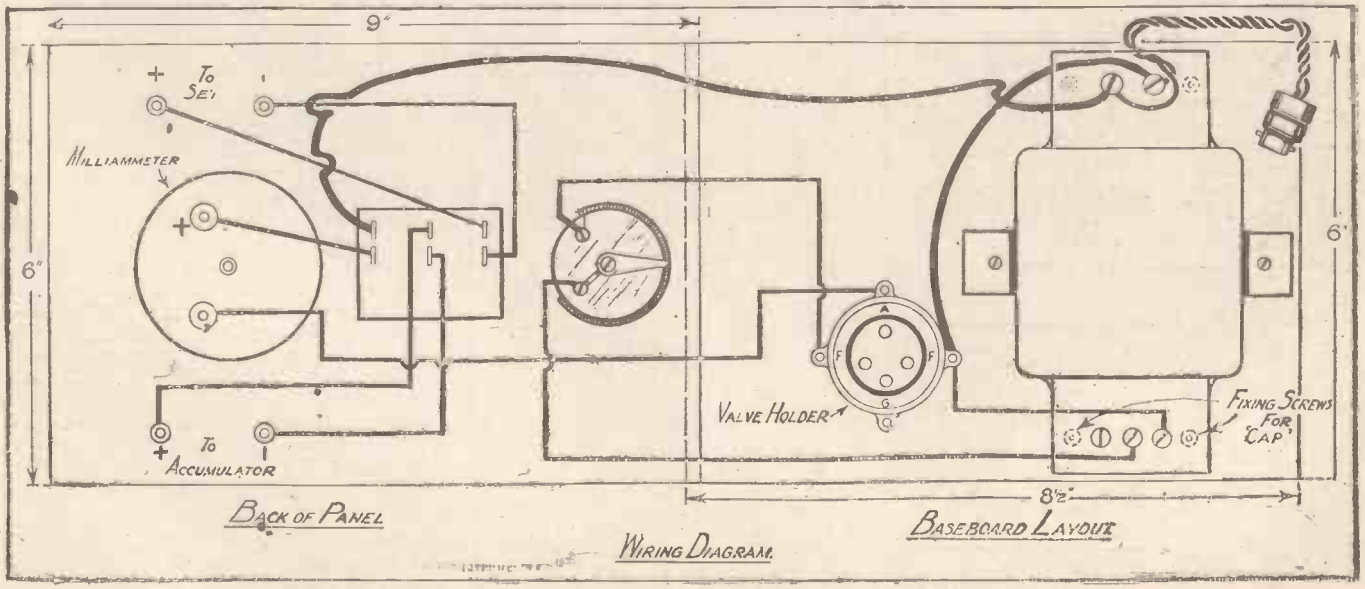


PANEL LAYOUT.

A guide for marking and drilling the panel.



Notice that the grid connection of the valve holder is not used with the special rectifying valves.

TERMINAL HINTS.

By PERCY W. HARRIS, M.I.R.E.

THE home constructor now has a wide variety of terminals to choose from, in making up his set. There are, of course, the ever-popular and inexpensive W.O. type purchasable in brass or nickel finish, from any wireless dealer, and the various indicating and insulating terminals which give such a smart appearance to a modern receiver.

In buying the first type there are several precautions to be taken. First of all, do you require these terminals for what may be called a "permanent" set? If so, be sure that you buy them lacquered. Many sold are made of bare brass and after a few weeks become badly discoloured, spoiling the appearance of the whole set.

For general experimental work in which appearance is not important this question will not worry you, but in any case it is handy to keep a bottle of cold lacquer (this can be purchased very cheaply from a number of sources), so that when the job is finished you can touch up the terminals and preserve their good condition.

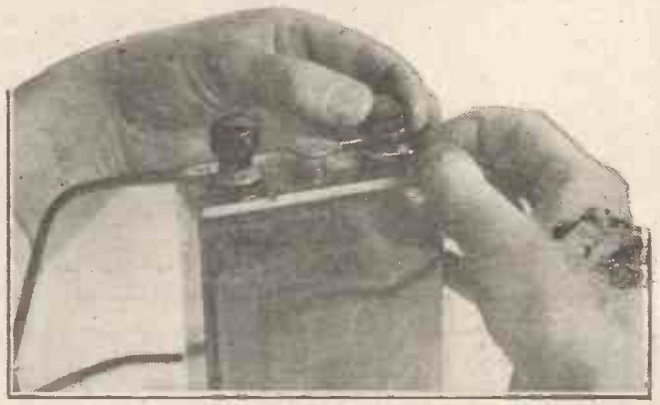
If several of the components on the set are nickeled (on-and-off switches, jacks, and many other components are now generally sold in a nickel finish) it may possibly be that the terminals will be the only other metal work showing. In such a case you will enhance the appearance of your set by purchasing the nickeled terminals at a very slight additional cost.

Much trouble is frequently caused by the loosening of terminals after they have been wired up. The reason is that, while you may have tightened the lock nut so that you feel certain the terminal can never move, the heat applied by the soldering iron will soften the ebonite, causing a certain shrinkage which may make the lock nut quite loose. For this reason I always take the precaution, after soldering up wires, of running round all nuts with a pair of pliers or a spanner. A very useful spanner for this work is the magneto spanner, sold by any motor-cycle shop or garage.

Short-circuiting a battery by brushing a lead against another terminal is an accident that can be avoided by connecting the battery terminals to the leads *after* connecting the leads to the set.

You will save much trouble arising from heating the terminals if, when you are soldering, you keep handy a wet duster, against which the heads of the terminals can be pressed. This will conduct away a good proportion of the heat. Immediately after you have removed the soldering iron you can take hold of the joint with the wet duster and cool it rapidly.

A good hot soldering iron, clean and well tinned, applied to a freshly-filed surface of the brass to which a touch of soldering flux has been applied, will enable you to solder very rapidly and before such heat has time to creep up the shank and soften the ebonite.



The corrosion of accumulator terminals can be prevented by applying vaseline in a manner indicated in the accompany article.

Fixing Indicating Terminals.

Many of the indicating terminals sold have in the shank a transverse hole in which telephone tags or other wire can be secured. In fixing the indicating terminals to the panel it is often found that after the nuts have been tightened the name on the top of the terminal is askew. To avoid this, unscrew the terminal head before you tighten it at the back, and slip through the hole in the shank a piece of stiff wire, the end of a scriber, awl, or anything which will pass through the hole, and in this way hold it securely in place with the lettering at the correct angle. You can then be sure that the shank will not turn while you are tightening up the lock nut at the back.

When you buy a new accumulator, unscrew the terminals, make sure that the brass work is perfectly clean and apply a liberal coating of vaseline to all exposed metal work.

Do not worry yourselves about bad contact here. You will find by experience that when the connecting wires are tightened the presence of the vaseline will not make the slightest difference to the flow of the current.

Periodically you may find it desirable to take off the terminals, wipe away the old vaseline which will naturally collect dirt from the atmosphere, and replace it with new. Providing there was no corrosion at the beginning, the vaseline will effectively prevent that nasty, greeny, chalk-like deposit which so often grows around accumulator terminals, and eats through the connecting wires.

SOLVING THE H.T. PROBLEM.

(*Continued from previous page.*)

taking a filament current of just about one ampere.

This does not mean, of course, that you take one ampere from your mains, as the voltage is stepped down and the current stepped up. The valve consumes, at the most, six watts, and although no step-down transformer is 100 per cent. efficient, no more than a 50 per cent. efficiency in this transformer would make the power consumption only 12 watts. Added to this, you have the actual current taken for charging the high tension accumulator (about a twentieth of an ampere, which means about another 12 watts), so that the cost of running the unit is probably very much the same as that of running an ordinary 30-watt electric light.

It is not advisable to run these rectifying valves with a higher emission than about 50 milliamperes, which, although it may be considerably less than the maximum charging rate recommended on your particular high tension accumulator label, is nevertheless an excellent "trickle" charging rate for regular charging. Assuming, for example, that you have a high tension accumulator of a capacity of 1,500 milliamps. placing it on charge with this apparatus once a fortnight from, say, 10 p.m. till 6 p.m. the next evening will more than compensate for the regular running, in that fortnight, of a very big set.

For example, if you run a receiver for three hours a day for fourteen days with a load of 20 milliamps., you will have taken out 840 milliampere hours. Twenty hours' charging at the 50 milliamp. rate once a fortnight will provide an adequate re-charge. Relatively few people take such a load for as many hours in a fortnight. Even a big 8-valve set should not require the use of this charger for more than 24 hours a week.

Method of Operating.

The method of adjusting this set is slowly to turn on the filament current by means of the filament rheostat, until your charging rate shown on the millammeter reaches 50 milliamperes. It does not matter, with 200- to 240-volt mains, whether you are charging a 60- or a 120-volt battery, for with the Burndept valve type U. 695, or other similar valve, and the filament resistance nearly full on, 50 milliamps. will be passed with ease. With a 60-volt high-tension accumulator the filament needs dimming more, until 50 milliamps. is shown on the meter.

Once you have adjusted the unit for your particular battery, the filament resistance can be left "set," only the change-over switch being used for operation.

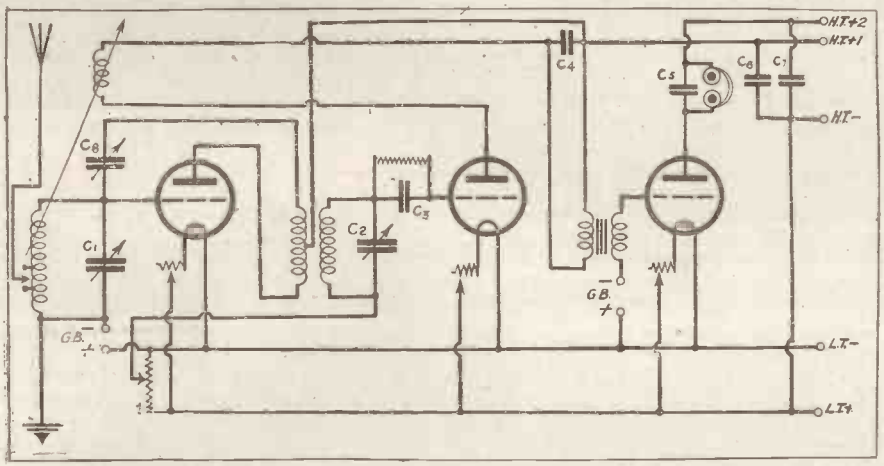
BRING YOUR OLD SET UP TO DATE.

PART II.

By PERCY W. HARRIS, M.I.R.E.

Further Practical Details of an Inexpensive Conversion Scheme.

YOU can readily obtain one or two very useful components by the aid of which, and by making a few changes in the wiring, you can adapt your receiver to a modern neutralised circuit, getting much higher efficiency by removing the cause of oscillation and by avoiding losses. First of all, take one of the several excellent neutralising condensers now sold (most of them are one-hole fixing) and attach it to your panel in some convenient position near the high-frequency transformer socket. Now make the following changes of wiring carefully:



This figure is reproduced from last week's issue for easy reference. Notice that the detector bias is now adjustable.

(1) If the filament resistances are in the negative leads, reverse the connections to the L.T. positive and the L.T. negative terminals within the set, as shown in Fig. 2. This will place the filament resistances in the positive valve legs, a better position for modern valves if grid bias is used.

(2) Remove the lead which goes from the variable condenser to the potentiometer slider and connect it directly to one of two new terminals for grid bias. Connect the other terminal to the negative L.T. wire.

(3) Connect one terminal of the neutralising condenser to the grid of the H.F. valve.

(4) Change the wires on the underside of your panel from those shown in Fig. 3 to those shown in Fig. 4. (Note: Figs. 3 and 4 will be found in last week's issue). You will notice that the lead which previously went to the H.T. positive and the variable condenser now goes to the second terminal of the neutralising condenser. Join the potentiometer slider, which was previously connected to the first valve, to the detector valve, as shown in Fig. 2. (Reproduced again above).

(5) Take the lead which previously went from the L.F. transformer to the L.T. negative lead to one of two more terminals, which you can place in a convenient part of the panel. The second terminal should now be joined to the negative L.T. lead.

Grid Bias Terminals.

The terminal connected to the transformer should be marked "grid bias negative," and the terminal connected to the negative filament lead should be marked "grid bias positive." I would also advise you to place a third terminal at some other convenient point, and mark it "H.T. positive 2." The lead which previously had been taken from the telephone or loud-speaker terminal to the common H.T. positive should be disconnected and taken to this H.T. positive 2. You will then be able to apply a higher voltage to your last or note-magnifying valve, with considerable improvement in results.

Simple Changes.

You will thus see that the changes we have made inside the set itself have been changes in wiring, and the fitting of one small condenser and five terminals. To plug into the set, we want one or two other components, and then we are ready to start work again with the improved results which I have foreshadowed. The further components are, firstly, a tapped aerial coil. No. 60 is a good size of the Lissen series. Join the aerial wire to one or other of the tappings (which of the two to use, you will find by experience).

In the Igranic series, a Unitune Aperiodic Fixed Coupler can be used. As previously mentioned, with the Lissen X coil the earth connection is left as before, and the aerial taken to one or other of the tappings. In the case of the Unitune both aerial and earth are disconnected from the set, the aerial being connected to one terminal of the Unitune coil and the earth to the other.

There is one important precaution necessary when using the Lissen X coil. See that the coil socket is so arranged on the set that the earth connection goes to the *socket*, and not to the pin of your coil holder. It is, of course, a simple matter to reverse these connections if you find they are not correct in your set. In the case of the Unitune there is no need to make any change.

A Few Costs.

Now the Lissen X coil costs 6s. 4d., and the Unitune coil 4s. 6d., so this expense is not great. A neutralising condenser can be obtained for a few shillings. The Gambrell neutrovernier, for example, costs 5s. 6d.; the McMichael, 4s. 9d.; the Igranic micro condenser, 5s. 6d.; and other makes have similar prices.

The one further special component required is a Gambrell "Transadapta" fitted with four-pin base to plug into the socket previously used for the H.F. transformer. The Transadapta is a device which enables you to use two plug-in coils side by side to form a very efficient H.F. transformer. A Transadapta costs 6s. 6d.

If your H.F. transformer socket is

(Continued on next page).

Some of the modern neutralising condensers now available for the home constructor. They are all "one-hole-fixing."

BRING YOUR OLD SET UP TO DATE.

(*Continued from previous page.*)

arranged on the panel so that the socket which would correspond with the grid of the valve is at the top, and the equivalent of the anode socket at the bottom when plugged in, the Transadapta will give you the primary coil on the left-hand side and the secondary coil on the right. The base of the Transadapta is knurled to form a special switch which, when rotated, reverses the direction of the windings of the secondary coil.

Plug-in Coil Arrangement.

The Transadapta is used by plugging-in two coils of the ordinary plug-in variety, of which, doubtless, you have several. For the primary in my scheme, you will require a centre tapped coil, for which I suggest a Gambrell centre-tapped B coil, a No. 75 centre-tapped Lissen, or any of the other good makes sold with centre tappings. For the secondary you can use any No. 75 coil you have in stock, or, of course, if you have to buy a coil for this, I would suggest getting one of the same make as that in which you purchased the centre-tapped coil, so as to make a good-looking pair.

A minute or two serves to adjust grid bias.

It now only remains to connect a flexible lead from the centre tap of the primary coil to the positive H.T.1 terminal. With this done I can tell you how to neutralise the set, and how to get the best from it. I shall be very surprised if your signal strength is not, at least, fifty per cent. better on the distant stations, and your selectivity will be very considerably improved.

Neutralising Adjustments.

It is important to remember, however, that the big advantage of properly neutralised radio frequency does not show up so well on very loud signals as on those which are fainter.

Assuming you have already made the changes, first of all place your "X" or "Unitune" coil in the aerial socket, without connecting aerial and earth to the set. Join up your batteries, insert your valves into their sockets in the usual way, and connect your telephones to the output terminals, or, if you are using a loud speaker, join this up as before. In the left-hand Transadapta socket place the centre-tapped 75 coil or a Gambrell C centre tapped, and in the right-hand socket a 75 or C without centre tap. Connect a single dry cell as grid bias in the left-hand grid bias terminals, and a suitable valve between the other terminals (L.F. grid bias). Turn your neutralising condenser to the minimum position and place your aerial tuning condenser at a low reading—say, 20 degrees.

Simple Neutralising.

Now slowly swing your second condenser backwards and forwards (the valves, of course, being switched on) and you will probably find that over a small band of readings on the second condenser, oscillation will take place. As you swing the condenser dial backwards and forwards you will pass in and out of this oscillation band. See that your reaction coil is placed in a position for minimum coupling to the aerial coil—i.e. at right angles to it.

Now slowly screw down the neutralising condenser for a turn or so and, leaving the aerial condenser in the same position as before, once again swing the second condenser backwards and forwards.

After a few turns of the neutralising condenser you will probably find a narrowing of the oscillation band; that is to say, if previously the oscillation had commenced at, say, 10 degrees on your condenser and continued to, say, 30 degrees, it may now start at 15 degrees and only continue to 25 degrees. Continue adjustment of the neutralising condenser, each time swinging the second condenser, and you will soon find a point where oscillation will not occur at any setting of the second condenser.

Now, without changing the neutralising condenser, set the aerial condenser at, say, halfway and repeat the experiment. The set should now be stable, but possibly there may be slight oscillation and a slight further adjustment of the neutralising condenser may be needed. The point is, so to adjust the neutralising condenser that whatever setting you may require on the aerial condenser, there is no corresponding point on the second condenser at which the set will oscillate.

Reaction Control.

With reaction the set will go in and out of oscillation with delightful smoothness and without any backlash. Now join up your aerial and earth and tune in the signals in the usual way. Preferably take a moderate strength station for the next adjustment. When you have tuned in and obtained good signals from some station other than the local, carefully vary the potentiometer knob until you find a position at which the best signals are secured. This position can be left permanently set.

The third test is to find which tapping on the X coil—if you are using this—gives you the best signals with your aerial. Probably there will not be a very great difference between them (remember, you must retune when changing), but I should imagine that the tapping, including the larger number of turns, would give slightly better results. Sometimes, when you can afford to sacrifice a little signal strength, it is useful to use the lower number of turns and thus obtain additional selectivity at a slight reduction of signal strength.

If you have made the changes suggested, write and tell me of the improved results you get. Remember, too, that by neutralising the set in the manner I have described, you will have considerably reduced the demands made upon your high-tension battery.

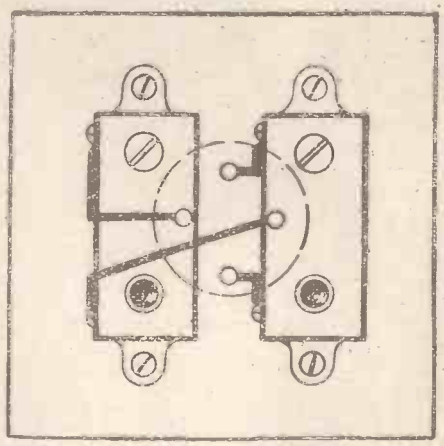
You will notice that provision is made for grid bias where perhaps it had not been before. If you have no previous experience in the adjustment of grid bias, do not imagine it is a complicated matter. All you have to do is to connect the positive wander plug of your grid bias battery to the positive grid bias terminal on your set and then, by taking a flexible lead from the negative grid bias terminal to the other wander plug, adjust the voltage by means of the tappings on your grid bias battery to the figure desired.

Adjusting Grid Bias.

The best grid bias will depend upon the make of valve and the high-tension voltage you use, but practically all makers give figures on the small sheet packed in the box with the valve. Remember, too, that you cannot do any harm by adding too much grid bias.

In all the makes of coils, larger figures will be required for the Daventry range. The Igranic people make honeycomb high-frequency transformers with centre tapped primaries, mounted on four-pin bases so that these can be plugged straight into your existing set without the intervention of the Transadapta.

Some readers who will not desire to return to the four-pin base transformers may care to make a change to the coil sockets which can be screwed on to the panel in place of the existing valve sockets. The diagram above shows the connections to what were previously the four sockets of the valve-holder. This method will be found cheaper than purchasing the Transadapta, but once the change is made it is no longer possible to use the four-pin transformer.

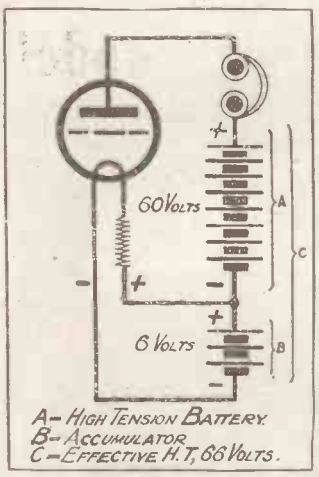


How to connect a pair of fixed coil sockets in place of the valve sockets.

Furthermore, the advantages of being able to reverse the secondary windings rapidly is lost. This, however, is not an important matter, for it is comparatively simple when carrying out one's first experiments to reverse the connections to the secondary (the right hand) coil-holder to find which of the two connections is the better.

Note.—In this section Mr. Harris will discuss each week interesting points from the large correspondence he regularly receives. Readers are invited to write to him on matters of interest, and extracts from their letters, together with Mr. Harris' comments, will be published from time to time. It must be pointed out, however, that general and technical queries cannot be answered in this section, but should be addressed to the Technical Query Department, complying with the conditions laid down under the heading, "Technical Queries" in each week's issue of POPULAR WIRELESS.

A CORRESPONDENT in the North of England has written to me on the subject of why some designs show the negative of the H.T. battery connected to the positive of the L.T. accumulator, while others show negative to negative. Either method is sound, but I prefer the former, for if we connect the H.T. negative to the L.T. positive, the voltage of the accumulator is added to that of the H.T. battery in circuit. Thus, if we are using a 6-volt accumulator and a 60-volt H.T. battery, the effective H.T. voltage in the circuit will be 66 and we might as well have this extra 6-volts at no further cost to ourselves and with no lowering of efficiency. The only advantage of the negative to negative scheme is that there is sometimes less chance of burning out your valves if a condenser is shorted in certain circuits.

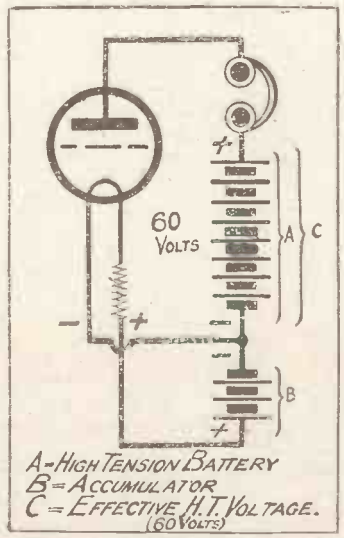


Illustrating the query on H.T. voltage.

This reminds me that few experimenters realise that when such a connection is made, as shown in the diagram above, there is no reason for connecting the Mansbridge or other blocking condenser across only the H.T. battery. In such circumstances the connection should be taken from H.T. positive to L.T. negative—across both batteries and not across the whole H.T. supply.

An interesting point affects the use of the shunting condenser across the primary of an L.F. transformer. It is still generally the custom to connect it from the plate of the valve to the H.T. lead. A better scheme and one which in many modern circuits gives definitely better results is to connect the condenser from the plate of the valve to the L.T. negative.

After all, the whole object of this shunting condenser is to by-pass the H.F. component back to the filament, and if the condenser is connected across the transformer, this H.F. current has to find its way back through the shunting condenser joined in parallel with the H.T. battery, across the capacity, between the leads and in other ways. If the H.T. battery leads are long, it is quite possible to obtain very undesirable effects in this way.



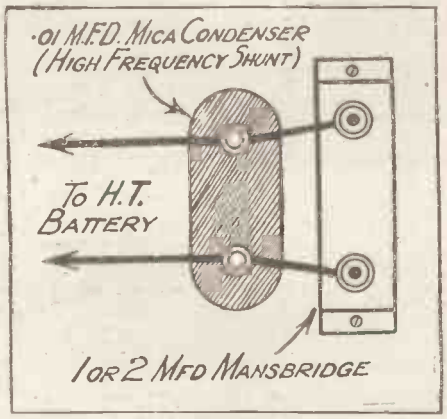
This arrangement gives a lower effective H.T. voltage.

Shunting the H.F.

It must not be imagined that the ordinary Mansbridge type of shunting condenser, because it has a very large capacity, is necessarily a good H.F. by-pass. However, such condensers by-pass L.F. currents with ease, particularly when the value is as high as 1 or 2 mfd. They also serve a very excellent purpose in acting as a reservoir of energy to steady the H.T. battery discharge, which may not always be quite so regular as one could desire.

At the same time, owing to the peculiar construction of the Mansbridge type (they are made by rolling up a long narrow paper and foil condenser) the H.F. resistance may be fairly high.

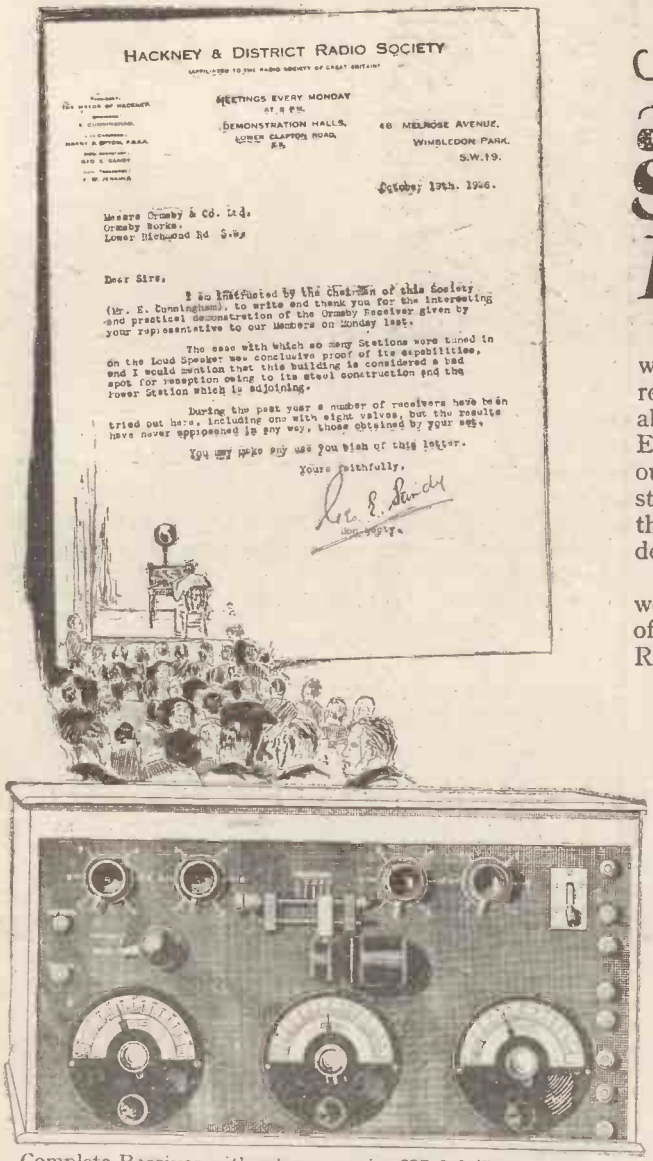
For this reason, in a circuit where radio frequency amplification is important, it is well to experiment with shunting the large Mansbridge condenser with a good, high quality mica condenser of, say, ·01 mfd. size, so that the H.F. current has a very low resistance H.F. path, while the L.F. currents are adequately by-passed by the Mansbridge. It should be remembered that the ·01 mfd. condenser offers negligible opposition to the passage of the H.F. current and, indeed, in many cases may afford a far easier path than the 2 mfd. condenser can offer. The actual arrangement of the condensers is shown above.



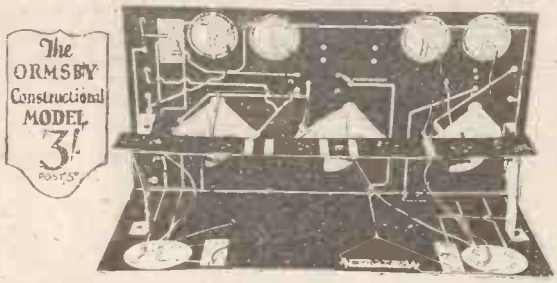
H.F. and L.F. shunt condensers.

A Valve Query.

"Will it pay me to use bright-emitter valves in my set, as they are so much cheaper than the dull-emitter kind?" asks a reader in South London. He mentions that he has bought a three-valve set and has a four-volt accumulator. I would strongly recommend him to buy the dull-emitter type, for the additional cost of the valves should not be more than eighteen shillings for the three, while his accumulator will last six or seven times as long without charging, using the dull-emitter type, provided he chooses an economical kind. It is easy to save the difference in cost between the two kinds of valve during a year in the fewer charges necessary. And then, think of the arm-muscles and the long tramps saved!



Complete Receiver without accessories £25-0-0 (Royalty paid).



A circuit that amazed a Radio Society — Read this Letter!

The letter on the left comes from a Radio Society which has tested nearly every long-distance type of receiving apparatus Doesn't this prove the remarkable powers of the Ormsby 4-Valve Long Range Extra-Selective Receiver? The Receiver which cuts out London almost under 2 L O's aerial, and tunes in station after station, no matter at what distance, on the loud speaker, with amazing ease and clearness, as demonstrated daily in our New Oxford St. showroom.

Letters from all over the country tell us of the wonderful achievements of this circuit, nearly all of them from customers who have constructed the Receiver from our Patent full-size model.

Build this set from the ORMSBY Model

You will build this remarkable receiver with ease and perfect confidence.

The model is a full-size reproduction of the Ormsby 4-Valve Long Range Extra-Selective Receiver, and is made in stout cardboard. Every component is shown in position and every wire is shown full size and to template. It is just a plain and straightforward model which gives wire for wire full size. The same circuit and design that achieved the wonderful results in the above letter.

If you would experience the thrill of long-distance wireless—of being independent of your local station—send for one of these full-size models to build from, and you can have a perfect long-distance Selective Receiver within a few hours. Complete in box with full instructions.

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Better be safe than sorry!

¶ See that your Battery Eliminator employs T. C. C. Condensers

MOST Battery Eliminators contain Condensers which have to stand up to the full voltage of the mains. The mains supply is often as high as 250 Volts A.C., and ordinary condensers tested to 300 volts cannot be guaranteed to stand up to this pressure for a long period.

Therefore, for safety's sake, use—or see that your Battery Eliminator utilizes—the special T.C.C. High-voltage Condensers. Built and tested to withstand 600 volts, the T.C.C., having been used on domestic lighting supply for a number of years, is perfectly safe and absolutely reliable. For behind it are twenty brimming years of experience in Condenser-making—years during which millions of Condensers, from large 4-ton Power models (consistently used by the G.P.O., Admiralty, War Office and Cable Companies), to the famous little green 1½-ounce Wireless Condensers have been used. In the name of safety, could there be a better choice for a Battery Eliminator than T.C.C.?

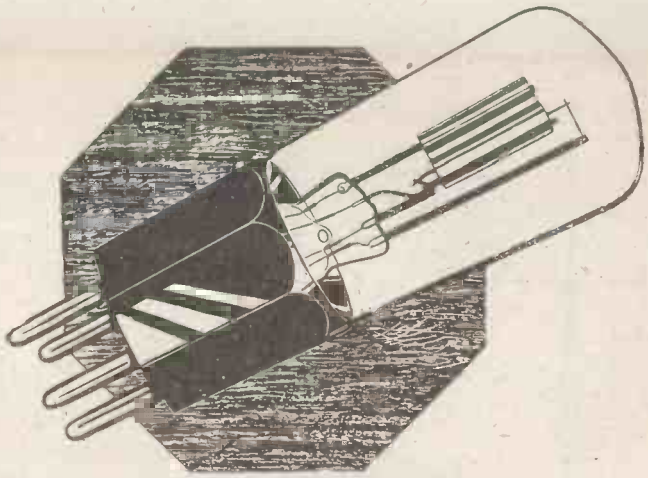
¶ *T.C.C. 600 volt D.C. Test Mansbridge Condensers for Battery Eliminators come in capacities of :5, 1, 2, 4, 5, 8 and 10 mfds.*

T.C.C. Condensers

(Tested & Guaranteed)

for Battery Eliminators

Advts. Telegraph Condenser Co., Ltd., N. Acton, W.3. Gilbert Ad. 6238



Features of the OCTRON Radio Valve

No. 1 The Filament

The Filament of the Octron—the heart of the valve—has been selected with the greatest care and is specially tested under the strictest supervision by filament experts. Its mounting has been so arranged as to hold it firmly without either a tendency to strain or to looseness. This point ensures longer life under the most strenuous conditions—and consequently *Valve Economy*. Furthermore, the Octron Filament consumes less current and gives greater volume and range than many valves.

For efficiency and economy use Octron Valves.

Watch for other points or send for full description of all types.

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Can be seen on several stands at the Manchester Wireless Exhibition.

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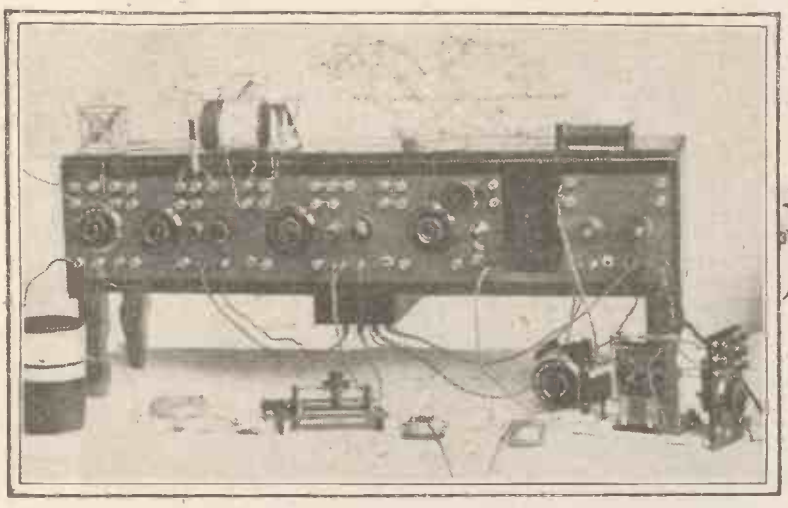


The INTERPLEX

Further Details about a very Interesting System.

PART II.

By J. ENGLISH.

HAVING reviewed the general features of the system, we now turn to the practical side of construction, and the first thing to be considered is the containing cabinet, the construction of which entails no intricate carpentry. If the constructor decides to make up the number of units used in the original, then the dimensions given herein should be followed. On the other hand, if it is required to alter these dimensions for lack of space, or to allow for addition of further units at some future date, then only the dimensions of the framework carrying the units need be adhered to, but in any case due care should be taken to make the width of the cabinet inside sufficient to accommodate the longest baseboard.

The photograph shows the main construction of the cabinet.

This part comprises a back, two sides, end, in front, a top and bottom bar, the whole supported at each end by two pairs of 6 in. legs. The dimensions given in Fig. 2 will probably furnish the constructor with all the information he requires, but before proceeding further, he should decide whether the cabinet is to stand on a table or bench, or whether it is to be clamped against a wall. In the latter case no legs will be required.

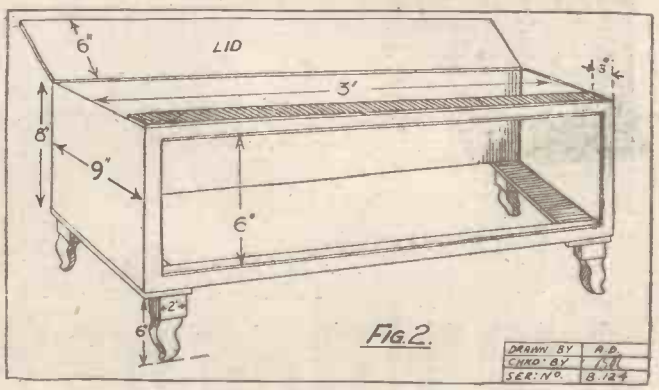


FIG. 2.

The Cabinet.

A section of the bars forming the front framework resembles somewhat a picture frame moulding, as shown in Fig. 1. Each bar is composed of a 3-ft. length of 1 in. square wood with a similar length of $\frac{3}{4}$ by $\frac{1}{4}$ in. lath screwed to it. The $\frac{1}{4}$ in. recess, so formed at top and bottom, accommodates the unit panels, and care should be taken that these 6-in. panels fit easily in any position between the two bars. Should the length of the bottom bar, which carries the whole weight of the apparatus, exceed 3 ft., then it would be preferable to use a length of well seasoned oak, or some other hard wood that will not sag under the weight.

The supporting legs are mounted by screwing one to each end of two lengths of wood 9 in. by 2 in., these in turn being screwed to the bottom of the cabinet one at each end.

The lid may be in one piece 9 in. wide, or divided, as the photograph of the finished set. Here the front section, 3 in. wide, is permanently screwed down, and serves as a ledge on which to place coils, etc. The rear lid may then be opened for inspection of the interior without having to remove these components.

The bottom should be fitted, but not permanently screwed down until the panels have had their locking devices fitted. This bottom board fits inside the cabinet and is screwed to the boards holding the legs and also to the main framework.

When all constructional work is finished the cabinet can be stained or polished in the usual way.

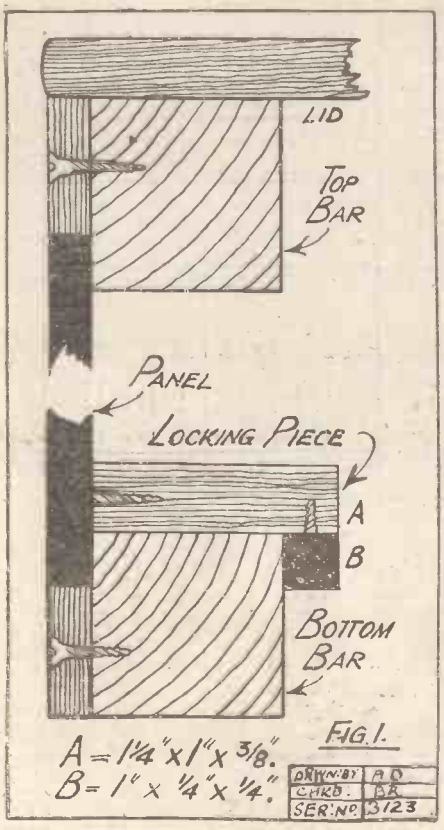
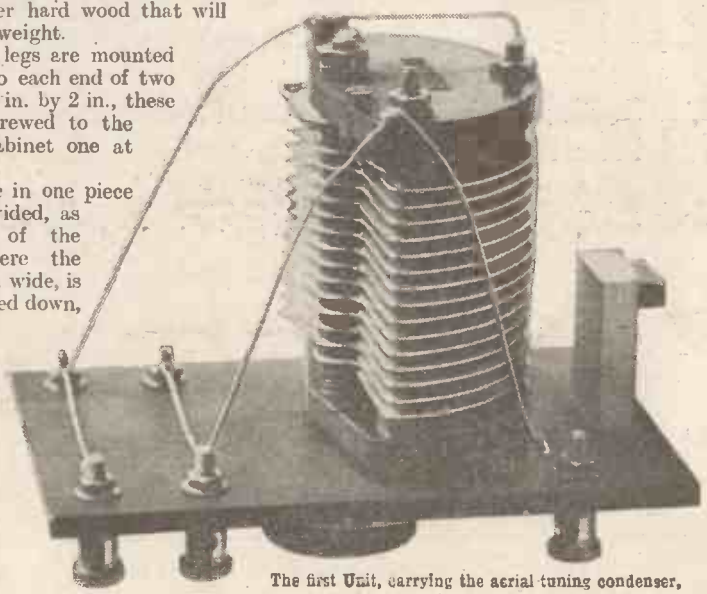


FIG. 1.

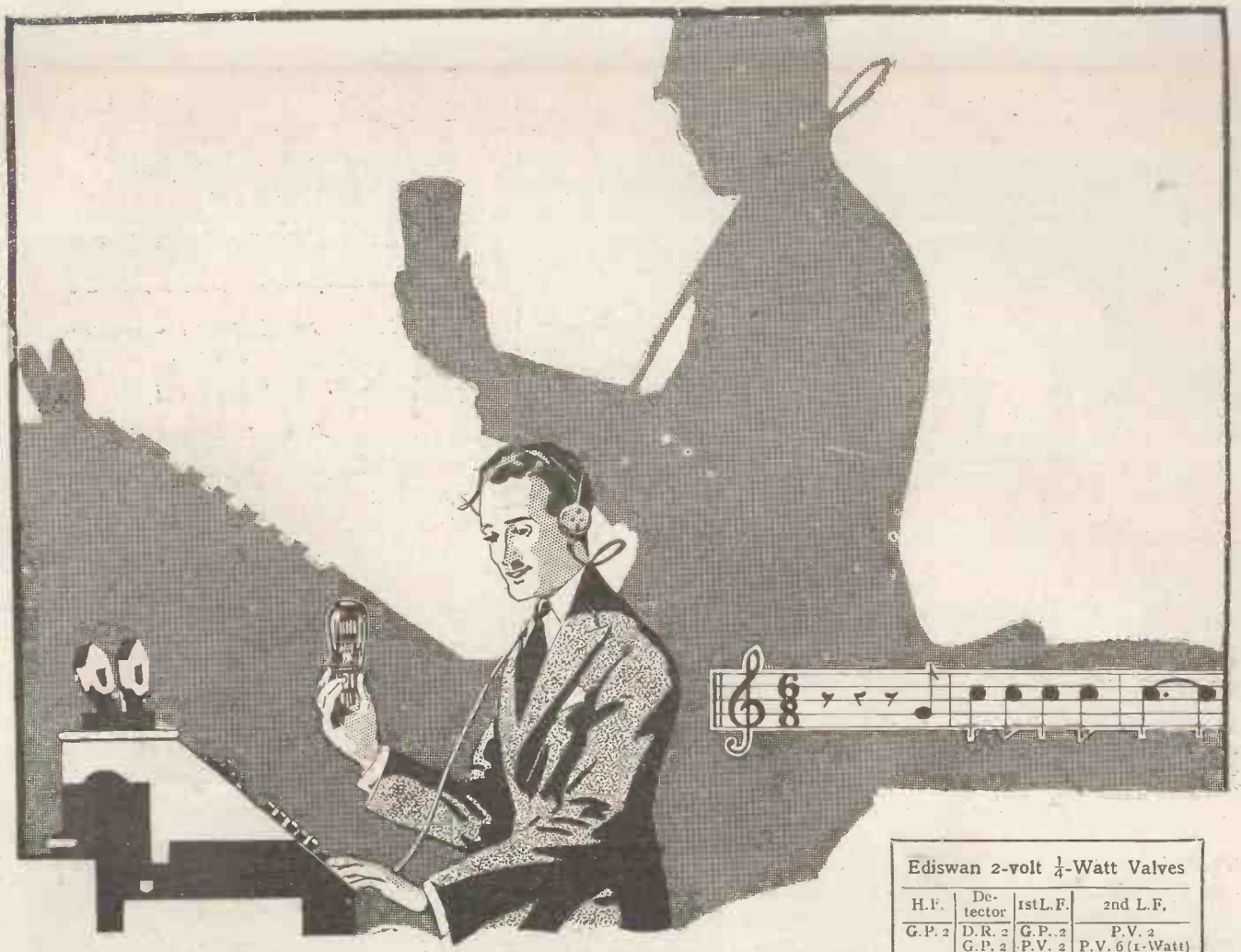
Constructing the Units.

The next step is the preparation and construction of the units, the full number

(*Continued on page* 567.)



The first Unit, carrying the aerial tuning condenser.



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GLORIOUS to hunt through the Ether to catch the distant station. Listen to this "View Halloo" for instance :—

"With a red stripe A.R., which worked excellently on 6 watts, I have worked all Britain, Irish Free State, France, Holland, Belgium, Channel Islands, Spain, Portugal, Germany, Italy, Sweden, Poland, Finland, East Prussia, Tunis, Madeira, Canada, Porto Rico, Denmark."

T. P. A., Belfast.

What a gallop beneath the stars! And what a tribute to the sheer all-round efficiency of Ediswan Valves! *They last and last and last.*

Ediswan 2-volt ¼-Watt Valves

H.F.	Detector	1st L.F.	2nd L.F.
G.P. 2	D.R. 2	G.P. 2	P.V. 2
	G.P. 2	P.V. 2	P.V. 6 (1-Watt)
		Resistance Coupling	
		*R.C. 2	P.V. 6 (1-Watt)

*The anode resistance used should not be less than 1—5 megohms.

PRICES: G.P. 2, D.R. 2, and R.C. 2, 14/- each: P.V. 2 and P.V. 6, 18/6 each.

RECOMMENDED EDISWAN COMBINATIONS

Receiving	Accumulator or Battery Volts	Prices	P'w'r	Prices
*A.R.D.E.	1.8–2	14/-	P.V.6	18/6
‡R.C. 2	1.8–2	14/-	P.V.6	18/6
‡R.C. 2	1.8–2	14/-	P.V.2	18/6
G.P. 2	1.8–2	14/-	P V 2	18/6
D R. 2	1.8–2	14/-	P.V.2	18/6
*A.R. .06	3	14/-	P.V.8	18/6
G.P. 4	4	14/-	P.V.4	18/6
*A.R.	4	8/-	P.V.4	18/6
R.	4	8/-	P.V.4	18/6
*A.R.	6	8/-	P.V.5	18/6
R.	6	8/-	P.V.5	18/6

*Made in L.F. and H.F. Types.
‡When R.C. 2 is used as detector, anode bend rectification should be employed.

All DULL EMITTERS except A.R. and R.

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THE EDISON SWAN ELECTRIC CO. LTD., 123-5 QUEEN VICTORIA STREET, LONDON, E.C.4

V S

TALLY HO!

Fit
EDISWAN VALVES
and nurse your set

Here are a few more proud "Tally Ho's" from the John Peels of the Ether:—

ACROSS THE WORLD!

"I can tune in Rugby any morning at all at 6 a.m. It certainly is great to have the Test scores laid on, and all the official British news, without having to wait for the papers hours afterwards. My valve is an Ediswan A.R. 06."

K. G., Melbourne, Australia.

OSLO ON SUNDAY NIGHT

"The Ediswan Valve purchased in August 1924 is still going strong. There is none to beat the A.R.D.E. for tone, life, loudness. I pick up San Sebastian, Hamburg, and Oslo on the loud-speaker on Sunday nights."

J. H. T., Sandbach, Cheshire.

SHIPS IN THE PACIFIC

". . . with one of your A.R. type receiving valves as detector I have heard signals from amateur stations in U.S.A., N.Z., Australia, Mexico, Brazil, Argentine, India, U.S.A. ships in Pacific, and all Europe."

B. W. W., Coventry.

AUSTRIA HUNTS DAVENTRY

"We listened in to Rome, Toulouse, Paris, Copenhagen, Malmo, Vienna, Budapest, Zurich, and Daventry. Daventry we are most interested in, and we frequently find that three valves are sufficient for clear reception, although 750 miles away."

H. W. D., Hallein, Salzburg, Austria.

1200 HOURS' RUNNING—HILVERSUM

"I am using 4 A.R. 06 Valves on a straight circuit 4-Valve set. After 1200 hours' running can still get Berlin, Hilversum, some Spanish Stations, and Hamburg at good loud-speaker strength."

A. C. B., West Kent.

***NOW* YOU KNOW THE VALVES TO USE! *NOW* YOU KNOW WHY KEEN WIRELESS MEN *ALWAYS* INSIST ON "EDISWAN"**

Ask your Dealer for a copy of Booklet—"The Ediswan Range" or write direct to Ediswan.

EDISWAN

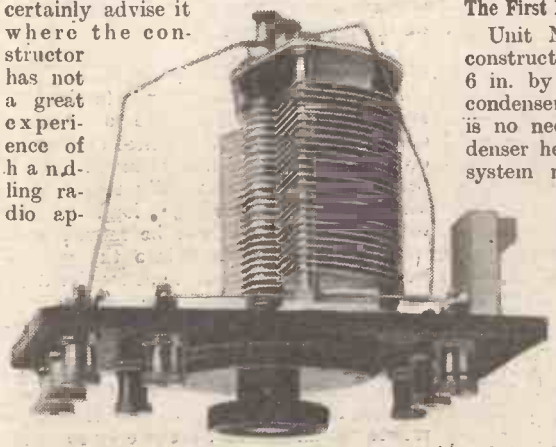
THE EDISON SWAN ELECTRIC CO. LTD., 123-5, QUEEN VICTORIA STREET, LONDON, E.C.4

V S

THE INTERPLEX.

(Continued from page 563.)

of which can be made up at once, or in easy stages. There is no reason why the latter plan should not be adopted, and I would certainly advise it where the constructor has not a great experience of handling radio apparatus, as he can get the hang of things better by making up one or two units and experimenting with them thoroughly before proceeding with the remainder. Thus units No. 1 and No. 2, together with suitable coils and 'phones, will cover most of the ground for crystal circuits, while the addition of one or two units Nos. 3 and 1 of Nos. 4 and 5 comprises sufficient apparatus for experiment with single valve circuits, straight, reflex, "stunt" or super. These units will probably keep the experimenter busy for a considerable time, and after completion of the remainder he will have enough apparatus to satisfy the most riotous cravings for experiment.



Another view of Unit No. 1, showing the disposition of the terminals.

The First Panel.

Unit No. 1, which is very simple in construction, comprises an ebonite panel 6 in. by 3½ in., eight terminals, variable condenser, and wire for connections. There is no necessity to use a square-law condenser here as the capacity of the aerial system nullifies the advantages of such types. The capacity of the condenser may be ·001 or ·0005 mfd., the smaller value where much short-wave work is to be done.

After the panel has been marked out and drilled by reference to the composite drilling and wiring plan, Fig. 3, the locking device should be fitted, as shown in Fig. 1. To obtain the correct adjustment the panel is placed in the cabinet frame and the 1-in. wide wooden piece A, resting on top of the bottom bar, screwed to the panel. The ebonite piece B, ¼ in. square and 1 in. long, is screwed on last. The panel is removed by pulling forward from the top and then lifting up, and the locking device should be adjusted so that this works without any stiffness. A similar locking piece is required for units Nos. 1, 2 and 3, while units Nos. 4, 5 and 6, which have baseboards, require only the ebonite piece B, the baseboard taking the place of A in Fig. 1.

When wiring up, it is preferable, as in all the units, to solder connections to tags screwed down beneath the terminal units rather than to solder wires direct to terminal shanks, etc. Tinned wire No. 20 S.W.G. is better than a heavier gauge, as it is easier to work and as there are no long leads in any of the units, it is sufficiently rigid for the purpose. Also, this size of wire does not introduce so much stray capacity as a heavier gauge, and stray capacity is highly undesirable in an experimental system.

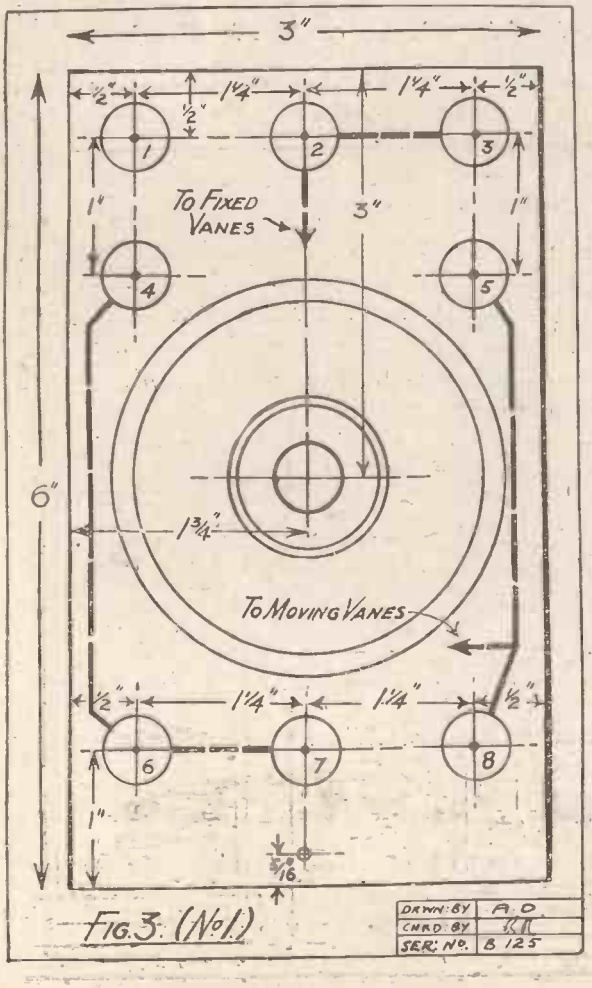


FIG. 3. (No. 1)

Adaptability.

The main purpose of unit No. 1 is to provide a number of terminals for inter-unit connections to aerial and earth leads which can be permanently connected to terminals 1 and 6 (Fig. 3). The terminals are so grouped and wired that the condenser may be used either in series or in parallel with the aerial tuning inductance. Connecting a coil to terminals 2 and 4, or 3 and 4 places the condenser in parallel, terminals 1 and 2 being shorted. For series condenser connections a coil is connected to terminals 7 and 8, which are also useful for introducing any component or circuit into the aerial system. To terminals 1 and 2 can be connected a fixed series condenser or a loading coil. Further uses of this unit will be evident later when we come to consider the operation of the entire system.

(To be continued next week.)

COMPONENTS.

	£	s.	d.
Cabinet		10	0
UNIT No. 1.			
Panel, 6 × 3½ × ¼		1	9
8 Eelex terminals		2	0
Variable condenser (·001)		10	6
UNIT No. 2.			
Panel, 6 × 2 × ¼		1	0
4 Eelex terminals		1	0
1 P.M. detector (R.I.)		7	6
1 Experimental detector		10	0
1 Jack D.P.S.T.		2	6
UNIT No. 3.			
Panel, 6 × 4 × ¼		2	0
6 Eelex terminals		1	6
Variable condenser, ·0005 or ·0003		8	6
UNIT No. 4.			
Panel, 6 × 4 × ¼		2	0
1 Baseboard			3
5 Eelex terminals		1	3
1 Dual rheostat (R.I.)		7	6
1 Grid leak (E.M.C.)		3	6
3 Eelex sockets			6
1 Eelex plug and socket			4
1 Single circuit closed jack		2	0
1 Valve holder (Benjamin)		2	6
1 Fixed condenser holder (McMichael)		1	0
UNIT No. 5.			
Panel, 6 × 3½		1	9
Baseboard, 8½ × 3¼ × ⅜			3
8 Eelex terminals		2	0
2 Eelex plugs			4
Variable condenser, ·0001		4	6
1 Transformer	1	5	0
1 Anode resistance		5	0
2 condenser holders (McM.)		2	0
Clips for battery, etc.			2
UNIT No. 6.			
Panel, 6 × 6 × ¼		3	0
Baseboard, 8½ × 5¾ × ⅜			6
4 Eelex terminals		1	0
2 Rheostats, dual		11	0
6 Eelex sockets		1	0
3 Eelex plugs			6
1 D.P.S.T. jack		2	6
1 Single jack		2	0
1 Transformer	1	5	0
1 Choke	1	0	0
2 Valve holders (Benjamin)		5	0
1 Fixed condenser holder		1	0
1 Grid leak, ·5 M.O.		2	6
1 ·01 fixed condenser		2	6
Clips for battery			6
F.C.C. PANEL AND SUPPLY LEADS.			
Panel, 9 × 5 × ¼		3	9
4 Eelex terminals		1	0
20 Eelex sockets		3	4
24 Eelex plugs		4	0
16 Eelex separators		1	4
Rheostat		3	6
Fuse		1	6
Wood, etc.			6
Total	£10	17	0

By CAPTAIN C. C. S. WHITE,

JUST as a conveniently planned house adds considerably to the comfort of the family, so a well-designed cabinet adds to the pleasure and satisfaction derived from wireless. Here is a design for a cabinet that has a place for everything and

everything in its place. Furthermore being self-contained, it has the double advantage that it presents a tidy outward appearance, and at the same time prevents your latest "hook-up" from being interfered with by unauthorised members of the household.

Neat Appearance.

The only leads outside the cabinet are the aerial and earth connections and two for the loud speaker. How very different from the untidy jumble of wire so often associated with wireless.

Incidentally, the popular type of cabinet, which is nothing more or less than a wooden box with one side omitted and replaced by an ebonite panel, possesses the great disadvantage that it is entirely unprotected from dust. This may not be so apparent whilst the set is new, but in time dust will collect on the ebonite panel and elsewhere, and form paths for the leakage of H.F. currents, with the inevitable result that the strength of signals will be reduced.

The cabinet is 3 ft. 1 in. high, 2 ft. 3 in. wide, and 1 ft. 3 in. deep, and has four main divisions. The top shelf contains the set proper, the middle shelf is available for H.T. batteries, and on the ground floor there is a space for the L.T. accumulator and a nest of three drawers which are extremely useful for storing headphones, spare coils, voltmeters and other small instruments.

The top compartment is arranged to take an ebonite panel (18 in. by 9 in. by ¼ in., a very convenient size) in either a horizontal or a vertical position. It is provided with a lid and two front doors, so that which ever way the set is mounted connections and alterations may be made without removing the panel. If mounted vertically, the set can be operated by opening the small doors and without disturbing the loud speaker or anything else which may stand on the top of the cabinet.

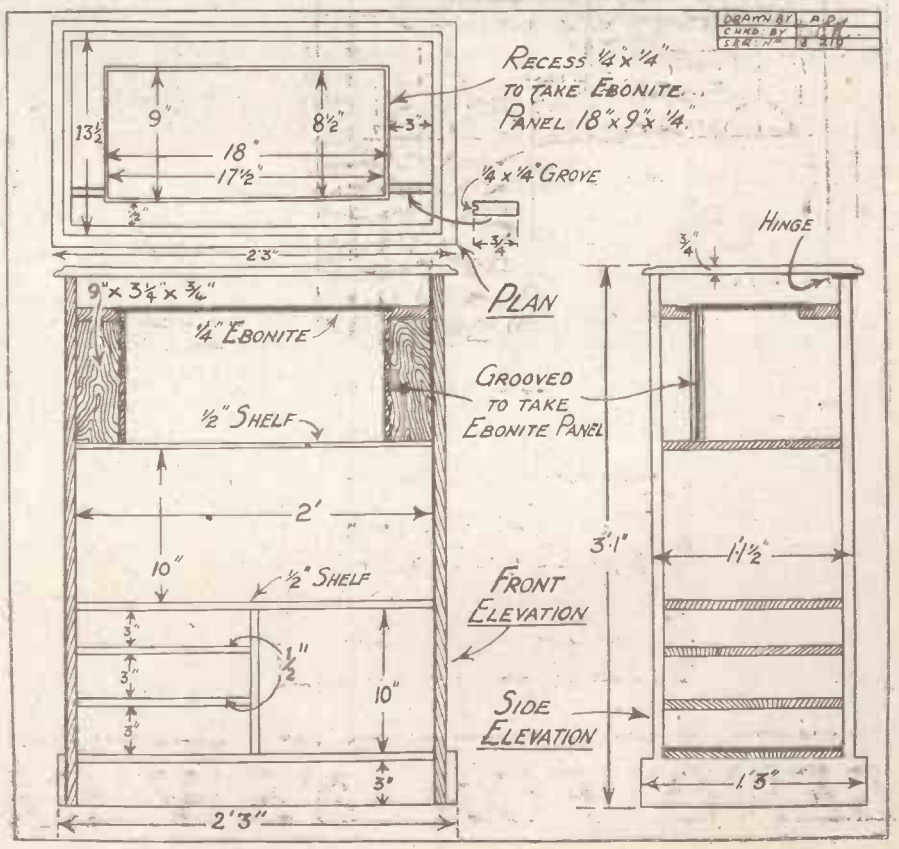
Loud Speaker Incorporated.

If it is required to incorporate the loud speaker there is ample space to do so by dispensing with either the nest of drawers or the lower battery compartment. But in actual practice it is usually found more convenient to have the loud speaker separate, so that it can be moved from room to room or even into the garden, whereas the set itself does not require to be movable.

The cabinet has been designed to accommodate a four-valve set, and dimensions have purposely been kept on the generous side. Whether the reader uses four valves or less, it is not considered advisable to reduce the dimensions, because by so doing one saves very little and takes off considerably from the cabinet's appearance as a piece of furniture.

The author's cabinet was made in mahogany and French polished, which gives it a very handsome appearance. But it can be equally well made in any other kind of wood, and finished to blend with the other furniture of the room.

Constructors desiring a really neat and efficient wireless installation will be well advised to build a cabinet somewhat on the lines of the one described, when the set itself will be well protected and the whole outfit will present a neat appearance.



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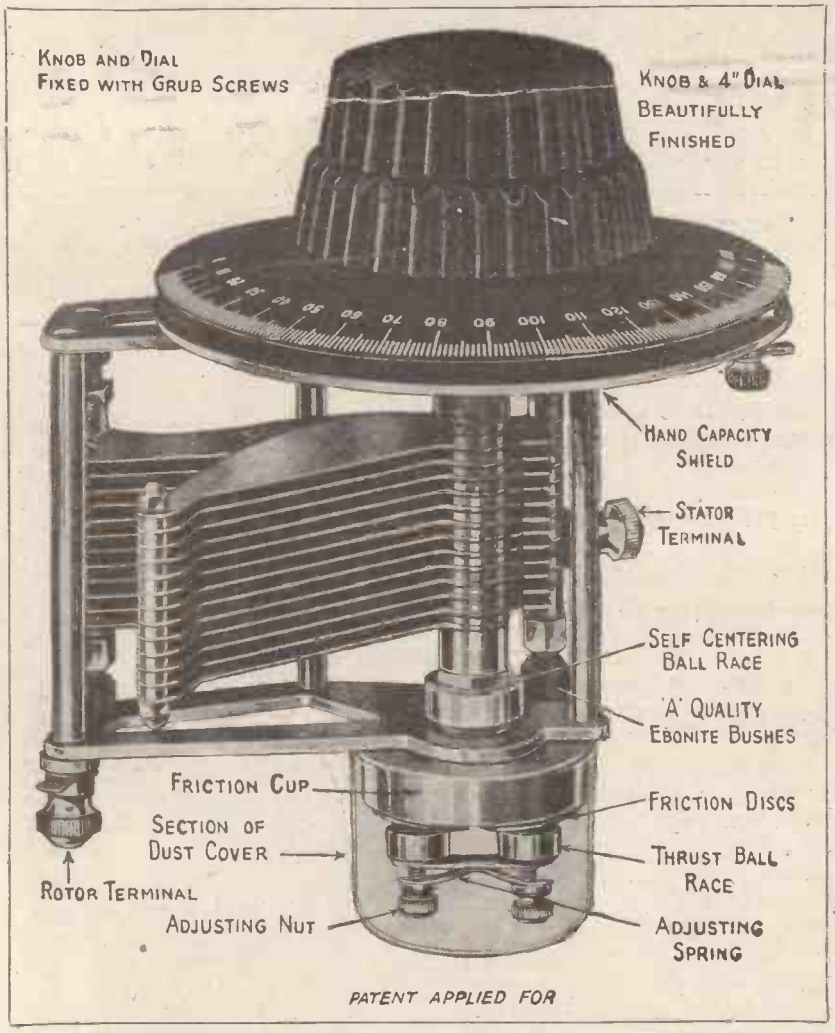
IDEAL RATIO 55—1.

THE markings of the ORMOND CONDENSER DIAL enable you to pick up any station with the minimum of trouble and without any unnecessary calculations. Precise tuning adjustments with noiseless operation are ensured by the general sound construction of this newest ORMOND product.



THE famous ORMOND SLOW MOTION FRICTION DRIVE (ratio 55-1) is incorporated and special ball bearings give liquid-like movement to every turn of the knob. It has an anti-capacity earthing shield which may be fitted, insulated from the condenser, and earthed by a separate connection. This world-famous ORMOND Component is easy to mount, having one and three holes for fixing, with both terminals and soldering tags for connections.

NOTE THE EXTRAORDINARILY LOW PRICES

With 4 in. Bakelite Knob		With Dual Indicator Dial	
·0005 mfd. ..	20/-	·0005 mfd. ..	21/6
·00035 mfd. ..	19/6	·00035 mfd. ..	21/-
·00025 mfd. ..	19/-	·00025 mfd. ..	20/6

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The NATIONAL WIRELESS WEEK
NOV. 7th—13th.
"Let your Friends Listen"

SEND FOR NEW CATALOGUE

If you had met Scott-Taggart—

SUPPOSING a month ago you had been on your way to a dealer to buy a valve and you had met Scott-Taggart. If he had recommended a certain valve as ideal for your purpose, would you have taken his advice? Supposing he had said: "When you get it, I shall be happy to test it out thoroughly and, after I am satisfied it is up to standard, give you a personally signed certificate to that effect," would you have accepted this offer?

You would not consciously have analysed the reputation he has built up as the best-known expert on valves in this country. You probably did not even know that his books on the subject have been a guide to over 500,000 readers of them. It might flash across your mind that he was the head of the great Elstree Laboratories and the keenest of critics of valves and apparatus. How far would his opinion have influenced your judgment? Would you have put his recommended and tested valve in your valve holder with confidence?

To-day you have actually to answer this question. John Scott-Taggart has relinquished all his former activities to produce the best valve he can. It is available in every type, and the designer personally initials every box to certify that the S.T. valve inside has been tested dynamically (i.e., under actual operating conditions) under his own supervision.

You are about to buy a new valve. Let it be an S.T.—the valve which, as its dynamic curve shows, gives high amplification and wonderful purity of reproduction. Thanks to the torodium filament and the high constant vacuum, its performance will be maintained, for S.T. valves are built—like the Pyramids—to last.

TYPES and PRICES.

2-Volt.				4-Volt.				6-Volt.			
H.F.	ST 21	1·8 volts. 0·1 amp.	14/-	H.F.	ST 41	3·7 volts. 0·1 amp.	14/-	H.F.	ST 61	5·6 volts. 0·1 amp.	18/6
L.F.	ST 22	1·8 volts. 0·1 amp.	14/-	Power	ST 42	3·8 volts. 0·1 amp.	18/6	Power	ST 62	5·6 volts. 0·1 amp.	18/6
Power	ST 23	1·8 volts. 0·15 amp.	18/6	Super Power	ST 43	3·8 volts. 0·25 amp.	22/6	Super Power	ST 63	5·6 volts. 0·25 amp.	22/6

DYNAMIC CURVES

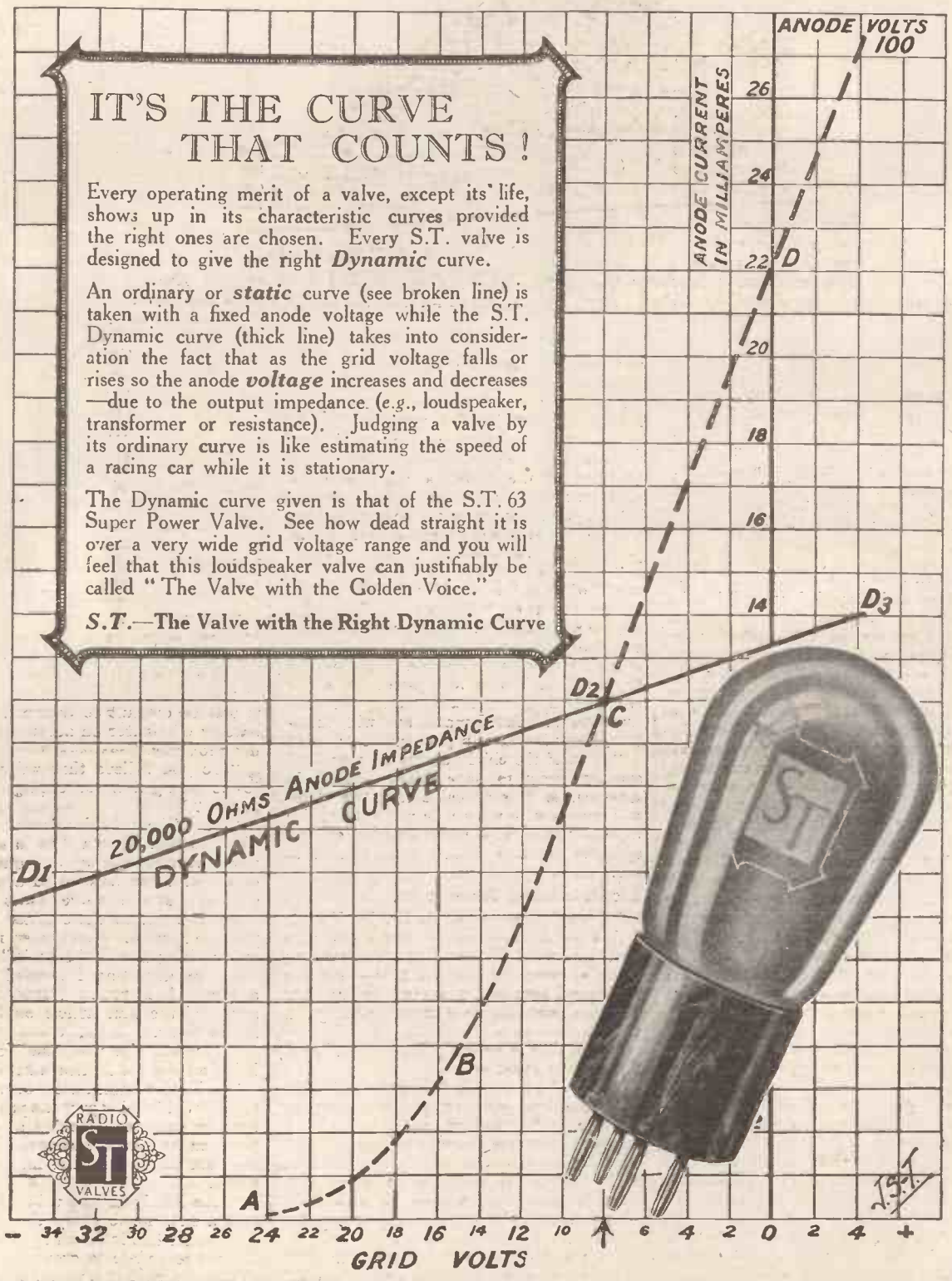
IT'S THE CURVE THAT COUNTS!

Every operating merit of a valve, except its life, shows up in its characteristic curves provided the right ones are chosen. Every S.T. valve is designed to give the right ***Dynamic*** curve.

An ordinary or ***static*** curve (see broken line) is taken with a fixed anode voltage while the S.T. Dynamic curve (thick line) takes into consideration the fact that as the grid voltage falls or rises so the anode ***voltage*** increases and decreases —due to the output impedance (*e.g.*, loudspeaker, transformer or resistance). Judging a valve by its ordinary curve is like estimating the speed of a racing car while it is stationary.

The Dynamic curve given is that of the S.T. 63 Super Power Valve. See how dead straight it is over a very wide grid voltage range and you will feel that this loudspeaker valve can justifiably be called "The Valve with the Golden Voice."

***S.T.*—The Valve with the Right Dynamic Curve**



A Chat With Lee de Forest

By LAWRENCE W. CORBETT.
(*"P.W.'s" New York Correspondent.*)

"SAY, Doc, d'ye remember me? Name's Wil B. Gonn, from way out Ludington, Mich. I'll have you shake hands with my friend Cyrus K. Potts, from Boston, Mass. Why, you sure look well, Doc. I'll tell the world—blah—blah!"

"Excuse, Mr. Forest. Farver wants your autergraf. Here's a pen. Ain't no ink in it, though!"

"Pardon me, Dr. De Forest, I represent the New York 'Daily Splash.' May I have a few words from you for your public, etc., etc.——"

Add to which the general commotion of a typical New York crowd, and you, considerate reader, will grant that it took the determination of such an individual as your faithful chronicler to thrust himself to the front and advise the keen-humoured Dr. Lee De Forest that POPULAR WIRELESS readers would like a word or two from him. And, incidentally, did I forget to record that the plot is laid one autumn evening at the Radio Show in the new Madison Square Garden? In New York, of course. Madison Square *Garden* is no garden, by the way, no more than is Oxford *Circus* a menagerie. It's the American edition of Olympia, where they hold dog shows, horse shows, and what not—not to forget the Radio Show.

Some Views on Cones.

The writer had struggled around booths innumerable, had watched the artists within a crystal-walled studio, shirt-sleeved, mop their perspiration-beaded brows, had given up in the attempt to estimate why the madding crowd insisted upon gathering unto itself every piece of literature that was offered free whether it be handed out by blonde or brunette; in fact, your author was more or less in the process of extracting himself from the tentacles of an octopus-like mass of swaying humanity, when, through a maze of faces, a familiar one was espied.

"Say, Doc, d'ye remember me? Name's Wil B. Gonn——"

Yes, it was the face of the Doc—of Dr. De Forest, who needs no more introduction to you than would Bernard Shaw. A furtive glance towards the nearest exit supplied the information that escape in that direction was effectively blocked by several corpulent gentlemen, and so the Doctor resigned himself to his fate. Greeting me in a fashion far exceeding in friendliness that I expected for intruding at such an inopportune moment, Dr. De Forest expressed his willingness to answer my questions which, I informed him, were asked expressively for POPULAR WIRELESS readers.

"Didn't you interview me about a year ago at my phonofilm studio?" he asked.

"Yes, indeed, Doctor. On the eve of your departure for London."

Not having been given the opportunity to speak to Dr. De Forest since that date, I asked him now what impressed him most during his visit to Europe in the radio field, of course.

"More recent developments may make obsolete my reply," he answered, "but I was certainly very much impressed by the Daventry station, which I consider a wonderful achievement of the engineers of your British Broadcasting Company."

Having visited the Amplion booth just previous to the discovery of Dr. De Forest's presence at the Show, a question of a different nature cropped up in my mind.

"Do you think that the cone loud speaker will become even more popular than it is at present?" I ventured.

"With the comparatively recent development of transformers for low-frequency amplifiers that are really capable of amplifying the whole audio-frequency range, it is not surprising that a loud speaker capable of equal frequency reproduction of the audible range should also be in demand for use in conjunction with the amplifier. The cone seems to fulfil this demand, and will, therefore, likely increase in popularity.

"Most of the chief patents on cone loud speakers seem to have fallen through in America, so it is probable that the 'fan' will have a wide variety to make his choice from, for most radio manufacturers of loud speakers are now adding cone models to their lines."

Radio's Important Developments.

"I see," I suggested to Dr. De Forest, "that the Amplion people have a new cone on their booth. This will be an interesting piece of news for English fans—that the recognised horn loud-speaker pioneers have branched out into cone manufacturing," I added.

"Yes, that is certainly interesting," said the famous inventor.

"Why," I inquired, "do you think that the cone loud speaker has not been so popular in England as in America?" I suggested that the patent situation in England hindered development along this line, and prevented manufacturers going into mass production on a cone, as is done in America, and thereby bringing a popular one within the means of all.

"I really cannot explain why England is so behind as regards cone development," was the reply to my question. "I can hardly reconcile myself to your suggestion that stringent patent regulations there hinder the production of a cheap one. If the patents have fallen through in this country, I don't very well see how they may be sustained abroad."

I then questioned Dr. De Forest concerning his opinion as to what were the most important developments in radio since the previous New York Radio Show.

"The wholesale tendency towards the elimination of high-tension batteries and the general use of the trickle charger for accumulator charging. To depend upon an outside man to charge your low-tension battery is now out of date. Many receivers operate direct from the mains without the necessity of a charger, both the filament and plate potentials coming from the house supply. Even the grid bias is being drawn from this source," answered Dr. De Forest. "However, I don't believe that the receiver operated direct from the mains (with no batteries) is destined to become popular.

"Receivers advertised as 'operated from the house lighting supply' will generally be found to have contained within their cabinets a low-tension battery of the wet type which is automatically connected to a trickle charger when the set is switched off for the night. The use of a trickle charger in conjunction with an accumulator, is, I consider, the ideal arrangement. The plate potential will be taken from the mains in most modern sets.

"An Interesting Circuit——"

"As the power amplifier is destined to become more popular," continued Dr. De Forest, "valves capable of handling a lot of current without overloading will be in great demand, and partly for this reason it will be difficult to design a low-tension battery eliminator on account of the filtering problems."

"Do you believe that valves are likely to be changed a lot during this coming season?"

"No. The only developments I believe likely to take place will be in the design of power valves. The urge for quality instead of distance has become so acute that the general purpose valve must necessarily disappear. With these latter it is hardly possible to expect good quality reproduction on anything like loud signals."

Before departing I handed the Doctor a copy of POPULAR WIRELESS in which appeared the first article on the Olympia Radio Show.

"This will give you some idea of what is being offered the British wireless amateur."

The Doctor immediately evinced interest, and started turning over the pages. Noticing that he continued looking at a particular page longer than the others, I glanced over his shoulder to see what interested him so much.

"The Filadyne," he volunteered. "One sees a new name every day, but I must admit that this looks an interesting circuit. Let me see, plate to ground——"

This, I considered, would be an opportune moment to make my escape, and hastily apologising for my intrusion, I left the Doctor deep in thought—— "Plate to ground."

Traders and manufacturers are invited to submit wireless sets and components to the "P.W." Technical Dept. for test. All tests are carried out with strict impartiality in the "P.W." Test room under the supervision of the Technical Editor, and the general reader is asked to note that this weekly article is also intended to provide a reliable and unbiased guide as to what to buy and what to avoid.—EDITOR.

"MOULDENSITE" LINK INSULATOR.

CONSIDERABLE losses will attend the use of inefficient aerial insulators, more especially in the smoke-laden atmosphere of our large cities. High-frequency currents such as are induced in a radio antenna by wireless signals are not of the robust nature of those which flow around lighting mains, and are not to be held in check by even moderately good insulating materials unless these are kept clean and are provided with long leakage areas. A difficult problem has been solved in an ingenious manner in the "Mouldensite" Link Aerial Insulator, a product of Mouldensite Ltd., Darley Dale, Derbyshire. The article consists of three perfect links provided with sharp edges around their inner sides. Thus, when stretched out, the middle link is in contact with only "knife-edge" areas of the other two.

The Mouldensite material is hard and non-absorbent and the long insulative paths are broken by the two knife-edge contacts so that even slight surface leakage is practically impossible.

The insulator is quite light, despite its mechanical strength. Price for two chains (one for each end of an aerial) is 5/-

M.A.P. "VERNI-NOB."

Quite a number of amateurs must have felt the want of some really cheap device which could be fitted to an existing set in order to provide a fine tuning adjustment for an ordinary variable condenser. The M.A.P. "Verni-Nob" costs 6d., and cheap though it is, it answers the purpose admirably. Carefully fitted, no idea of its usefulness can be gained by reflecting that its price is merely "six coppers." That this little product of the M.A.P. Co., of 246, Great Lister Street, Birmingham, caught the public eye at the Wireless Exhibition, is proved by the fact that over 8,000 were sold at Olympia. It can be easily fitted to a panel by drilling one ¼-inch hole. At the price of a high-class terminal we consider it excellent value for money.

NOVEL REMOTE CONTROL DEVICE.

With most remote control systems it is necessary to run extra leads or at least one lead in addition to the loud-speaker leads, but this is not the case with the Lissen "Telepathic." On the face of it this would seem an impossible proposition, and it was owing to the fact that we were somewhat sceptical that we asked Messrs. Lissen to send one along, so that we could test it. It operates in a rather uncanny manner. Merely by disconnecting one of the loud-speaker terminals yards away from the set the L.T. battery can be switched off. So far, so good; one can picture a relay which is "held" by the H.T. current passing through the loud-speaker extensions. But by connecting the loud-speaker lead on again, the L.T. is switched on and this, it must be mentioned, without the assistance of any other batteries than those used on the set. There are only four terminals on the "Telepathic." To one is connected a lead from a loud-speaker terminal on the set; to the other, one of the loud-speaker extension leads; to a third, one lead from the L.T. battery, and to the remaining terminal, a lead from an L.T. terminal on the set.

Of course the device embodies a double contact relay; but how this does the job—

(*Continued on page 576.*)

APPARATUS TESTED.

(Continued from page 574.)

well, we will leave our readers to try and piece the puzzle together themselves. Suffice to say that the control operates positively and in every way quite satisfactorily, and that we apologise to Messrs. Lissen for our quondam scepticism. To see, or rather, hear, the "Telepathic" control in operation is somewhat reminiscent of Maskelyne and Devant. Here, one moment, we have a perfectly "dead" line, a perfectly "dead" set; and two happily somnolent batteries (H.T. and L.T.) and the next moment by merely connecting up a loud speaker at the end of a pair of long extension leads everything springs to life with a click.

The Celestion Radioform Portable Receiver.

Of course, the device cannot be used if a choke-condenser or a transformer loud-speaker by-pass is incorporated in the set. The "Telepathic" is very well made, is small and neat in appearance, and costs £2 10s.

AN AMPLION VALVE.

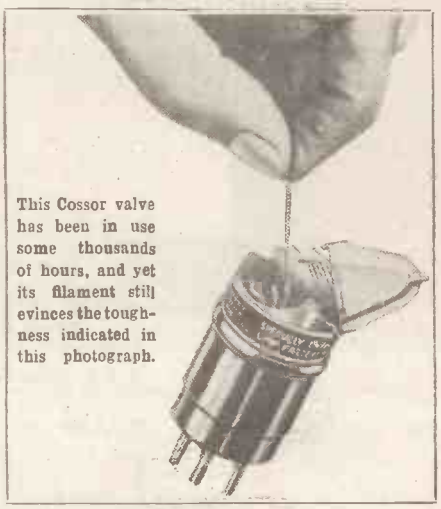
The loud speaker used with a multi-valve set forms a part of the anode circuit of the last valve, so that it is obvious that best results obtain when these two items are carefully chosen to work together. In these circumstances it is probable Messrs. A. Graham & Co., in producing the type AML 2/30 Amplion valve, have had foremost in mind the characteristics of their world-famous Amplion loud speakers, and a combination that would give evidence of successful team work. We have always advocated the policy of matched parts, so we were glad of the opportunity afforded us of taking these two Amplion products together by the arrival of a sample of the AML 2/30. It operates at 1·7 volts, and takes, according to Messrs. Graham, "30 centiamps.," although we personally would prefer to learn that it consumed 0·3 amps. or 300 milli-amps.!

It is, as previously indicated, a power valve, and has an impedance of 7,500 ohms, an amplification factor of 7, and retails at 14/-. It also has a Volume Factor of plus and minus nine. Volume Factor is a new term originated by Messrs. Graham and, we presume, indicates the power the valve will handle without causing distortion.

It is an extremely neat little valve, and is constructed on the "Shortpath" principle, with closely and skilfully assembled vertical electrodes. With up to 120 volts H.T. and 6 to 9 volts grid bias it delivers an excellent volume with a most commendable degree of purity of tone. Used in conjunction with an Amplion speaker, music and speech come through with outstanding clarity. It can be employed with other speakers, of course, and gives as proportionately good results.

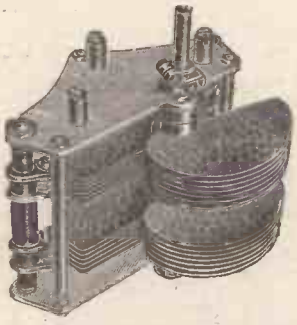
"HART" BATTERIES.

In an advertisement concerning Hart Batteries which appeared on page 508 of our October 30th issue, a printer's error occurred and unfortunately escaped correction. The price of the "Ray" model high tension Accumulator was stated to be 14/6. This should have been 14/8 the price at which the battery is usually advertised.



This Cossor valve has been in use some thousands of hours, and yet its filament still evinces the toughness indicated in this photograph.

IGRANIC COMPONENTS for MODERN CIRCUITS

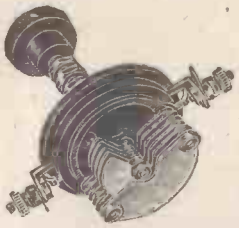


IGRANIC DUAL VARIABLE CONDENSERS (Square Law Type)

Extremely low losses, accurate square law characteristics, ball bearing movement and best possible workmanship throughout.

·0003 mfd. Dual .. **22/6**
·0005 mfd. Dual .. **27/-**

There are also:
Igranic Square Law Condensers.
Igranic-Pacent Straight Line Frequency Condensers.
Igranic-Pacent Square Law Twin Gang Condensers.
Igranic-Pacent Square Law Triple Gang Condensers.



IGRANIC MICRO CONDENSERS

Ideal for neutrodyne circuits and in all cases where extremely small variations of capacity are required. Can also be used for Vernier adjustments where a slow motion dial is not employed.

PRICE .. **5/6**
Bracket for base mounting, 6d.

Igranic Vernier Balancing Condensers same price.

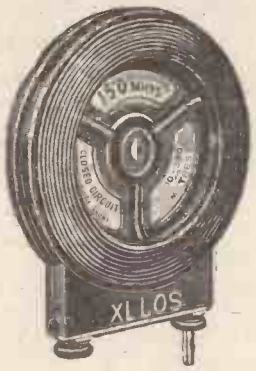
The NATIONAL WIRELESS WEEK
NOV. 7th.-13th.
'Let your Friends Listen'

Let your friends listen-in—encourage them to build receivers of their own, and tell them of the wonderful reception obtainable with—

RADIO IGRANIC ELECTRIC Co. Ltd DEVICES

The Igranic range of components includes every part necessary for the construction of modern receivers of the highest efficiency. Crystal user or multi-valve enthusiast, you will find particulars of just the parts you want in the Igranic Catalogue No. R 33, which will be sent you free on request.

IGRANIC "XLLOS" COILS
(Extra Low Loss)



Igranic 'XLLOS' Coils are wound in a special manner which results in the self-capacity being extremely low. The winding is enclosed in a sealed Bakelite shell which excludes dust and moisture and prevents the windings being damaged.

Pin and socket are separated by an air space, and the spacing between them is adjustable up to 2 ins.

PRICES from 3/9 each.

"IGRANIC" CENTRE TAPPED "XLLOS" COILS
(Extra Low Loss)

These coils actually have two separate inductances which may be used in several different ways, making them suitable for a variety of circuits and particularly useful for experimental work.

Igranic Centre Tapped "XLLOS" Coils are made in five sizes and cover wave-lengths of approximately 110–3,500 metres.

PRICES from 7/- each.

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Works: BEDFORD

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The Editor will be pleased to consider articles and photographs dealing with all subjects appertaining to wireless work. The Editor cannot accept responsibility for manuscripts and photos. Every care will be taken to return MSS. not accepted for publication. A stamped and addressed envelope must be sent with every article. All inquiries concerning advertising rates, etc., to be addressed to the Sole Agents, Messrs. John H. Lile, Ltd., 4 Ludgate Circus, London, E.C.4.

As much of the information given in the columns of this paper concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and the trader would be well advised to obtain permission of the patentees to use the patents before doing so.

Readers' letters dealing with patent questions, if sent to the Editor, will be forwarded to our own patent advisers, where every facility and help will be afforded to readers. The envelope should be clearly marked "Patent Advice."

TECHNICAL QUERIES.

Letters should be addressed to: Technical Query Dept., "Popular Wireless," The Fleetway House, Farringdon Street, London, E.C.4.

They should be written on one side of the paper only, and MUST be accompanied by a stamped addressed envelope.

Queries should be asked in the form of the numbered questions: (1), (2), (3), etc., but may be accompanied by a short letter giving any necessary additional particulars as briefly as possible.

For every question asked a fee of 6d. should be enclosed. A copy of the numbered questions should be kept, so that the replies may be given under the numbers. (It is not possible to reproduce the question in the answer.)

BLUE PRINTS. A series of 20 Blue Prints can be obtained from the Query Dept. price 6d. per Blue Print.

Only a limited number of circuits are covered in this series, and full details of the circuit arrangements available in Blue-Print form are published fortnightly in the advertisement columns of this journal.

All other back-of-panel diagrams are specially drawn up to suit the requirements of individual readers at the following rates: Crystal Sets, 6d.; One-Valve Sets, 6d.; One-Valve and Crystal (Reflex), 1s.; Two-Valve and Crystal (Reflex), 1s.; Two-Valve Sets, 1s.; Three-Valve Sets, 1s.; Three-Valve and Crystal (Reflex), 1s. 6d.; Four-Valve Sets, 1s. 6d.; Multi-Valve Sets (straight circuits), 1s. 6d. Except SUPER-HETERODYNE DIAGRAMS, all of which, irrespective of number of Valves used, are 2s. 6d.

If a panel lay-out or list of point-to-point connections is required an additional fee of 1s. must be enclosed.

Wiring diagrams of commercial apparatus, such as sets of any particular manufacture, etc., cannot be supplied. (Such particulars can only be obtained from the makers.)

Readers may submit their own diagrams, etc., for correction or for criticism. The fee is 1s. per diagram, and these should be large, and as clear as possible.

No questions can be answered by 'phone.

Remittances should be in the form of Postal Orders.

Questions and Answers

POTENTIOMETER AS STABILISER.

R. S. A. (Erdington, Birmingham).—I have a tuned anode H.F. amplifying valve in use, and have tried various methods of stabilising it, including neutrodyning. Now I wish to try a potentiometer instead, as I have one on hand (300 ohms). What are the connections, and how much current will the potentiometer take from the accumulator, which is of the two-volt type?

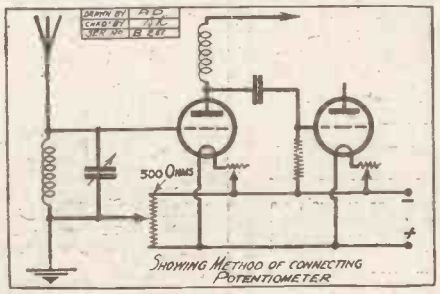
(*Continued on page 580.*)

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from page 578.*)

The method of connecting the potentiometer is shown by the accompanying diagram.

This shows the aerial condenser connected in parallel with the coil, the sides that are joined to earth being connected to the slider of the potentiometer also. The opposite ends of the potentiometer are joined across the L.T. negative and positive



Showing Method of connecting Potentiometer

leads. Although all the rest of the circuit is not shown, enough of the essential connections are given to make the method plain.

The current taken from the accumulator is found by Ohm's Law, $C = \frac{E}{R}$ where C = the Current, E = E.M.F. (i.e. voltage), and R = Resistance.

In this instance the E.M.F. is 2 volts and the resistance is 300 ohms, so the current = $\frac{2}{300}$ = ·007 amp. (approx.).

This represents a very small drain on the accumulator, but it is usual to switch off at the L.T. battery itself (and not merely at the rheostats), so that when the set is not in use no current flows in the potentiometer circuit.

CRYSTAL RECEPTION.

R. E. (Slough, Bucks).—Is a good outdoor aerial essential in order to get good signals with a crystal set?

Yes, under ordinary conditions. Generally speaking the importance of a good aerial is greater when using a crystal set than when a valve receiver is employed. The better the aerial the louder will be the signals, and this is especially so when the broadcasting station is situated several miles away from the receiver.

"THE SPIDER."

A. J. (Hastings, Sussex).—Is it essential to use the multi-ratio L.F. transformer for the "Spider Set," described in "P.W." No. 228 (October 16th, 1926)?

Yes. The multi-ratio type of transformer is essential for this set.

BY-PASS CONDENSERS.

E. L. (Kingston-on-Thames).—I have been told that I require a by-pass condenser across the primary windings of my L.F. transformer. (The set is an ordinary Det. and L.F.). What is a by-pass condenser?

The ordinary fixed condenser as shown in the accompanying photograph, can be used as a by-pass condenser, as suggested. The term "by-pass"

refers merely to the fact that when a condenser is connected across the primary of a low-frequency transformer or similar component it serves to by-pass H.F. impulses across that part of the circuit, because it affords an easy path for the H.F. currents that would otherwise be impeded by the high inductive winding of the transformer.

RANGE OF RECEPTION AND TUNING RANGE.

H. C. (Shepperton-on-Thames).—I have a crystal set consisting of a broadcast variometer, 'phones, with small condenser and crystal detector, and with a 25-ft-high aerial I get very good signals. I am told that a variable condenser would still further improve results and give better tuning. Is this so, and how should it be connected.

You would not improve results by adding a tuning condenser, as this is only useful for tuning a fixed coil or for "loading" a variometer.

The latter by itself is capable of very fine tuning, and the addition of a capacity across it would be detrimental, unless it is necessary to increase the *tuning* range of the instrument.

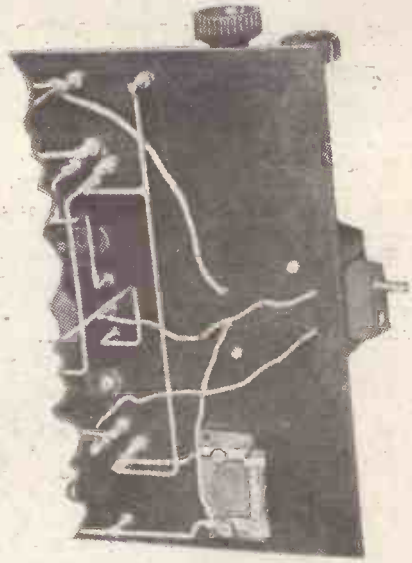
This tuning range is merely a band of wavelengths which the instrument will cover, and has nothing to do with the range of reception which is what you wish to increase.

FLEXIBLE COIL CONNECTIONS.

"Blue Print Constructor" (Horsham, Sussex).—I have made several sets from the "P.W." blue prints, but I find a difficulty in arranging the connections to the moving coil.

I have short lengths of flexible wire to connect up the moving coil, but as these sometimes need reversing, I should like to use flexible leads for all four coil connections. Would this impair the efficiency of the set?

There is no objection to using flexible leads for all the four coil connections. The leads should go through the panel as shown in the accompanying photograph, and they should be soldered to the nearest point of the wiring to which they are to be connected. Before "boxing up" the set, it is



advisable to space the leads apart from the rest of the wiring, avoiding parallel leads, so that interaction is reduced to a minimum.

WAVE-TRAP CONSTRUCTION.

"Interference" (Manchester).—What is a "wave-trap," and can it be successfully constructed at home?

A wave-trap is an additional circuit which is tuned to either "accept" or to "reject" signals. It is often very effective in this respect, especially when the interference is continuously on the same wavelength, as in the case of those who desire to receive other than their local broadcasting station, but who cannot eliminate the undesired signals.

A simple "acceptor" wave-trap can be made with a 75-turn tuning-coil and a ·0003 or ·0005 variable condenser. Join one side of the coil to the set's aerial terminal by a short external lead, and connect the other side of the coil to the condenser. The remaining connection of the condenser is then joined to the set's earth terminal, and the tuning of both set and wave-trap is varied until the best position for the elimination of interference is found.

The "rejector" wave-trap is made on very similar lines, but in this instance the coil used has 35 turns. It is connected outside the set between the A. and E. terminals, and the variable condenser is joined across it.

The method of operation is very similar, and it will be seen that the only difference in arrangement is that the coil and condenser are in parallel for a "rejector" circuit, but in series for the "acceptor."

(*Continued on next page.*)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from previous page.)

CRYSTAL SET PHENOMENA.

J. T. W. (Essington, near Wolverhampton).—Can you tell me what caused the following? I am using a crystal set, with a D.P.D.T. switch for switching from 5 XX to 5 I T, and I left the switch open last night while I was talking.

After a while I put the 'phones on, and, forgetting the switch was open, I thought the crystal was "off," so I touched it. As soon as the cat's-whisker touched the crystal there was a very loud crackling noise in the 'phones, and a small blue light was on the crystal where the whisker was in contact with it.

What with the noise in the 'phones and the blue spark on the crystal, I dropped the 'phones thinking there was lightning about, but it was a quiet night and was snowing slightly.

I came in and touched the crystal again, with the same result, except that the noise in the 'phones had changed to a loud buzzing, which could be heard ten feet away. I then thought the 'phones were at fault, so I put the switch over for 5 X X, which was as loud reception as ever. What caused this?

I can get Stoke-on-Trent and Nottingham on 'phones, and hear words quite plainly without any effort. London and Cardiff are much fainter.

I have got all stations named repeatedly for persons who have come to hear my set, for which I have to thank "P.W."

The cause of the crackling noise and of the blue sparks was an electrical charge upon the aerial. This would appear to have been a fairly powerful static charge, caused by the snow. The flakes of snow had been electrified in the clouds, and each one touching the aerial had imparted a slight charge to it, as it was insulated from earth (by the open switch). It thus became heavily charged, and when earthed through the crystal a fairly large current passed, causing the phenomenon you noticed.

BENDING EBONITE.

"CONSTRUCTOR" (Chatham).—Can a thin sheet of ebonite be safely bent, or will it break if an attempt is made?

The sheet will bend quite well if previously it is thoroughly warmed. This can be done by placing it in boiling water, or a small sheet becomes pliable over the steam from a boiling kettle.

For the Constructor

No. 7.—HOW TO SOLDER.

1. Clean the joint to be soldered with a file or emery-cloth, and smear a small quantity of flux over the cleaned surface.
2. Remove the iron from the flame and file the tip until its surfaces are bright.
3. Dip the cleaned tip of the iron into a shallow tin containing some flux and pieces of solder. This "tins" the iron ready for use.
4. Heat the iron in a gas flame or clear fire until the flames appear slightly green.
5. Apply the iron, on the tip of which a piece of solder has been melted, and thus "tin" the wire to be soldered.
6. Hold the wires to be joined in position and heat the tinned surfaces of both with the iron, applying more solder if necessary.
7. Thoroughly wipe the joint with a clean rag *immediately* after soldering, to remove all traces of flux.

CORRESPONDENCE.

Letters from readers discussing interesting and topical wireless events, or recording unusual experiences, are always welcomed, but it must be clearly understood that the publication of such does in no way indicate that we associate ourselves with the views expressed by our correspondents, and we cannot accept any responsibility for information given.—Editor.

A REPLY TO CRITICS.

The Editor, "POPULAR WIRELESS."

Dear Sir,—On page 436 of your issue of the 23rd ult., you published a letter from Mr. W. W. Woodman in which he criticised the design of certain components, amongst them being the Igranic-Pacent Rheostat. Mr. Woodman complains that the terminals are at the bottom of the rheostat, so that, unless it is fitted a good distance up the panel from the baseboard, difficulty is experienced in making the necessary connections.

We are afraid Mr. Woodman cannot have examined the Igranic-Pacent Rheostat, otherwise he would know that these rheostats can be mounted just as well with the terminals pointing upwards as downwards, according to which method suits the particular receiver in which the rheostat is used.

The dial of the Igranic-Pacent Rheostat is removable, so that when mounting the dial can always be arranged so that it is upright, and the fact that the spindle of the rheostat has two flat sides enables it to be fitted so that the pointer on the knob will point correctly to the "off" position on the dial, irrespective of whether the rheostat is mounted with the terminals upwards or downwards.

We always appreciate just criticism of our components, as our constant endeavour is to meet the public's requirements, but we are afraid in this instance Mr. Woodman did not make himself fully acquainted with the design of the extremely popular Igranic-Pacent Rheostats which he has criticised, and we only hope that he will remedy the matter immediately by purchasing one or more of these rheostats.

We are,

Yours faithfully,

IGRANIC ELECTRIC CO., LTD.

B.B.C. PROGRAMMES.

The Editor, POPULAR WIRELESS.

Dear Sir,—I entirely agree with the letter from "Ordinary Listener" published in the issue of "P.W." of the 23rd ult. Your article on "highbrow" items in the same issue is also very much to the point. Last evening (Thursday), for example, from 7 p.m. to 8 p.m., we were given from the London station 53 minutes of "talk" and 7 minutes of music. The majority of listeners are people who go to work and cannot, therefore, switch on much before 7 p.m., and as it is from this class of listener that the B.B.C. derive the bulk of their revenue, it is only right that when they do have an opportunity of listening, they should be given what they enjoy—i.e. entertainment, and not evening classes.

I think the view that classical music is not to the general taste is borne out by the fact that the thousands of music halls in this country with their bright and tuneful programmes are well patronised twice a night, whereas the organisers of *occasional* symphony concerts are constantly bemoaning the lack of support of such concerts and even the B.B.C. themselves could only half fill the Albert Hall for their first National Concert.

Yours faithfully,

"ANOTHER FOUR YEARS' LICENCE."

90, Warham Road, Harringay, N.8.

* * *

The Editor, POPULAR WIRELESS.

Dear Sir,—I was very amused by "Ordinary Listener's" letter. In my opinion, he must be "extraordinary."

I have been a regular listener for a considerable period, and have always had the greatest satisfaction possible from the programmes provided by the B.B.C.

If "Ordinary Listener" is a "jazzite" pure and simple, why does he not purchase a gramophone? He would then be able to have as many "Oh, Charlie, Take it Away's" as he desires. Seeing that owning a wireless set is purely optional, I don't see that he has the slightest grounds for grumbling and grousing.

As far as "what we want is entertainment, not education" is concerned, the man who does not wish to further his knowledge, or thinks he knows all that is worth knowing is not, in my opinion, worth his salt.

In closing, I would recommend "Ordinary Listener" to sit down one evening and try to arrange one month's programmes, and I am sure he would have to confess that he could not bring as much variety into them as do the B.B.C.

May I congratulate the B.B.C. on their remarkable variety in programmes.

Yours faithfully,

"ANTI-GROUSERS."

14, Arthurdon Road, Brockley, S.E.4.

ALL THE LATEST "P.W." SETS

Supplied as finished instruments or in parts for home construction.

NOW is your opportunity to acquire a really good set at a very reasonable price. Under the famous PILOT service, you can obtain from us all the parts for any set published in the various wireless papers, and you may rely upon receiving free advice and help from our Technical and Service Department. On the other hand, if you prefer to have your set ready built, we can supply it at a small extra cost. In either case, you are assured of first-class results.

A typical "Pilot" Receiver.

Amazing Success of The HALE 1-Valve Reflex Set

(Described by Mr. PERCY W. HARRIS in last week's issue.)

FINISHED INSTRUMENT, approved by Mr. P. W. HARRIS as being equal to the original model in every respect.

	£ s. d.
Highest quality components throughout, including Marconi Ideal Transformers, etc., Aerial Tested .. Hale and Marconi Royalties Paid.	8 10 0
PILOT kit of components	3 14 0
Polished Ebonite Panel, 16" by 8" by ¼", drilled ..	9 6
Polished Mahogany Cabinet and Base	1 7 6

¶ When a complete Kit of Components is ordered, a Marconi Royalty of 12/6 per Valve Holder is payable and should be remitted with order.

¶ ***Every finished set we sell is tested under the supervision of CAPT. TINGEY, A.M.I.R.E.***
(Late of Radio Press Laboratories)

"P.W." SPIDER SET.

A phenomenal demand has arisen for this popular Set. Are you building it the safe PILOT way?

	£ s. d.
Finished Instrument (Aerial tested and guaranteed, less coils and valves) ..	12 0 0
Marconi Royalties ..	1 17 6
Complete PILOT Kit of parts	6 16 9
'Red Triangle' Ebonite Panel 15" x 8" (matted and drilled)	12 0
Polished Mahogany Cabinet and Baseboard	1 10 6

Send for particulars of Mr. P. W. Harris's H.T. Charger for A.C. Mains *(Described in this issue.)*

The PILOT MANUAL contains illustrated details of a number of up-to-date sets which we thoroughly recommend. Much useful information on soldering, assembling, testing, etc., is also included. Post free .. .. **3d.**

THE PILOT MANUAL

PETO-SCOTT CO., LTD.

Head Office & Works: **77, City Rd., LONDON, E.C.1**

Branches: **62, High Holborn, London, W.C.1. WALTHAMSTOW—230, Wood Street. PLYMOUTH—Bank of England Place. LIVERPOOL—4, Manchester Street.**

P S 6247

DON'T USE A POWER VALVE IN ANY STAGE BUT THE LAST BUT

FERRANTI

British Made

TRANSFORMERS

ARE SUITABLE FOR ALL L.F. STAGES

TYPE AF3 25/-
The "Nearly Perfect" Transformer.

TYPE AF4 17/6
The best Transformer at the price.

FERRANTI, LTD., HOLLINWOOD, LANCASHIRE.

MÉTAL RADIO VALVES

Why pay more for valves when you can obtain "Métal" Radio Valves at the prices quoted. It isn't as if higher priced valves are better than "Métal." They are not, for with "Métal" Valves—one of the oldest makes—you can get results unobtainable with most valves. That is why they are used by the French Government and in countless Continental and U.S.A. sets.

PRICES:

Type.	*Fil. Volts.*	*Amps.*	*Price.*
C.L.62	2	0·06	10/6
C.L.202	2	0·2	8/-
6/100	4	0·06	9/6
Power.			
C.L.502	2	0·5	12/-
C.L.104	4	0·10	15/-

Your dealer stocks them. Write for list showing all types

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JOHN RAE, LTD., 60, BLACKFRIARS RD. LONDON, S.E.1.

EIH

TECHNICAL NOTES.

(Continued from page 542.)

atmosphere free from oxygen, *after* it has been made up, as strains of any kind are said to cause depreciation of its magnetic permeability.

The effectiveness of the shield may be judged from the account given of the tests on a galvanometer when shielded. Even at extremely sensitive adjustments of the instrument, the moving of comparatively large magnets in the neighbourhood of the galvanometer caused deflections of only a few milliammeters on the scale, and the switching on of a D.C. electric motor four feet away caused a similarly small effect. By means of a special arrangement, which it would take too long to describe, the actual shielding effect was measured, and it was found that with one shield the deflections due to an interfering magnetic field was reduced to about 0·5 per cent, whilst with another shield, made somewhat differently, this deflection was reduced to 0·1 per cent., that is to say a shielding ratio of 1,000.

It would appear that shields made up in this way would be very useful for certain wireless purposes.

The Phonic-Motor.

Another very interesting paper in the same journal describes a self-starting phonic-motor. For the benefit of those readers who may not be familiar with the phonic-motor, this is a rudimentary synchronous A.C. motor which consists essentially of an electro-magnet in roughly circular form, the gap between the poles being perhaps three or four inches, and an armature made up from a number of soft iron or stalloy stampings with teeth or serrations at the edge, being thus roughly the equivalent of a multi-polar armature but without any windings; this may be called the "rotor." The windings on the field magnet are supplied with the alternating current or with interrupted direct current (for example, from a vibrating reed or tuning fork), and it will be evident that if the rotor be spun by hand until the teeth are passing the magnet poles in unison with the interrupted or A.C. current, the rotor will continue running in synchronism with the alternations or interruptions of the applied current. When the phonic-motor (so called because it was first used in connection with tuning forks and other accoustic appliances) was first invented it was found very troublesome to get it running "in step," and various improvements have been made which have had the effect of making it much easier to start. At the same time, so far as I am aware, no self-starting phonic-motor has ever been devised until the one described in the journal above mentioned.

It will be evident that a motor of this kind will be very convenient for the purposes of a synchronous rectifier for battery-charging devices, and no doubt more will be heard of it in this connection in due course.

A NEW CAT'S-WHISKER.

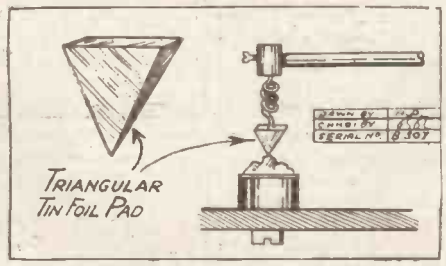
AMATEURS who are weary of re-adjusting refractory crystal detectors by means of the usual cat's-whisker method may be interested in the following method of obtaining rectification.

Remove the spiral cat's-whisker from its holder, cut off the long end of the article, and then to the remaining portion of the whisker, carefully solder a small triangular pad of clean tin, or lead-foil. Use Wood's metal for making the joint in place of ordinary solder.

Less Re-adjustment Necessary.

The cat's-whisker is now replaced in its holder, and the tin-foil pad is carefully adjusted on the surface of the crystal.

If during the first trials the resulting reception is slightly decreased in signal strength, take an ordinary pin and roughen up the under-surface of the tin-foil pad. An excessive number of contact points will thus be avoided, and the reception will regain its normal strength.



Owing to the irregularities of the crystal surface, and to the fact, also, that the surface of the tin-foil pad will not be perfectly level, electrical contact will only be made at one or two points on the crystal. The contact will not be by any means a flat one, and therefore effective reception with any of the ordinary varieties of galena crystals will be obtained. The increased weight and surface area of the tin-foil pad, however, will serve to stabilise the contact, and thus far less re-adjusting of the detector will be necessary.

Panel Talks: No 3.

How to safeguard your Set against Panel leakage

WHEN you buy a panel, what assurance have you that it will not, by surface leakage, nullify the many hours you spend in building your Set? How can you tell that it will not allow those vital signals to escape before they have reached the telephones or the loud speaker? Or perhaps you have already built a set, and are unable to account for a noticeable weakness in signal strength?

Apart from elaborate electrical tests there is only one protection against such defects—it is the "hallmark" which every panel of the American Hard Rubber Co. (Britain) Ltd. bears. The twin names, Radion and Resiston, are your insurance against surface leakage and all other panel ills.

In Resiston—brother panel to the world-famous Radion—is available, at a little lower price, a panel of superior qualities. The high-grade of hard rubber—the finest insulation material known to Science—used entirely in the manufacture of Resiston, ensures a panel which is free from the bugbear of surface leakage, which is perfect in insulation, which has a low dialectric constant, is permanent in its colour and of great strength.

Don't buy your panel in the dark! There is one great safeguard against all ebonite troubles—it is the word "Resiston." Say it to your Wireless Dealer.

Q Resiston comes in 47 stock sizes in Black or Mahogany grained finish. Each panel is protected by its own stout manilla envelope — your safeguard.

RESISTON PANELS

American Hard Rubber Co. Ltd., 13a, Fore St., E.C.2.

Gilbert Ad. 6228.

EASIER TUNING.

By W. OLIVER.

WITH the vast number of broadcasting stations that are now working within a comparatively narrow band of wave-lengths, it is becoming increasingly difficult to tune rapidly to any particular station. The twirling of condenser dials involved in the search for the broadcast you want is exasperating to yourself and, if your set has a tendency to oscillate rather too readily, the series of squeaks which results is even more annoying to your neighbours.

One of the easiest ways of avoiding all this is to keep an accurate record of dial-readings for all the stations you are in the habit of receiving. This involves a little extra trouble in the initial stage, but it subsequently saves a great deal of time and annoyance.

The "Dial Setting" Card.

The first step is to fit scales and pointers, or dials of some sort, to the moving spindles of the coil holder, so that the degree of reaction coupling, and that of the secondary coil, if there is one, can be recorded at a glance. Presumably you already have dials on the variable condensers.

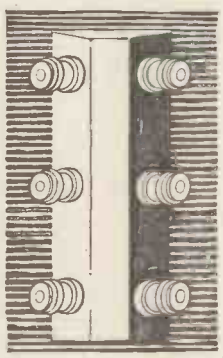
Next, you should get a large card of some sort that you can hang up near the receiver. Rule it into five vertical columns, and mark the first "coils," the second "coupling," the third "condensers," the fourth "station," and the fifth "wave."

Now suppose you tune in to, let us say, Bournemouth. If you have a 35-turn coil in the aerial circuit, a 50 in the secondary, and a 75 for reaction, jot down "35/50/75" in the first column. If the secondary coil pointer is at, say, 50°, and the reaction coupling at 30°, write "50/30" in the second column. Then glance at the condenser dials; suppose the A.T.C. is set at 29°, and the H.F.C. (if there is one) at 62°, jot down "29/62" in the third column. Finally, write "Bournemouth" in the fourth column, and fill in the wave-length in the fifth. (Of course, in the case of a large set with more than two condenser controls, additional columns will be needed on the card).

Rapid Searching.

Make similar records for all the other stations you tune in regularly. Then, when you want to pick up any particular transmission, you have only to set the controls at the readings given on your card, switch on the set, and if the station is receivable at all it should be heard immediately, without a lot of complicated tuning; only a very slight adjustment of one condenser should be necessary to bring the set into perfect tune.

Of course, if you make any drastic alterations to the aerial and earth system, the records will no longer hold good, and must be revised accordingly.



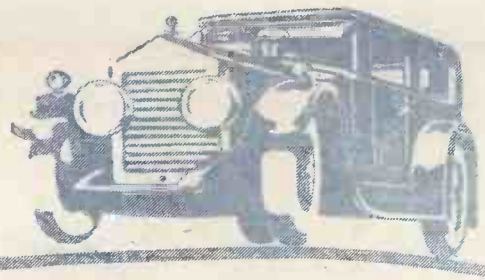
THE ODDS ON SUCCESS

That gratification of personal vanity which we call "success" depends not only on our individual ability for its attainment, but to an equally effective degree on the materials which we choose as being of the greatest practical assistance to our effort. When we build our wireless set, however, this mechanical element assumes the superiority, for we follow certain definite constructional lines and find little scope for our own initiative. Therefore, based on the perfection of the various component parts, the odds are greatly on the side of success. Theoretically this may be sound but in practice we find that it is not the perfection of any single instrument that counts but also its ability to function correctly in relation to the remaining components with which it is to co-operate. Designed to fulfil these requirements in every way, the R.I. Multi-Ratio Transformer has almost completely reformed present day audio-frequency amplification as far as quality and power of reproduction are concerned. Apart from its value as an ordinary transformer, it offers all the advantages of a number of different ratios and impedance values — enough to satisfy the demands of any circuit and any value. With its use the odds on successful audio-frequency amplification are decidedly heavy, so much so that the question of odds hardly enters into the matter—The R.I. Multi-Ratio Transformer presents a cast iron certainty. Price 25/-

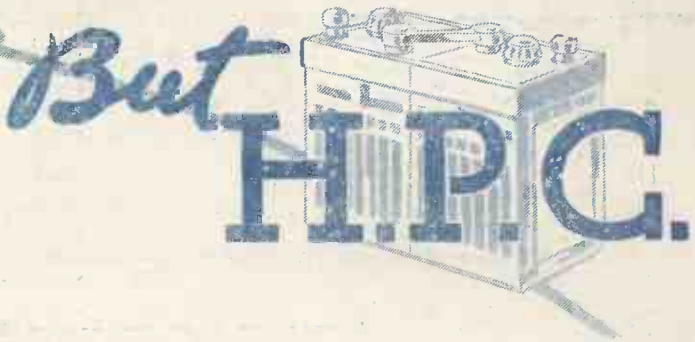
Write for the R.I. Catalogue—

R.I. Ltd., 12 Hyde Street,
New Oxford Street,
London,
W.C. 1.

The mark of Better Radio



Not M.P.G.



But H.P.C.

THE history of the radio valve industry is remarkably similar in outline to that of the motor industry.

In both cases the first endeavour was to secure reliable operation. For years the design of cars and valves was improved stage by stage, giving better results and longer service. Then came the question of perfecting that achievement by giving in the case of cars more

M.P.G.
(miles per gallon)

In 1925 Mullard placed on the market the first of a series of valves with qualities far in advance of the old standards and consuming only one-tenth ampere, with the result that the broadcasting public were enabled to secure up to seven times more

H.P.C.
(hours per charge)

from their accumulators.

At the same time these special valves gave them better, purer reception and the danger of loss due to accidents was reduced to a minimum owing to the extreme toughness of the unique Mullard P.M. Filament these valves embodied. In one short year over £200,000 has been saved in reduced upkeep costs by the users of Mullard P.M. Valves, apart from the renewal expenses that have been obviated by the vastly increased life of these valves.

Consider greater economy and greater results when you select your radio valves.

Ask Your Dealer for Mullard P.M. Valves with the Wonderful P.M. Filament.

For 4-volt accumulator or 3 dry cells

THE P.M. 3 (General Purpose) 0·1 amp. 14/-
THE P.M. 4 (Power) 0·1 amp. 18/6

For 6. volt accumulator or 4 dry cells

THE P.M. 5 (General Purpose) 0·1 amp. 18/6
THE P.M. 6. (Power) 0·1 amp. 18/6

For 2-volt accumulator

THE P.M.1 H.F. 0·1 amp. 14/-
THE P.M. 1 L.F. 0·1 amp. 14/-
THE P.M. 2 (Power). 0·15 amp. 18·6

These prices do not apply in Irish Free State.

British Made in a British Factory

Mullard P. M. Valves will improve any receiver

Mullard

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R/R

POPULAR WIRELESS. November 13th, 1926. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

The Constructors' Competition: Your Last Chance

Popular Wireless

Every Thursday PRICE 3d.

No. 232. Vol. X. Scientific Adviser: SIR OLIVER LODGE, F.R.S. November 13th, 1926.

Special Features

EIGHT-PAGE SUPPLEMENT FOR CONSTRUCTORS

EDITED BY PERCY W. HARRIS, M.I.R.E.

Can Wireless Help the Farmers?
The Multiplex Valve
Aerial Efficiency
Home-Made H.T.
Novel Rectification
Selective Reaction

Our cover photograph shows Mr. Singleton, of Wolverhampton, operating his amateur transmitting station. Mr. Singleton has succeeded in carrying out two-way tests with a New Zealand amateur, on 45 metres and over comparatively lengthy periods.

Marconiphone "IDEAL" Transformer
Ratios 2·7–1, 4–1, 6–1, 8–1.
25/- each.

Marconiphone SUPERSONIC Transformer
20/-

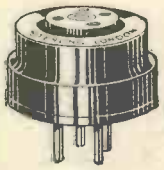
Sterling Square Law Variable Air CONDENSERS (*Geared Type.*)

·00025 ..	**10/-**
·0005 ..	**12/-**
·001 ..	**13/6**

Marconiphone GRID LEAKS
·1, ·25, ·5, 1·0 2·0, 3·0, 5·0, ·05 Capacity,
1/3 each.

Sterling COIL HOLDERS
Double, 18/6
Triple, for mounting on either side of a panel, **20/-**
Triple, mounted on base, **22/6**

Sterling FIXED CONDENSERS
All capacities.
1/6 each.



Sterling 'NON PONG' Shock Absorbing VALVE HOLDER, **2/9**
ADAPTER, **3/6**

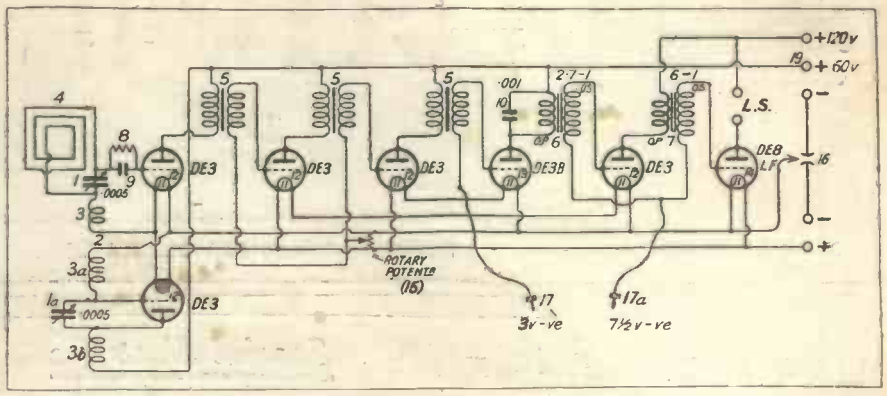
Adapter.

Sterling Rotary Type POTENTIOMETER
300 ohms. Resistance **5/9**

Marconiphone High and Low Tension SWITCH
3/6

In making a Super-Het

everything depends on the Components



Marconiphone and STERLING Radio Components

The arrangement consists of a Detector Valve connected to a tuned frame aerial and associated with a separate Oscillator Valve. Following the Detector are two stages of Intermediate-Frequency Amplification and a second Detector Valve, the intervalve coupling being effected by three Marconiphone Intermediate-Frequency Transformers (5). The sixth and seventh valves are Low-Frequency Amplifiers coupled by means of Marconiphone Ideal Transformers, so ensuring purity of reproduction and ample volume. L.T. and H.T. supply to all valves are controlled by means of a simple battery switch (16).

COMPONENTS REQUIRED.—2 Sterling Square Law Geared Condensers ·0005 mfd. 1 Sterling Triple Coil-holder. 3 Sterling Coils :—

	Pick-up.	Oscillator.
(250– 550)	1 R.2691B.	2 R.2691D.
(1,000–2,000)	1 R,2691B.	2 R.2691H.

1 Sterling Frame Aerial, Portable Folding Type. 3 Marconiphone Intermediate Frequency Transformers. 1 Marconiphone Ideal Transformer, ratio 2·7–1. 1 Marconiphone Ideal Transformer, ratio 6–1. 1 Marconiphone Gridleak (mounted), 2 megohms. 1 Sterling Fixed Condenser, ·00025 mfd. 1 Sterling Fixed Condenser, ·001 mfd. 7 Sterling Non-Pong Valve-holders. 5 Marconi D.E.3 Valves. 1 Marconi D.E.3B Valve. 1 Marconi D.E.8 L.F. Valve. 1 Sterling Rotary Potentiometer. 1 Marconiphone Battery Switch. 2 Wander Plugs. 1 6-volt 30-amp.-hr.. Accumulator. 2 Marconiphone 60-volt Dry Batteries. 9 Terminals. 1 Ebonite Panel.

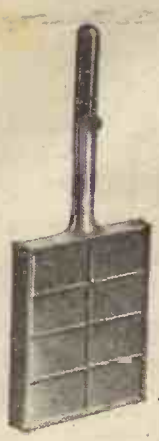
Fuller details regarding the above will be found in our booklet, "CIRCUITS FOR BUILDING RADIO RECEIVERS," which contains complete information and diagrams for the construction of various types of sets. Copy free on request.

THE MARCONIPHONE COMPANY LIMITED.

(Sole Agents for Sterling Telephone & Electric Co., Ltd.)

Head Office : 210-212, Tottenham Court Road, London, W.1.

Regd. Office : Marconi House, Strand, LONDON, W.C.2.



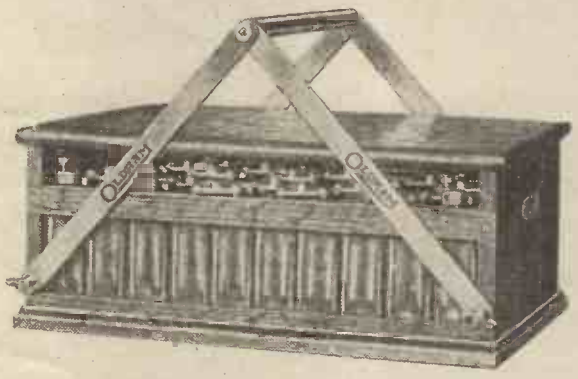
Here is the Plate

THE plate is the heart of any accumulator. A better plate obviously means a better accumulator. That used in all Oldham Accumulators is made under the famous Oldham Special Activation Process. This in itself is a guarantee of longer life free from buckling or sulphation. Observe that the plate used in the Oldham H.T. is as carefully constructed as those used in larger Oldham Accumulators. It is ribbed to retain its active material. It is stout to prevent buckling. From first to last it is thoroughly well made and built to give good honest service.

—here is the Cell

EVERY cell in an Oldham H.T. is a miniature 2-volt accumulator. The glass containers are of the best quality—and capable of withstanding any amount of rough usage. Compare them with flimsy test tubes sometimes used. We want ours to last for several years and we build them to give good service. Look at the illustration again. Note the generous sump below the plates to catch the inevitable mud which is sure to collect after a time. This is evidence of careful design. Without this "mud space" current would leak away and your battery would not hold its charge. Observe also that there is ample room for the electrolyte to circulate continuously around the plates. And when the accumulator is put on charge the acid spray cannot splash out of the vent. Finally, don't forget that every Oldham can be tapped at each two volts. A critical H.T. voltage is often invaluable for long distance reception.

60 volts complete as this 53/6



Gives the regular power flow which guarantees perfect reproduction.

—and here is the Oldham H.T. Accumulator

IT is bristling with good ideas. Take its portability, for instance. Every H.T. Accumulator has to be recharged periodically—you'll want to buy one that can be conveniently carried down to the Charging Station. The stout handle on the Oldham makes carrying a very simple matter.

Perhaps you may only want 60 volts today, but if you add a power valve to your Set you'll be certain to need a higher H.T. voltage. If you buy an Oldham, that problem is solved for you. All Oldham H.T. Accumulators are made on the unit system. Each unit consists of 20 volts. Add as many of them together as you like. One tier of three rows for 60 volts, two tiers each of three for 120 volts and a similar arrangement for 40, 80 or 100 volts. To steal a slogan from a famous bookcase it is "always complete—yet never finished." With an Oldham you will be ready for anything. The framework of the Oldham H.T. is solidly constructed of oak. It is a handsome piece of apparatus. When fitted with its lid and base it is ready to take its place in any room. Finally, a word of advice: The capacity of the Oldham is big—no less than 2,500 milliampere hours. It will serve any Set even if fitted with power valves. Always judge a H.T. Accumulator by its capacity. If you have been used in the past to H.T. dry batteries a revelation awaits you when you change over to an Oldham.

10d. per volt

60 volts, £2-10-0 100 volts, £4-3-4
80 volts, £3-6-8 120 volts, £5-0-0
Complete with polished aluminium handles
Solid Oak Base, 3/6 extra

OLDHAM

Special Activation Process Accumulators

OLDHAM & Son, Ltd.
Denton, Manchester

London Office & Service Depot:
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Phone: Sloane 2701

Gilbert Ad. 6276

The "Cosmos" Condenser

The "Cosmos" Spring Valve Holder.

The "Cosmos" Rheostat.

The "Cosmos" High Frequency Choke Coil.

Cosmos

RADIO COMPONENTS

ensure reliable sets.

THOSE constructors who desire smooth working, reliable and neat-looking sets, use "Cosmos" Precision Components.

"COSMOS" LOW LOSS SQUARE LAW SLOW MOTION CONDENSER

The "Cosmos" Condenser is a slow motion condenser with absolutely no backlash, either when new or after use. This desirable feature is accomplished by the use of a spring belt held in tension, which permits coarse tuning with the large knob, and a 10·1 slow motion with the small knob.

Cone bearings allow for adjustment and the slow motion bracket can be mounted for *remote control*.

The Condenser for fine tuning.

Slow Motion	·00025 mfd.	14/9
	·0005 ,,	15/6
Ordinary	·00025 ,,	12/-
	·0005 ,,	13/-

"COSMOS" ANTI-VIBRATION SPRING VALVE HOLDER

The shock-absorbing element in the "Cosmos" Valve Holder is not a stiff flat spring or sponge rubber which absorbs moisture, but a separate spiral spring for each leg. This construction gives maximum elasticity.

Price for Panel or Baseboard Mounting : **2/9** each.

"COSMOS" RHEOSTAT & POTENTIOMETER

The "Cosmos" Rheostat is strongly constructed to give a smooth, reliable and continuous contact. The contact arm moves round the inner side of the winding, and is thus protected from accidental damage. It takes up little space, and is one-hole fixed.

PRICES : Each	"Cosmos" Filament Rheostat			Potentiometer
	6 ohms 1 amp.	20 ohms ·4 amp.	34 ohms ·2 amps.	300 ohms —
	4/6	5/-	5/-	6/-

"COSMOS" HIGH FREQUENCY CHOKE COIL

Suitable for use in reflex circuits or in circuits similar to the Reinartz. The sectionalised windings have the lowest possible self-capacity (5·5 mmfd.) and an inductance of 55,000 microhenries.

Owing to its small inductive field, which lessens the chance of stray capacity or inductive coupling, it is far more suitable for use as high frequency choke than large inductance coil.

Price for H.F. Choke Coil 6/6 each.

Ask for copy of Folder No. 4117/6.

METRO-VICK SUPPLIES LTD.

(Proprietors : Metropolitan-Vickers Electrical Co., Ltd.)

155, CHARING CROSS ROAD, LONDON, W.C.2

Crescendo!

Faint twitterings of sound across the ethereal void, murmurs of music as from a muffled band, mysterious and unidentifiable noises—these were the phenomena after which the ears of early broadcast listeners eagerly strained.

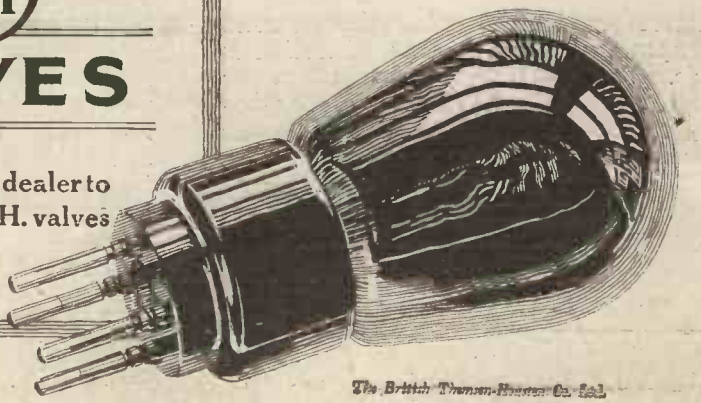
That phase ha fortunately passed, and no listener is content unless he can obtain from his set, not only a clear and faithful reproduction of the transmitted music, but also a sufficient volume of sound to give a sense of reality to the performance. The growing demand for greater volume has been accompanied and encouraged by successive improvements in valves. To-day by means of the well-known B.T.H ".06 ampere" valves, it is possible to operate a multi-valve receiver with the same current consumption as was previously required for a single valve set. In other words the listener can, by the aid of these valves, obtain a volume of sound sufficient to fill a large hall, with no greater consumption of current than was formerly needed for the adequate vibration of a telephone diaphragm.

B T-H

VALVES

Ask your wireless dealer to demonstrate B.T.H. valves

2578



The British Thomson-Houston Co. Ltd.

Types and Prices:—

Eureka Concert Grand
A superb L.F. Transformer hermetically-enclosed in a coppered steel case proof against atmospheric influences. Fully guaranteed. No. 1 25/-. No. 2 21/-.

Eureka Reflex
For reflex work a special Eureka is available. Gives an exceptional volume of mellow clear tone. Fully guaranteed. 15/-.

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For those who cannot afford the necessarily higher price of the larger Concert Grand we have introduced the Baby Grand. Fully up to the same high standards of workmanship. Fully guaranteed. No. 1 15/-. No. 2 15/-.

Eureka L.F. Choke Unit
The Eureka Choke Unit, incorporating grid leak and condenser, is the finest instrument of its type. Fully guaranteed. 25/-.

The wise concert-goer chooses his seat with care

MAYBE it has been your misfortune to occupy a seat at a concert close to the drums. During the whole evening your impression of the music has been overshadowed by this irritating boom-boom-boom. The piping notes of the flute and the delicate tones of the oboe have been inaudible. To catch the melody your ears have had to fight through this resonant background.

Perfect reproduction of broadcast music is more often than not a question of balance. If an L.F. transformer is used which amplifies the low notes at the expense of the high ones, distortion is inevitable. You will hear the drums and the 'cellos and lose the flutes and the oboes. In other words, your seat will be too near one side of the orchestra. The regular concert-goer sits a reasonable distance from the orchestra—by experience he has learned that distance lends enchantment to the ear! The Eureka L.F. Transformer has been designed to give listeners a truthful rendering of orchestral music. It does not—indeed it cannot—amplify some tones at the expense of others.

By reason of its exclusive method of winding and its non-laminated core it is scientifically corrected against distortion. Just like the anastigmat lens in a camera, for instance, which is corrected to avoid giving a distorted image. Any lens will give some kind of a picture and any L.F. transformer will give some degree of amplification. But it may not be true to nature. The Eureka Transformer has now been before the public for three years. Its popularity amongst those who appreciate radio components of high quality has consistently and deservedly increased. Tens of thousands of listeners are to-day enjoying by its aid, a quality of radio music which can only be compared to the actual broadcast transmission in the studio by the artistes themselves.

Re-creates the EUREKA Living Artiste

Advertisement of Portable Utilities Co., Ltd., 8 Fisher Street, London, W.C. 1.

Gilbert Ad. 6271

Now, for but 65/-,

comes the really handsome Loud Speaker

BROADCASTING was as yet unknown when the sponsors of the now famous Brown range of Instruments placed upon the market the first Loud Speaker ever to be used in this country for Wireless purposes. 'Brown H.1' was in being when 'B.B.C,' '2LO,' '2ZY' and '5XX' were meaningless hieroglyphics. The firm which then lead the way in making Loud Speaker reproduction possible has ever since set the pace in Loud Speaker design. It was the Brown H3 which first brought high quality reproduction within the means of the average listener; it was the Brown HQ which brought to a realisation the ideal of a really handsome Loud Speaker at an unprohibitive price. Now Brown once again leads the way. In the new H3Q Model, for the remarkably low price of 65/-, there is available an instrument whose appearance will enhance the setting of any room. All that is best in acoustical design gives to the H3Q a remarkable fidelity of reproduction. All that is artistic in design gives the H3Q a distinctive and pleasing appearance. For a little over three pounds you can buy a Loud Speaker which will look well in your home and fill it with a faithful rendering of the evening's broadcast. Your dealer is selling many Brown H3Q Loud Speakers—get yours from him now.

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20 inches high.
2000 or 4000 ohms.
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Retail Showrooms: 19, Mortimer Street, W.1; 15, Moorfields, Liverpool; 67, High Street, Southampton. Wholesale Depots: 2, Lansdown Place West, Bath; 120, Wellington St., Glasgow; 5-7, Godwin Street, Bradford; Cross House, Westgate Road, Newcastle; Howard S. Cooke & Co. 59, Caroline St., Birmingham. Robert Garmany, Union Chambers, 1, Union St., Belfast, N. Ireland.

EVEN before Columbus discovered America the Aztecs evolved a method of treating raw rubber to give it greater resiliency and preserve it against decay. Balls of rubber taken from the Temple of Palenque (shown above) are still in existence. After five hundred years they are as pliable as when the priests first kneaded them into shape. What the secret of their manufacture was, no one can say precisely. It has died with the inventors. The process, however, obviously used little heat for it is the heat used in vulcanising to-day which ultimately causes the rubber to lose its nature—or as we say, to perish.

Heat, too, has a destructive effect on many other substances. Take the filament of a wireless valve as an example. Here—if it is a bright emitter—the filament is incandescent. It crystallises and becomes very brittle. Ultimately it fractures and the valve is useless.

But in the latest Cossor valve, heat has been practically banished. The new kalenised filament gives off a powerful flow of electrons without the suspicion of a glow. As a result it can never become brittle. Even after several thousands of hours of use it is still quite supple.

The Aztecs knew that heat *destroys*

This time-defying filament, besides functioning at such a low temperature, is also wonderfully economical in current. It consumes only one-tenth of an ampere at 1·8 volts.

Or, to give a definite example, an accumulator lasting 10 hours at a charge with a 2-valve Set using bright emitters, would last more than 200 hours if these wonderful new Cossor Valves are used. **A free gift of 190 hours of broadcasting every time your accumulator is charged!**

Because these new Cossor Valves will give you such long and economical service—with a mellowness of tone which is truly remarkable—you are wasting money every day you retain your present valves in use.

Available in three types: Black Band for Detector use, Red Band for H.F. use, 1·8 volts, ·1 amp. consumption, 14/- each. Also Stentor Two Power Valve, 1·8 volts ·15 amps. consumption, 18/6.

Cossor Point One

Issued by A. C. Cossor Ltd., Highbury Grove, London, N.5

Gilbert Ad 6256.

Popular Wireless

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RADIO NOTES AND NEWS.

Armistice Day—2 L O's Traffic Cop—The Radio Bug—America in Daylight—The Boon of Broadcasting—New Stations Coming—"Pay as You Listen."

Armistice Day.

THE arrangement of the programmes for a day of national mourning is no easy task, but the broadcasting for this day of a thousand memories has been well arranged. Commencing with a Canterbury Cathedral service, the features include a speech by Viscount Grey on the League of Nations, an "In Memoriam" concert, Evensong from Westminster Abbey, and—"Back to the Army Again"—The Roosters Concert Party.

"Happy Returns."

THE actual anniversary of the B.B.C.'s birthday is not until Sunday, November 14th, but it has been decided to celebrate it on Saturday. A specially written radio revue has been arranged to start at 7 p.m. It is entitled "Happy Returns," and the cast will include our old friend Tommy Handley, and other microphone favourites.

When Geneva Rules the Waves.

EUROPE'S scheme for order in the air is still somewhat "in the air" at the time of writing, but it was expected by the B.B.C. and Continental authorities that at first there would be a settling down. Those who hoped for an immediate haul of long-distance stations must not be too impatient. Eventually, perhaps, we shall be able to start at the bottom of the scale and tune in a station at every degree, like going up a flight of stairs—but not this week!

Europe's Ether Police.

WHEN Europe's broadcasting chiefs decided upon ending the wavelength muddle, they agreed it was essential to co-operate on wave-meters. It was decided that all Europe's wave-meters should be made in Brussels, and forwarded from there to the stations concerned. They are made in Belgium under the direction of M. Braillard, the Belgian expert, and when passed as correct, they are despatched to the various stations to do point duty, and to keep the transmissions upon the exact wave-length.

2 L O's Traffic Cop.

THE "traffic-cop" for 2 L O arrived from Brussels at the end of last month, and it is interesting to note that this wave-meter is *not* of the crystal-control type. Essentially it is a coil and condenser, across which a lamp (or a galvanometer) is fixed. The instrument will be fixed to the wall near the 2 L O transmitter, and if the latter's wave-length is O.K. the lamp glows continuously. If the main transmitter gets out of tune the little lamp sulks, and will not glow until the wave-length is right again. The accuracy is of an extremely high order, and the traffic-cop is so sensitive that allowance has to be made for variations due to heat and cold.

Mrs. Rhoda Thake, a centenarian listener who thoroughly enjoys listening to broadcasting.

The Radio Bug.

LITTLE Lennie, spending his first day in the country, watched a big spider. It swung down from a branch, and started spinning a web across two twigs.

"Hey, Pop! Come here," said Lennie.

"Whatja want?," says Pop.

"Look at this bug, Pop. He's gonna put up a wireless!"

Germany Going Ahead.

BRITAIN'S wireless licence holders now number well over two million, and next in Europe comes Germany, where steady increases continue every month. At the beginning of September the number of licences held in Germany was 1,258,199.

Curious Atmospherics . . .

HERE is a curious experience that befell a Newton Heath (Manchester) listener. He was recently listening in from a crystal set, stroking a cat that lay at his feet. Simultaneously with every stroke he noticed atmospherics in the 'phones. But thinking they might be caused by movement of his body and the flex cord, he tried stroking the carpet instead of the cat. He found that only by stroking in one place could he obtain the atmospherics, and there they appeared even when the cat was stroked by somebody else.

. . . Caused by a Cat.

THE curious noises seemed so inexplicable that later the attention of Sir Oliver Lodge was drawn to the incident. Sir Oliver recalled a somewhat similar effect that he noticed in his early experiments, when using a coherer as detector. He attributes the noise to little sparks, caused by stroking the dry cat, and sufficiently powerful to affect the neighbouring wireless set.

Has any reader of "P.W." noticed a similar effect?

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

Some Circle.

THE Birmingham Radio Circle is not a mere circumference, round emptiness. During the Birmingham Radio Exhibition it started to make rings round the visitors, and collected a nice little £265, to endow a cot at the Birmingham Children's Hospital. It's not every Circle that can pay away £265 and remain all square, is it ?

America in Daylight.

WRITING of a recent Sunday morning, a Worthing reader says, "Tuning in at 9.40 a.m. to listen for any amateurs on the low-wave band, I was startled to hear at terrific 'phone strength an American voice speaking to the Philippine Islands. Waiting for the call sign, it turned out to be 2 X A F, Schenectady, New York, making a special transmission to Australia, Shanghai, etc. There was brilliant sunshine here, and daylight more than half-way across the Atlantic."

Special Trans-World Transmission.

THE set used on this occasion was a three-coil-tuner, described in "P.W." about a couple of years ago, followed by a resistance-coupled amplifier. Schenectady has been asked to confirm this reception, but in the meantime, any reader who was puzzled by powerful American signals at the hour named can be pretty sure he was hitched up to hear America calling Australasia and the Far East.

"Ariel's" Announcements.

I HAVE been asked to make the following announcements :

1. Will Mr. R. Anderson, of "London," who wrote to a well-known firm recently about their Battery Eliminator, communicate at once with the firm in question ? His request to them cannot be complied with, because he forgot to enclose his address !

2. The North London Experimental Radio Society meets at Holly Park Schools, Holly Park Road, N.11. Particulars from hon. sec., 61, Carey Street, Lincoln's Inn, W.C.2.

Beam for Portugal.

THE Portuguese Government is establishing a beam wireless service between the mother country and the Portuguese Colonies, and some of the stations are already under construction. The Marconi Co. announce that sites have been chosen, and construction commenced at Lisbon, Cape Verde Islands, the Azores, and in East and West Africa. The stations in the scheme that will work on the short-wave beam system are being erected at Lisbon, Loanda and Mozambique.

The Boon of Broadcasting.

"BROADCASTING is the greatest boon that has come to the nation in modern times," said Sir Wm. Noble, in opening the third Manchester Wireless Exhibition at the City Exhibition Hall. Dr. Ferranti was in the chair, and amongst the speakers was Capt. Eckersley, who advocated that licence fees should be spent in improving broadcasting. "There is practically no limit to the money that can be spent effectively on broadcasting," said the Chief Engineer, adding naïvely : "There is still the question of my salary, for instance !"

Sideways Wound Coils.

REFERRING to the article on "Sideways wound Coils," that appeared in "P.W." No. 229 (page 414), Mr. Uriah Beaton, of 45, Chalk Farm Road, N.W.1, informs me that this method of winding is covered by a patent granted to Mr. C. B. Kersting and himself.

TECHNICAL TERMS ILLUSTRATED.

The Crystal Detector.

THERE was a young fellow named Hector,
Who asked his new girl to select a
Nice jewel, or confection,
To prove his affection.
She proved a good —▶|—

A World's Record.

ONE of the Australian Commonwealth liners, the "Jervis Bay," recently put up a very fine radio record on her voyage from Australia. When she arrived at Plymouth her wireless operators could boast that the vessel had kept in daily radio touch with Perth (W. Australia) from the time she left until she arrived in Plymouth Sound !

SHORT WAVES.

From a musical paper :
Mr. Miller Craig, of the B.B.C., spoke on : "How the British Broadcasting Company can co-operate with the festivals." An organised cork-drawing competition, perhaps ?

* * *

"Just imagine the poor comedian who makes all his best jokes in dead silence. It would send most of our leading stage comedians to an early grave." ("The Northern Whig.") This is certainly a very good suggestion !

* * *

Wireless pirates are to be hunted up again, we understand. We hope it will be "fine" for them ! ("Popular Radio Weekly.")

* * *

"Why the dickens doesn't the Postmaster-General buy a wireless set ?" said the motorist whose car had hit a telegraph pole and pitched him into the ditch. ("Sunday Pictorial.")

* * *

An explorer recently returned from the South Sea Islands says that there paper decays, leather is spotted with mildew, and metals tarnish and rust. Were some of our bright young radio playwrights brought up in the South Sea Islands ?

* * *

That "Beaming" boy—Senatore Marconi.

* * *

Sir J. Vijayaraghavachari recently arrived in London. We can imagine the fervent prayers of the B.B.C. announcers that it wouldn't be necessary to mention his name in the News Bulletin. ("Humorist.")

* * *

A lady correspondent says that her father simply raves about the reproduction of her four-valve set which she built in accordance with instructions given in "Popular Wireless." A friend who saw this letter said he could quite sympathise with her, as he had heard him several times when he missed the sixteenth hole !

* * *

"One thing that will be secured by this new wireless scheme is that only ministers with 'wireless' voices will conduct services through the microphone." ("Glasgow News.")
And only people with listening-in faces will be allowed to hear them.

The power used on the "Jervis Bay" is only 250 watts, but signals were clear all the way except for one awful night, near Gibraltar, when the record nearly went west. But they got through before 24 hours, and next day Perth could hear as well as ever again.

Armistice Day in Canada.

THE Ottawa and Montreal stations are broadcasting a special Armistice Day programme this (Thursday) evening on a joint wave-length of 434 metres. Amongst the items will be "It's a long, long way to Tipperary" and "The long, long trail."

New Stations Coming.

THE announcement that a new broadcasting station has been opened at Seville, Spain (E A J 17), reminds me that others will be sprouting up like mushrooms before long. The Austrians will shortly be testing out the new Klangenfurt station, whilst Yugo-Slavia opens up a Belgrade station next month, to be followed soon afterwards by another at Spalato. The Germans are getting busy with a station at Hoch-Mayer, another at Dergerloch, and a new 10-kilowatter at Königsberg !

Dozens more are "on paper," waiting their turn to edge into the ether !

Short-Wave Telephony.

THAT short-waver I mentioned a fortnight ago, who has been vociferating telephony just below Königswusterhausen recently, turns out to have been Mount Valerian, Paris. There is a "Buffalo" wandering about down on these waves, too. I understand that, when he is at home, this denizen of the prairie lives in an R.A.F. portable transmitter.

Maidstone Radio Week.

ENTRIES for the free competition in connection with Maidstone Radio Week will close to-morrow (November 12th), the forms of application being obtainable from the hon. sec., 44, Postley Road, Maidstone. The Maidstone Wireless Exhibition will be held in the Corn Exchange from November 16th to 20th, inclusive.

The Crystal Telephone.

READERS who were intrigued by the "Crystal Telephone," referred to in the Correspondence columns of "P.W." No. 229 (October 23rd issue), will like to know that the inventor—Mr. Leslie Miller, A.M.I.E.E.—tells me that the instrument has aroused great interest. He adds that his patent on the Crystal Telephone (Thermophone) became void on October 8th, so that other experimenters are now free to try to develop this type of receiver.

"Pay as You Listen."

SEVERAL correspondents have asked my opinion of the advisability of buying wireless sets on the deferred payment system—(commonly known as the Kathleen Mavourneen system : "It may be for years, or it may be for ever !") There seems to be a lingering prejudice against the method, but personally I think it has a lot to commend it, especially if handled by a reputable firm. There's a lot to be said for "a pound down" and an aerial up !

ARIEL.

Can Wireless Help the Farmers?

RADIO-CULTURE AS A PRACTICAL POSSIBILITY.

By J. F. CORRIGAN, M.Sc., A.I.C.

THE radio world has been amused recently by the reports which are to hand concerning the alleged increase of growth of certain plants and vegetables under the influence of radio waves. I use the word "amused" here because, all things considered, the attitude of radio men has been really one of amusement rather than one of interest. We have been treated to all sorts of predictions in the daily press concerning the state of affairs

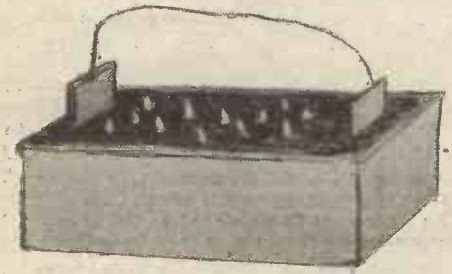

Fig. 1. An early experiment to test the effect of galvanic currents upon seedlings.

which will be set up when the world's agricultural and vegetable produce is grown by the power of radio. And all because someone has come along with the germ of a new idea, an idea which, if it could be applied to practical ends, would, in a fair measure, revolutionise the economic basis of many of the world's commercial markets.

New Ideas.

People don't like new ideas. They object to being made to depart from preconceived notions. Hence the quantity of pleasant ridicule which has been poured out upon this latest sign of the extension of the sphere of wireless.

In this connection, it is interesting to

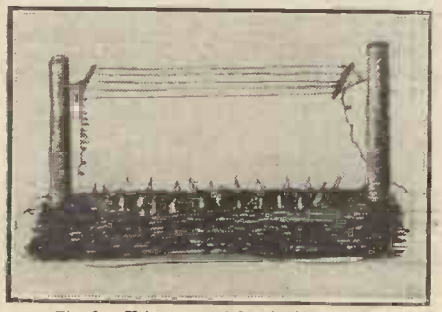

Fig. 2. Using an aerial at high potential.

recall the fact that the same sort of thing happened when Edison first announced his invention of the phonograph, when Graham Bell brought out his telephone, when Professor Röntgen hit upon the idea of the X rays. And even a certain young man, Guglielmo Marconi, by name, was not exempt from such a torrent of witticisms when he first came to England, his mind full of great ideas concerning the possibility of signalling over considerable distances without the aid of connecting wires. There used, in fact, to be a popular song, the burden of which related the things which would happen when "Mr. Marconi first signals to Mars."

Recent Experiments.

To come back to our main subject, however, a certain Nottingham market gardener is reported to have discovered that his cucumbers, tomatoes and other vegetables were obtaining energy from his wireless aerial, and that, under these conditions, their active growth was very much increased. Accordingly, therefore, he conducted a few interesting experiments. He constructed a number of cage and spiral aerials, which were suspended in greenhouses over the growing plants. The result is stated to be a 25 to 30 per cent. increase in the vegetable produce obtained, and also an increase in the actual rate of growth of the plants. Further experiments are proceeding.

A Belfast horticulturist bears out the above claims also. Using an aerial arranged a few feet from the ground in the form of a trellis, he trained a number of peas and runner-beans up the structure. The results showed a great increase in the productivity of the growths. In this direction, also, more experiments are being carried out.

Now, it is not my business to attempt to prove or disprove the above briefly stated reports. They can be regarded in any manner the reader pleases. Nevertheless, I propose in this article to bring together a number of facts, all of which go to prove that vegetable and plant growths are undoubtedly influenced by electric currents, and especially by those of a high-frequency nature.

In the first place, if we go back in history to the end of the eighteenth century, we shall find Galvani, one of electricity's most brilliant pioneers, experimenting with the fixed impression in his mind that he could influence the germination and growth of seeds by means of electricity. Galvani's experiments were failures, however.

About a hundred years later, to wit, in the nineties of the last century, somebody or other conceived the idea of growing seedlings in a box which had a carbon and a

Fig. 3. A typical example of the "Sundew" plant.

zinc plate placed in the soil at opposite ends, similar to the sketch shown at Fig. 1. It was considered that under the influence of the water contained in the soil and of the inorganic soil salts, a minute current would be generated and that this current would favourable influence the germination and subsequent growth of the seeds. A few successes were reported here and there with this method, but interest in it soon waned and further attempts were given up.

(Continued on next page.)

CAN WIRELESS HELP THE FARMERS?

(Continued from previous page.)

At a later date a number of other experimenters, among whom were Sir Oliver Lodge, took up the investigation of this new science of "electro-culture." In general, they arranged wire network aerials over the growing plants. These aerials were charged up to a potential of something like 15,000 to 20,000 volts, the current being allowed to flow into the wires for a

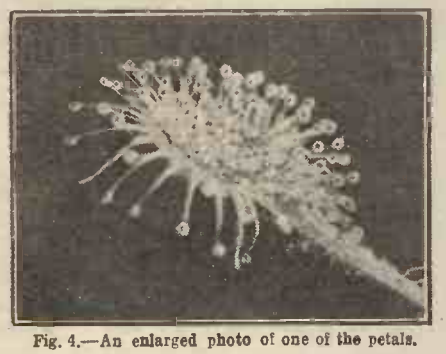

Fig. 4.—An enlarged photo of one of the petals.

period of a few hours daily. Good results were reported by this method, which is illustrated diagrammatically at Fig. 2.

Practical Possibility.

From time to time during the later periods, various agriculturists and scientific farmers have taken up the question of influencing crop growth by electrical means, and it is now a tolerably well-known fact that the presence of high potentials in the neighbourhood of plants are a direct incentive to their favourable and ready growth.

It is, therefore, quite within the bounds of practical possibility that radio waves may help along the growth of plants in the manner stated in the recent reports. But the question will naturally arise in

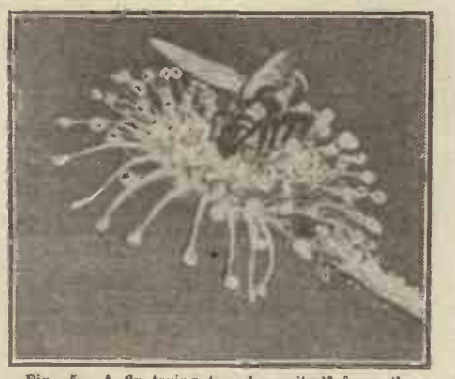

Fig. 5.—A fly trying to release itself from the tentacles of the Sundew.

the mind of the reader as to why all the vegetation lying in the path of the radio waves broadcast from the various transmitting stations throughout the length and breadth of the world does not increase in its rate of growth and productivity. The answer may probably be this. A wireless set does not receive actual ether waves. It receives minute impulses of electrical current which have been generated in the aerial wires under the influence of the ether waves flowing past. Therefore, a train of ether waves, as such, would have no effect on plant growth. They must be converted into electrical currents by means of a metallic conductor before this influence can arise.

On the other hand, as long ago as 1904, Major G. O. Squier, of the United States Signal Corps, showed that trees and other large masses of vegetation actually absorb ether waves and that they can be used as receiving aerials. In such cases the trees must be acting as semi-conductors, but, nevertheless, the currents set up in them under the influence of radio waves must be too minute to have any appreciable influence on their rate of growth.

Some experiments of my own, conducted a short time ago, tend to show that electromagnetic waves set up in the ether can be "sensed" by plants. A brief description of these experiments may be of interest to the reader.

There grows wild in many parts of England and Wales a little plant which is most remarkable for its sensitive properties. This plant is commonly known as the "Sundew." It is quite a small, lowly-growing affair, as will be evident from a glance at the photograph, Fig. 3. The Sundew has bright red fleshy petals, and a number of these plants growing together is sufficient to give a brilliant red tinge to the ground in the locality.

Now, the most interesting thing about the Sundew plant is that it possesses carnivorous habits. It is a fly-catching plant. The illustrations (Figs. 4, 5, and 6) will depict this remarkable property of the plant. Fig. 4 is an enlarged photograph of one of the petals of the plant. It will be noticed that the petal is furnished with a number of filament-like tentacles, each one of which terminates in a sucker device. Now, if a fly or other unfortunate winged insect happens to alight upon the plant, a sticky substance is immediately exuded from the petals, and the fly is unable to release itself from the plant. The tentacles then begin to bend over the fly until eventually they completely imprison the insect.

A Peculiar Effect.

The suckers of the plant finally fasten themselves on the body of the insect and extract the juices from it. Thus the Sundew plant actually eats the fly. Fig. 5 is an actual photograph showing the fly attempting to release itself from the flower of the plant, whilst Fig. 6 depicts the flower of the plant in a closed-up condition with the insect prisoner within it.

All the above may have very little interest to the wireless enthusiast, but the interesting fact derived from my experiments is that, apart from being acted upon by chemical means, the filaments of the Sundew can be made to respond to electromagnetic waves. In one series of experiments, a growing Sundew plant was placed about two and a half inches from the discharge knobs of a one-pint Leyden jar. The charged Leyden jar was then discharged in the usual manner. After the spark had passed, the filaments of the plant slowly closed up, just as if they were holding a fly in the midst of them.

Subsequently, a thin sheet of ebonite was placed between the Leyden jar and the plant. On repeating the experiment, the same result took place, and similar results were also afforded when sheets of coloured glass were interposed between the plant

Fig. 6.—The final stage: the fly is completely imprisoned by the plant.

and the Leyden jar. Thin sheets of metal, however, prevented the discharge of the jar from influencing the plant.

Another Interesting Test.

Another experiment which tends to show that certain currents can influence plant growth is one which can easily be carried out by the amateur. Procure a glass trough in which is suspended a fine mesh gauze. On the surface of the gauze scatter a few mustard and cress seeds. Place at each end of the trough two carbon rods to act as electrodes, and then very carefully fill up the trough with clean water until the level of the water just reaches the underside of the gauze.

Now connect the carbon electrodes to the 'phone terminals of an ordinary crystal set which is itself connected to the aerial and earth in the usual way. Carbon electrodes *must* be employed in the above cell owing to the fact that if ordinary metallic ones were used, contamination of the water would result.

Within thirty-six hours the seeds will begin to germinate, and the rootlets will

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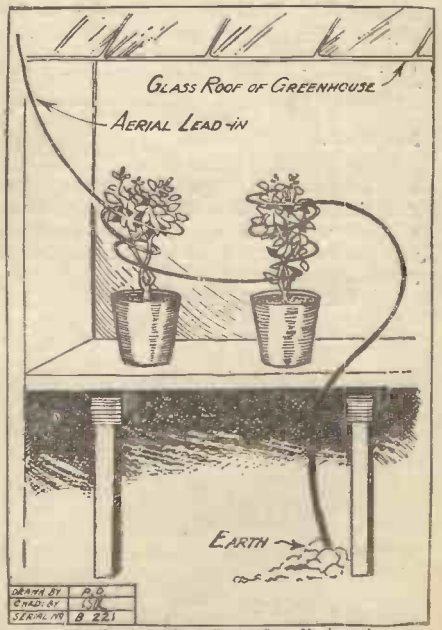


Fig. 7.—Testing the effect of radio impulses on growing plants.

TWO USEFUL HINTS.

FROM A CORRESPONDENT.

Battery Leads.

IN a multi-valve set designed to give maximum results, it is usual to provide a separate H.T. positive terminal for each valve, and a separate grid battery negative terminal for each L.F. valve. This means that the number of wires hanging down from the back of a four-valve set may become quite appalling; there may be no less than five H.T. leads and three grid battery leads, besides the accumulator flex.

A large number of leads of this kind may be convenient on occasions, but they are untidy and not at all necessary for ordinary work. Two connections to H.T. positive are generally quite sufficient, one applying about 50 or 60 volts, and the other 100 to 150 volts for the power valve and for any valve that is resistance coupled. If the battery terminals on the set are readily accessible, therefore, it will usually be possible to reduce the number of H.T. positive battery leads to two by linking terminals together. If this is not convenient it is worth while to construct a small panel, as indicated in Fig. 1, which may be hidden behind the set. This will enable either of the selected voltages to be applied to any of the valves at will, and two wires only will hang down to the H.T. battery instead of four.

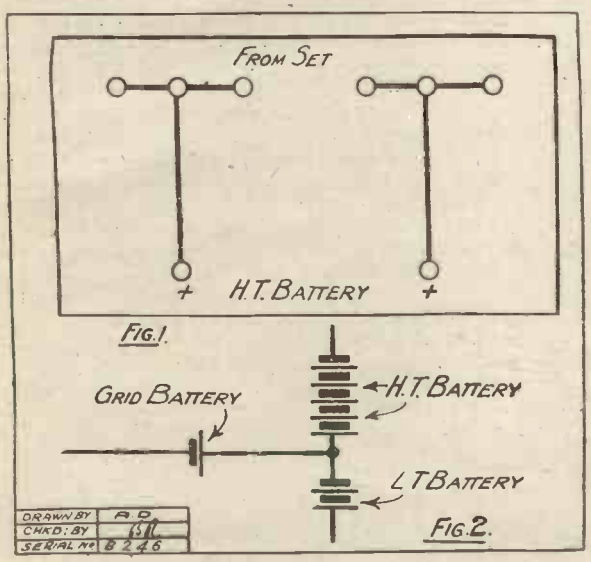


FIG. 1.

FIG. 2.

Grid Bias.

The H.T. minus lead from the set may be eliminated by the simple plan of connecting the negative end of the H.T. battery direct to the negative terminal of the accumulator—or to the positive, as the case may be.

The grid battery, which is usually small and compact, is often housed inside the set, or under the baseboard, but if this cannot be done, the grid battery positive lead, at any rate, may be abolished by connecting the positive end of that battery to the negative end of the accumulator. If the batteries are linked together in the circuit diagram as shown in Fig. 2, grid bias may be obtained from the H.T. battery by plugging the H.T. negative lead in at + 3 or + 4½ volts on the H.T. battery, and using the negative end of that battery for the grid battery negative lead.

By adopting these devices the number of leads from the set to the batteries may be reduced to about half their former number, and if these are neatly bound together by means of a strand of silk, there will be no loss of efficiency and the general appearance of the wireless corner of the drawing-room or lounge will be much improved.

Occasional Distortion.

When the loud-speaker unexpectedly begins to distort, and keeps it up, the cause in three cases out of four is either that the high-tension battery is run down, or that the low-tension supply needs renewal. These should be looked to first, and the writer would go so far as to suggest that if they are all right, it would be worth while tuning in a second station (if two stations are available at loud-speaker strength) before searching farther. The trouble *may* be in the transmission, particularly if the programme is being simultaneously broadcast and the local station is a provincial one.

However, there are many factors that may account for occasional distortion, and sometimes the most obvious is the last to be thought of: incorrect adjustment of the loud-speaker magnets, for example, or a faulty connection to the grid-battery, or excessive reaction. But sometimes the cause is unusual, and not at all obvious. On two recent occasions, for instance, the writer has found distortion to have been caused by a length of flex which had become worn so that only one thin copper strand held the spade-tag to the rest of the wire. In one case the wire was the lead-in from the aerial to the set, and though it is not quite clear why distortion should have been the indication of this fault, such was the fact. In the other case the wire in question was the loud-speaker extension, and the substitution of new flex effected a cure.

A much more persistent case of distortion, in a set which incorporated a filter circuit (choke across the loud-speaker and 1 mfd. condenser in series) was discovered, after many tests, to be caused by faulty insulation in the 1 mfd. condenser. In this case there was less of signal strength as well as distortion. The condenser was returned to the makers, who replaced it without question.

CAN WIRELESS HELP THE FARMERS?

(*Continued from previous page.*)

descend into the water. Now, if the electrodes have been continually connected up to the crystal set it will be found that all the rootlets are turned towards the positive electrode.

Naturally, this effect is not due to actual radio currents, but to rectified currents which pass from the set into the cell, and which (if an ordinary crystal set is used) will be of the order of between 35 and 80 micro amps.

Experiments on the influence of radio currents upon plant growth may also readily be carried out. All one really requires is a greenhouse, or, in lieu of that convenient structure, a window ledge, on which are placed a few growing plants. A helix of insulated copper wire is placed around each plant, in the manner indicated in the diagram, Fig. 7. The helices are connected together in series with an ordinary aerial lead-in and the usual type of earth connection.

If this arrangement is fitted up, the growing plants will continually be exposed to the influence of incoming currents from the aerial, and it is very probable that interesting results will be observed.

Future Possibilities.

Here space compels me to leave this interesting and novel subject. Without a doubt it is a well-established fact that ordinary steady and high-frequency alternating currents have a beneficial effect on the growth of plants of all kinds. Whether radio currents have this effect is a question which is not yet settled. But, nevertheless, it is a question which could easily be settled with the aid of a little patient experiment on the part of some interested amateur.

If the possible influence of radio energy upon vegetative growths is finally shown to be a constant and a beneficial one, there is no gainsaying the fact that another application of radio's aid to modern civilisation will quickly be put into practice. Looked at in its correct perspective, the above possibility is one of tremendous future importance. Owing to the world's rapidly increasing population, many economists have predicted a future time at which the production of grain, cereals, and other indispensable articles of food will not come up to the demand. Despite the fact that these gloomy predictions have vigorously been disputed, they are ones which compel consideration by every thoughtful man. If, however, future research within the next few decades shows that radio is capable of coming to the rescue, and of helping the farmer and agriculturist to increase the productiveness of his land, the fear of any lasting food shortage within the next few centuries can definitely be put aside.

Personally, I think such a state of affairs will come about before the world is very much older. And to any sceptical reader who chances to read these lines I would point out the fact that there are very many good folk living to-day who, ten years ago, would have scoffed at the mere idea of broadcasting.

TECHNICAL NOTES.

A Weekly Feature Conducted by

Dr. J. H. T. ROBERTS, F.Inst.P.
(*Staff Consultant.*)

THE question of the relation of the loud speaker to the last valve of the receiving set, or to be more exact, the relation of the impedances of the loud speaker and the last valve respectively, is a very important one which often does not receive the attention it deserves.

It is taken as a fairly general rule that the conditions are best fulfilled when the impedance in the valve is equal to that external to the valve, that is, in this case in the loud speaker. I should remark, however, that this rule is very much disputed by some authorities.

So important is it, at any rate, that the loud speaker and the last valve of the set should be matched, that some manufacturers, both in this country and in the States, are supplying special valves with their loud speakers, or are recommending particular specifications of valves to be used with them. In more than one case the loud speaker is sold completely equipped with its own low-frequency power amplifying unit.

These actions on the part of manufacturers represent an attempt to ensure that their instruments shall be used in the proper way so as to yield the best results. It is evident that a loud speaker cannot be expected to give its best results when used in conjunction with other accessories or components with which it is, so to speak, entirely out of sympathy.

In the early days of broadcast reception, so long as the programme could be definitely received and recognised, quality was of small account. But to-day things are different, and quality is all-important. It is for this reason that the refinements indicated above have gradually been introduced.

Loud Speaker Resistances.

This brings up a question, which is representative of many which I receive, as to the employment of a transformer between the last valve and the speaker.

The question whether a transformer should be used depends upon a number of considerations, of which, perhaps, the two principal ones are, firstly, the impedance, or the "resistance," as it is wrongly called, of the loud speaker, and, secondly, the desirability of avoiding a steady current through the loud-speaker windings.

If the loud speaker has a very low "resistance," say 100 or 200 ohms, it will be necessary to employ a step-down transformer, as this value will differ very greatly from the impedance of even a low-impedance power valve. But if the impedance of the speaker is, say, 1,000 ohms or more, it will not be necessary—although it may be desirable—to use a step-down transformer, if a power valve of medium or low impedance be used in the last stage. It must be borne in mind that many of the present-day power-valves have a very low impedance.

If, however, an ordinary valve of comparatively high impedance be employed in the last stage, it will certainly be desirable to use a step-down transformer, even with a speaker of 2,000 ohms resistance.

Of course, the foregoing remarks do not take any account of the second consideration mentioned above, namely, the steady current through the loud speaker. This steady current may be obviated by the use of a transformer, as already mentioned, and if the impedance values of the valve and the speaker are correctly matched, a 1 to 1 ratio transformer may still be used: this will prevent the steady current without upsetting the impedance ratio.

Before leaving this point, I should mention that a choke filter circuit may be employed, but I will deal with that more fully later on.

If a transformer be not used, and the steady plate current be allowed to pass through the loud-speaker windings, it is important to see that the current passes in the proper direction, that is, in the direction to strengthen and not to weaken the magnetism of the speaker magnets.

New Valve Amplifier System.

The suggestion to employ valve amplifiers for the amplification of the sounds reproduced from a gramophone is by no means new; indeed, several practical systems have been developed in which this is done. A recent apparatus, and one which has a number of novel features, is the Panatropor, by the British Brunswick, Ltd. This is a gramophone in which the mechanical vibrations produced by the record are caused to produce electrical variations (by means of a special device which is, of course, the equivalent of a microphone), and these electrical variations are amplified by means of an L.F. amplifying system, after which they are conveyed to a special loud speaker.

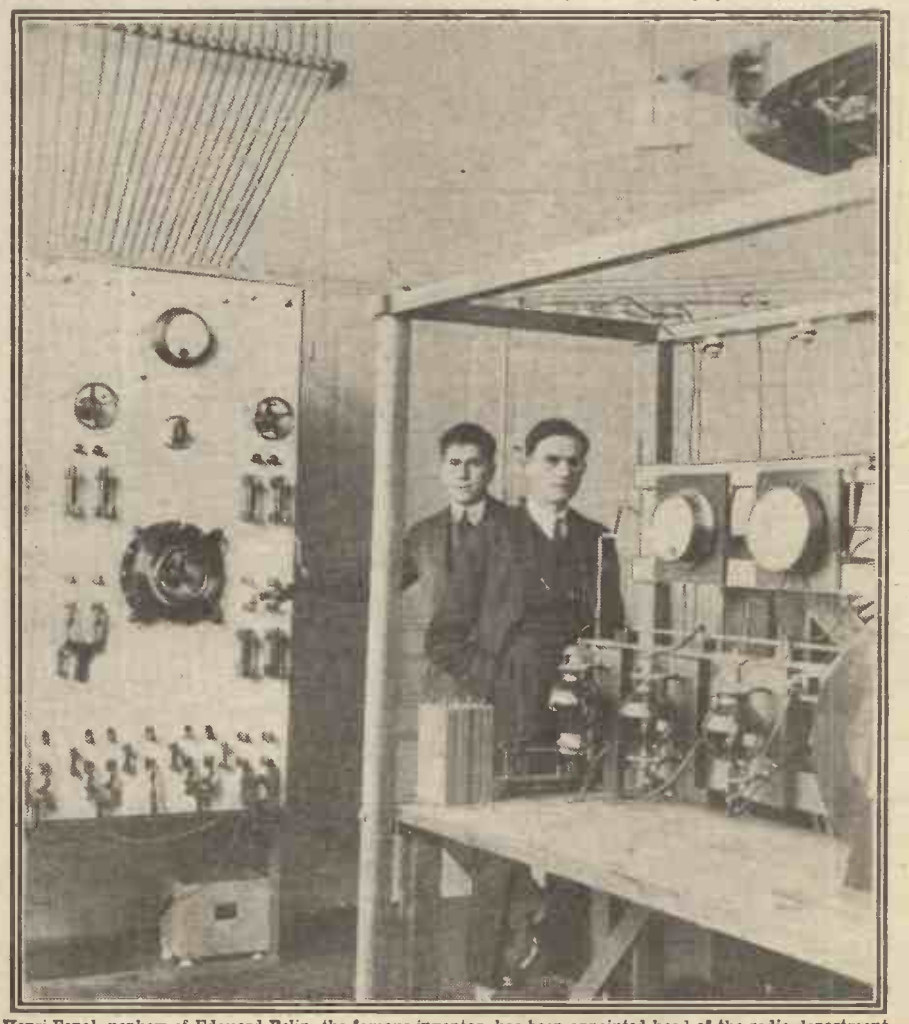
As mentioned above, there is nothing new in the general system, but by the use of a number of special features and *refinements*, a reproduction is obtained in this instrument which is claimed to be much superior to that obtained from similar apparatus which has been hitherto used.

H.T. Battery Life.

What is the life that may reasonably be expected from an H.T. dry battery? This question, though so frequently asked by amateurs, is just as impossible to answer off-hand as the corresponding question amongst motor-car owners, "How long should a set of tyres last?" The answer is that it all depends upon quality, treatment, and use.

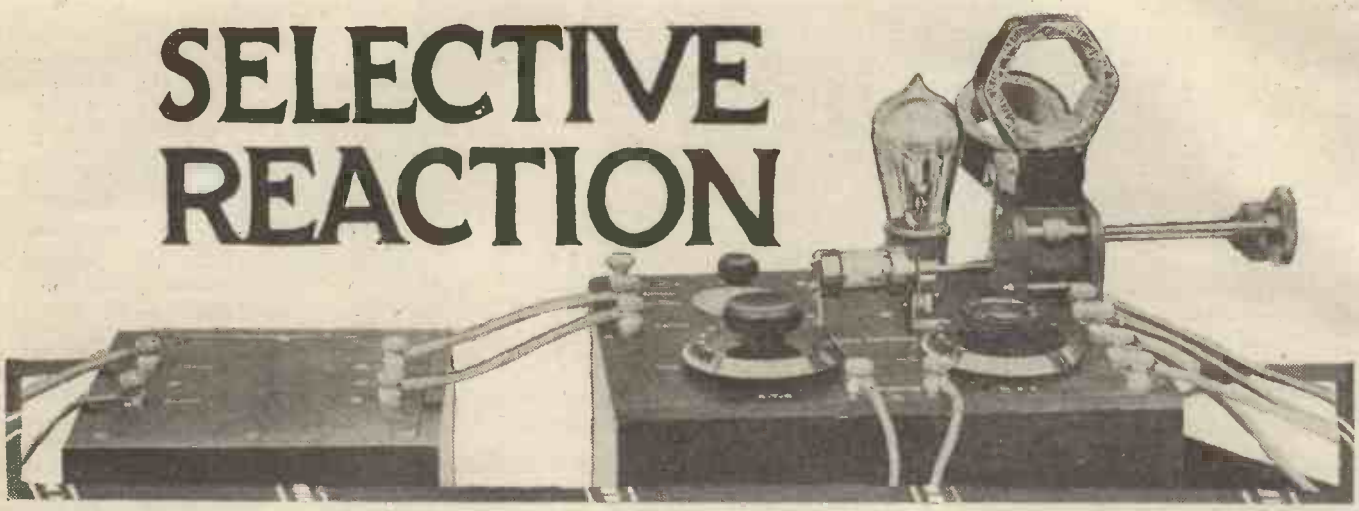
It is obvious that a cheap battery, especially of certain of the cheap German types that have made their appearance largely in the last year or so for wireless purposes, cannot be expected to give the same performance as a battery of a reliable make. Secondly, if the battery is kept in a warm

(*Continued on page* 656.)



Henri Fenal, nephew of Edouard Belin, the famous inventor, has been appointed head of the radio department of the Malmaison laboratories.

SELECTIVE REACTION



A Novel Theory of Magnetic and Capacity Reaction Combined as an Aid to Selectivity.

By NORMAN R. ROLPH.

DURING recent experiments the writer hit upon a novel circuit arrangement whereby both magnetic and capacity reaction, applied in a two-valve reflex receiver, were found to introduce super selectivity. The reasons which appear to underlie the effect of this combination of well-known reaction effects have been carefully thought out, but it does not necessarily follow that the attempted explanation given hereafter is correct.

Sailors and longshoremen alike will tell you that the man has not yet been born who can understand the action of the tides or accurately forecast the direction that may be taken by coastal currents.

The same thing is true of high-frequency currents. The reason why so many experimenters fail to get the maximum amplification out of H.F. stages is because it is like trying to imprison a flash of lightning in a basket. There are leakages all round. Every component used and every lead in a receiver utilising H.F. amplification provides a means of escape whereby the impulses are by-passed to adjacent parts, and thence to earth.

Faulty H.F. Stages.

And thus with the vast majority of three-valve circuits (1—v—1) you can switch off the H.F. stage and continue to receive without much inconvenience. It was in an attempt to get a little more out of a high-frequency stage that the writer turned his attention to the aperiodic type of coupling shown in Fig. 1. This is an instance of an H.F. valve coupled by means of a high-frequency choke and condenser to a detector valve with leaky grid condenser rectification.

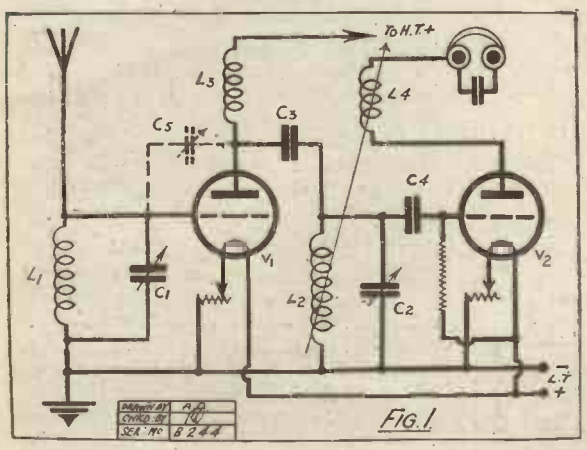


FIG. 1.

The receiver was first set up as shown, except for the absence of the capacity reaction condenser shown in dotted lines.

Here L_1 C_1 comprise the aerial circuit and the grid tuning arrangement of the H.F. stage. L_2 C_2 enable the grid of the detector to be tuned, L_4 is the reaction coil which is shown coupled to the grid coil of the detector, and L_3 is an air-cored H.F. choke of high inductance and relatively low distributed self-capacity.

Its action is to choke back the amplified H.F. impulses flowing in the anode circuit so that they may be by-passed through the condenser C_3 to the detector-grid via the grid condenser, C_4.

It will be noted that the electrical position of C_3 in the circuit is across the high-tension supply, so the insulation must be perfect, for should the high-tension negative be connected to L.T. positive the filaments would be endangered by a condenser of faulty construction. This arrangement gives us an aperiodic stage between two tuned circuits, and thus the stability of the H.F. stage is assured, there being no two tuned circuits in juxtaposition.

At the same time it was felt that something might be done to improve the selectivity of the receiver, and also to increase its sensitivity. Accordingly a capacity-reaction condenser, as shown, was introduced, various capacities up to ·0003 mfd. being experimented with.

Sharpening Tuning.

It was, of course, realised that judicious reaction applied to the H.F. grid would sharpen tuning considerably, and might even be used as a vernier to tune between interfering stations. It was not expected that the receiver would now become not only selective between stations on adjacent frequencies, but controllable throughout 80 to 100 metres by this one condenser, combined, of course, with synchronised adjustment of the magnetic reaction applied to the grid of the second valve. Yet this was the case, and having tuned the two grid circuits to resonance (with C_5 at its minimum) it was possible to pick up stations round the dial of this condenser until at wave-lengths of 80 to 100 metres longer, the signal strength seemed to suffer. Thus the Liverpool relay station coming in strongly at the minimum, by increasing the capacity to the full nominal ·0003 mfd., and at the same time tightening the coupling of the coils, the receiver was found to tune easily and controllably to 390 metres or thereabouts.

A Peculiar Effect.

The operation became similar to a single valve detector, and when the grid tuning condensers had been advanced in harmony with each other a further 80 metres or so could be comfortably explored on a sort of vernier jaunt. This effect was perplexing, and the following is an attempt to solve the puzzle.

(*Continued on next page* 648.)

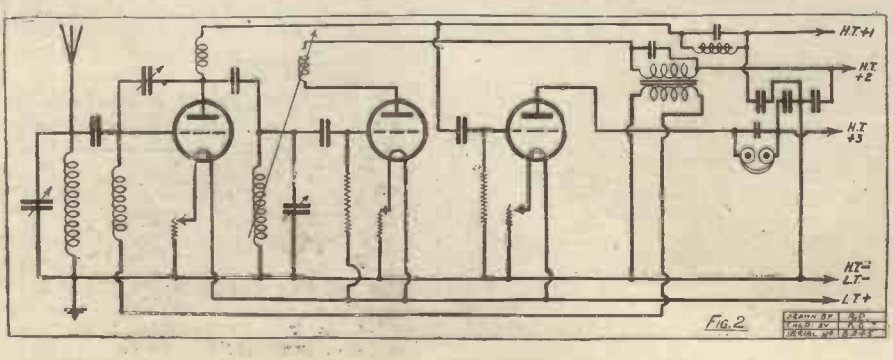
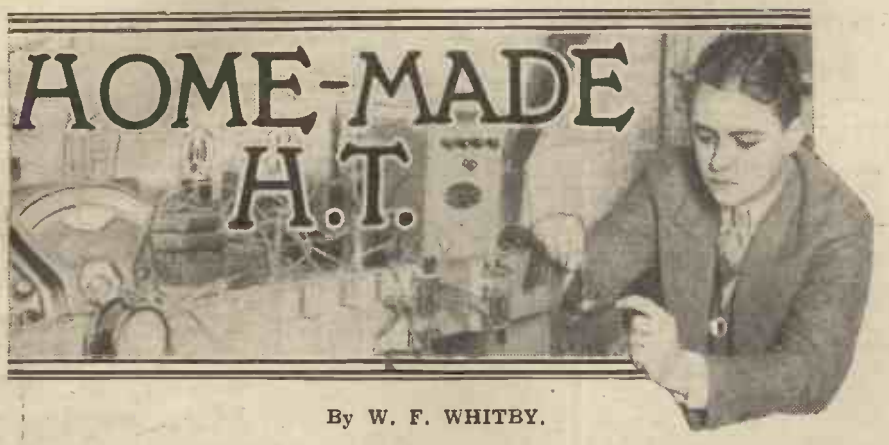


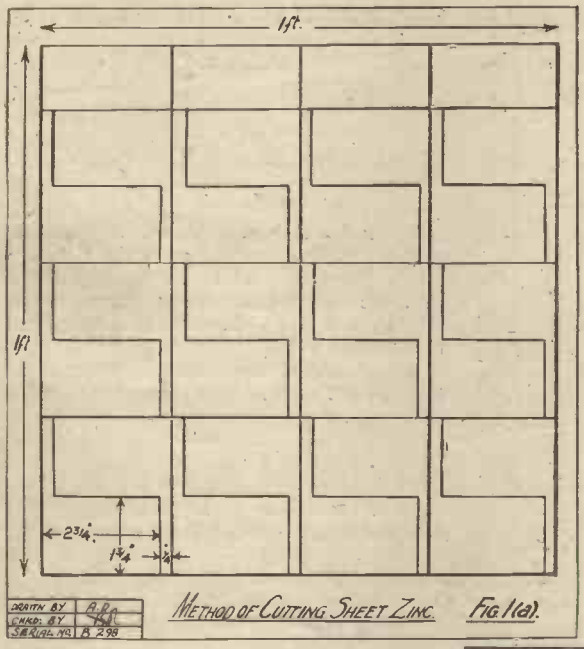
FIG. 2.

HOME-MADE H.T.



By W. F. WHITBY.

MOST wireless "fans" at some time or another have occasion to think hard things about their H.T. batteries and, on the score of expense alone, a wet H.T. battery is a worth-while proposition. A 60 cell (approximately 90 volts) wet battery can be made up for about seven shillings, and with a little attention periodically will serve its purpose faithfully for quite a considerable period, possibly for years.



Method of Cutting Sheet Zinc. Fig. 1(a).

The Necessary Parts.

First, let us take the materials required for making such a battery: (a) 60 small glass jars (these can be purchased at 1d. each—see "P.W." small ads.); (b) Zincs (negative pole). These also can be purchased at 1d. each, but if the constructor does not object to a little work a cheaper, and possibly better, way is to purchase about three square feet of No. 14 gauge sheet zinc and to cut it as in Fig. 1a. This can be purchased for 8d. per square foot, each square foot being sufficient for about twenty-four zincs; (c) Carbons (positive pole). These are the cheapest of all, for they cost nothing to one who has a discharged H.T. battery—or flash-lamp cells.

Having all the materials the next step is the preparation for assembly. The tops of the jars should each be dipped about a quarter of an inch in paraffin wax in order to prevent the electrolyte from creeping. The zincs should be cut as already described, and bent as in Fig. 1b so as to fit inside the jars.

The carbons must be dug out of the old batteries intact, with the brass cap and manganese dioxide packing complete—these then will resemble Fig. 2. Before soldering the zincs to the brass caps on the carbons, make sure that these caps are a tight fit and are not cracked. Should you find any that are damaged or loose—scrap them, and use in their places spacing washers such as are used for spacing the fixed vanes of a variable condenser. In order to use these the carbon must be filed slightly smaller till the washer just fits on; then, if the carbon is pushed home immediately after soldering the washer to the zinc, it will be found that on cooling the washer will grip the carbon tightly, thus making a good, sound electrical connection.

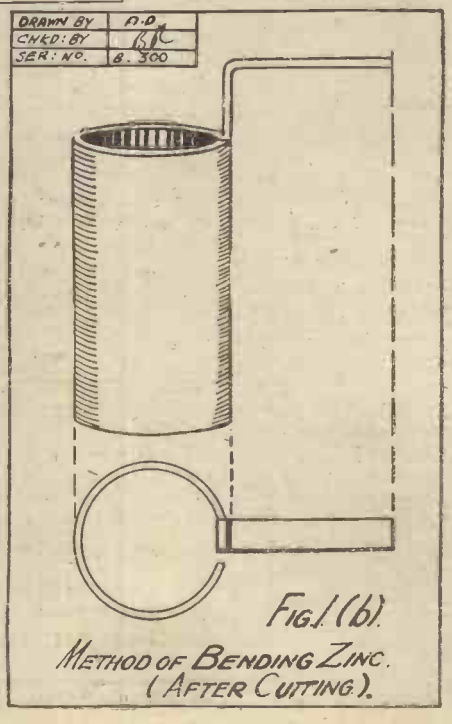


Fig. 1 (b).
Method of Bending Zinc. (After Cutting).

On completion each unit should appear as in Fig. 3. To finally assemble the battery place your jars in a box in rows, and commence by placing a zinc complete with soldering tag, but with no carbon attached, into the first jar. This is the negative pole. Next, take a complete unit and place the carbon (positive) inside the zinc of the first jar, and the zinc (negative) into the second jar, and so on to the end. The last jar is completed by placing a carbon only with soldering tag inside the zinc; this is the positive pole. Next fill the jars with ammonium chloride (sal ammoniac)—six ounces to one pint of water—and the battery is ready for use.

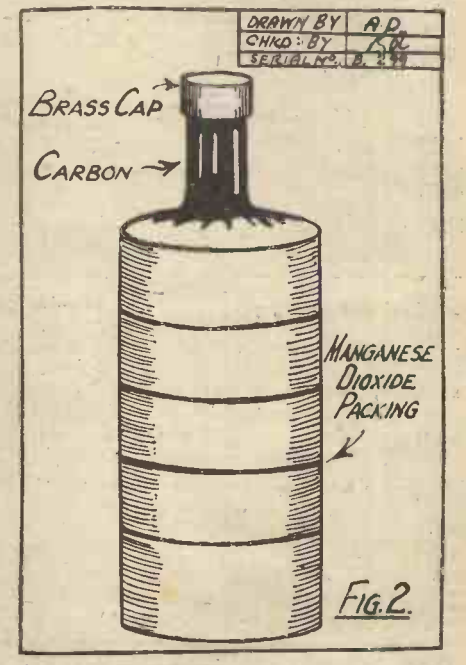


Fig. 2.

Economical Battery.

With an occasional run-over to see that the jars are filled with sal ammoniac, this battery will run for quite a considerable time without further attention.

It will be found that "push-on" paper clips are a very convenient method of taking tappings, and the battery has the additional advantage of being very elastic, as tappings can be taken from each cell by simply pushing the clip on to the connecting tag.

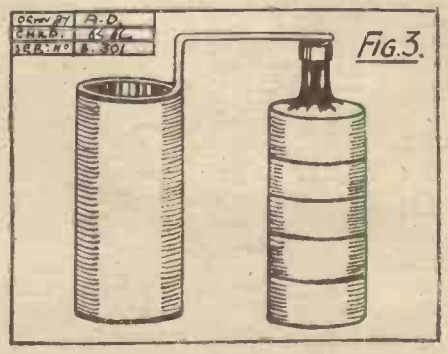


Fig. 3.

It should be remembered, however, that after the construction of the battery and the filling of the jars with solution have been carried out, the whole thing shall be left for about twelve hours before any attempt is made to put the battery into service.

YOUR LAST CHANCE!

£200 IN PRIZES FOR READERS

Closing Date, November 16th.

WHAT YOU HAVE TO DO—

The Editor of POPULAR WIRELESS is offering 5 prizes of £25 each and 5 of £15 each to readers of POPULAR WIRELESS who enter the "P.W." Constructors' Competition by filling up the coupon on this page. There is no entrance fee.

The prizes will be awarded under the following categories:

A. A prize of **£25** for the best home-made L.F. amplifier unit. Second Prize **£15.**

B. A prize of **£25** for the best home-made Variable Condenser, approx. capacity ·001 mfd. Second Prize **£15.**

C. A prize of **£25** for the best original wireless receiving set component. Second Prize **£15.**

D. A prize of **£25** for the best home-made Variometer for B.B.C. wave-lengths. Second Prize **£15.**

E. Special prize for readers under 16 years of age. A One Valve B.B.C. wave-length (not 5XX) receiver, size limit for panel 10 in. by 7 in. First Prize **£25.** Second Prize **£15.**

READ THESE RULES CAREFULLY.

The First Prize of £25 in each class will be awarded by the Editor of POPULAR WIRELESS for what he considers the best constructive effort within the terms laid down for the respective classes. In all cases workmanship and design and the amount of actual "home made" apparatus will be primarily considered in the judging. The second prizes will follow according to merit.

The Editor may divide any of the prizes, at his discretion. The Editor's decision will be absolutely final and binding in all respects.

Any number of entries may be sent, but each entry must be separate and distinct in itself and must be accompanied by a separate signed coupon (as given here). Thus, if you want to enter two of the classes, just buy another copy of "P.W." which will give you the necessary coupon.

All apparatus must be addressed to:

"Amateurs' Radio" Competition,
The POPULAR WIRELESS,
7/9, Pilgrim Street, Ludgate Hill,
London, E.C.4 (Comp.)

and it must reach that address not later than TUESDAY, November 16th. Nothing arriving thereafter will be admitted for adjudication.

When packing your apparatus, pack carefully and make sure that you enclose stamps to cover the cost of its being sent back to you, otherwise its return cannot be guaranteed.

And when sending up your apparatus it will help us if you use on the parcel a label (according to the class you are entering), as given in the 16th Oct. issue of "P.W." Every care will be taken of entries, but no responsibility can be undertaken in this respect. This contest is only open to *bona fide* wireless amateurs.

Any apparatus of professional make (other than the smaller component parts and accesories) will be disqualified.

No one connected in any way with POPULAR WIRELESS is eligible to compete.

Apparatus will be returned as soon as possible after the adjudication.

ENTRANCE FORM.

I (Signature).....

of (Address).....

.....,

an amateur in wireless construction, wish to enter the "P.W." Constructors' Competition Class.....(write "A," "B," "C," "D" or "E," as the case may be) and hereby agree to abide by the Editor's decision. I declare that the entry herewith submitted, is of my own construction. (If under 16 years, please state age.)

To the Editor ("Amateurs' Radio" Competition Dept.), POPULAR WIRELESS, 7/9, Pilgrim St., Ludgate Hill, London, E.C.4 (Comp.)

BROADCAST NOTES

BY OUR BROADCASTING CORRESPONDENTS.

The P.M.G. Weakens—The Royal Charter—De Groot—Programme Criticism—Cutting the Cackle—The Menace of Education—Is Mr. Reith in the Charter?

The P.M.G. Weakens.

THE announcement that, after all, the House of Commons will have a chance to discuss Broadcasting before the end of the year shows that listeners have been exercising some of their political influence. It is now an open secret that the Whips were astounded to receive so many danger signals from private members who had been pestered by constituents about the Broadcasting legislation, But there is no sign as yet of a change of financial policy. While weakening on procedure, the P.M.G. reiterated that, in his opinion, the £620,000 allotted to the B.B.C. for the current financial year was quite adequate. Naturally, he did not go out of his way to explain that of this £620,000 only £495,000 was available for programmes, engineering and administration; the balance was for capital and liquidation. The essence of the problem is that for the period in question programmes alone should receive just twice the amount set aside for programmes, engineering and administration. But as long as a Civil Servant, or for that matter a Minister of the Crown, is to decide on the standard of programme to be given to broadcast subscribers, absurdity will be perpetuated.

The Royal Charter.

The future constitution of British Broadcasting is still undisclosed. Authoritative political circles agree that there has been prolonged discussion in the Cabinet on whether or not to give more than the merest perfunctory lip service to the Report of the Crawford Committee. The chief bone of contention has been the maintenance of Post Office supremacy. The Crawford Committee was for limiting this to the technical side, but the Post Office has been conducting an intensive campaign to retain ascendancy on the programme side as well. The alarming thing now is that so far as the Government are concerned the Post Office appears to have scored a notable success. It remains for Parliament to let the light of publicity illumine many of these dark corners.

"My Programme."

This series is running well, and attracts widespread interest. Viscountess Astor will probably make number six, due for November 29th. George Grossmith will take the eighth. Father Ronald Knox, the Bishop of Truro, and Mr. J. L. Garvin are other probables.

De Groot.

In every competition on the comparative popularity of programme items De Groot has figured in the first three, and usually has been first. It is a great pity, therefore, that his broadcasting is now a matter of history. But the B.B.C. have got to retrench constantly while licence revenue accumulates at the Post Office. At the present rate, there will be other notable economies before long. If the financial policy remains the same, the Savoy Bands, the London Radio Dance Band, the various Radio Revue companies, and most of the special features will be washed out. There will be a revival of gramophone music on the ether.

Programme Criticism.

The system of regular outside critics which the B.B.C. instituted last year is being abandoned. The idea of this was that a few listeners taken from different walks of life should send in regular reports on the programmes. This attempt to get a cross-section of public opinion proved helpful at first, but each critic tended to get into a groove, and ultimately nearly every point made was cancelled out. Moreover there was very little constructive criticism forthcoming.

Evensong from Temple Church.

There is a strong probability that, beginning shortly, evensong will be broadcast from Temple Church on certain Sundays.

Soft-Pedalling Speeches.

It is good news that the B.B.C. is ruthlessly rejecting proposals for the broadcasting of speeches at public dinners. There is always a keen demand for this sort of thing from interested quarters. Pressure, both social and political, is brought to bear at Savoy Hill. Among dinners recently rejected are several connected with the Imperial Conference, the British Olympic Association Dinner, and a Dinner to Lord D'Abernon. Listeners will be relieved to know of the new policy at Savoy Hill. The sonorous platitudes of the great are no substitute for decent music. When there are alternative wave-lengths, then perhaps a few of these dreadful functions can be broadcast. For those actually present an abundance of good food and wine is some compensation.

Peggy in "Paddy."

Arrangements are in hand for a special radio production of "Paddy the Next Best Thing," starring Peggy O'Neil. This should be broadcast in the last week of November.

"We and Others."

By permission of Sir Oswald Stoll, this popular item will be broadcast late in November or early in December. It had been hoped to include it in the National Wireless Week programmes, but there was a good deal of delay in granting the permission.

The B.R.D.A.

The British Radio Development Association, formed last spring at the initiative of the B.B.C., is being revived. The success attending the effort to co-operate for the purpose of National Wireless Week has brought the larger issue to the front once more. It is likely that the new Radio Manufacturers Association will take an active interest in the B.R.D.A.

Cutting the Cackle.

Routine bulletins and talks are to be limited to five minutes in future. This is a welcome decision. It is also stated that the 9.30–9.45 period is in future to be filled according to programme values. Thus if the talk available is not of definite entertainment interest, then music will be substituted.

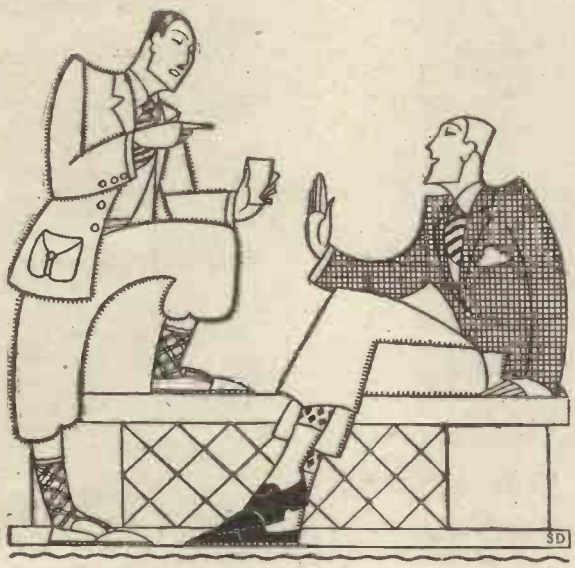
The Menace of Education.

The confident assertions about the Radio University, and the already frequent meetings of educational pundits, have naturally given rise to some apprehension in the minds of discerning listeners. Is the new régime to see an orgy of uplift and high-browism in its most offensive and patronising forms? The continued delays in the high power plans put the régime of alternative programmes farther and farther away. Except for the purpose of publicity and post-prandial eloquence, there is no possibility of really effective alternative programmes until 1928. It becomes all the more necessary therefore that the depredations of the high-brows on programme time shall be resisted to the utmost now. What listeners want is, roughly, the balance they have had under the Broadcasting Company's regime. If this is upset, then there is no doubt whatever that licences will fall off. Already the rumours of the effect of the change-over has reduced the rate of increase in licences to an almost "level" curve. The point of decline is not remote.

Is Mr. Reith in the Charter?

POPULAR WIRELESS was the first to call attention to what might be the crowning scandal of the change over in Broadcasting control. To leave Mr. Reith off the new Board of Governors was deplorable but understandable. To leave his name out of the Charter would be an outrage. There is no indication yet as to what is to be done in this matter; but if Mr. Reith's name is not in the Charter, then there is to be a big fuss in Parliament.

EXPERTS IN RADIO ACOUSTICS SINCE 1903



'Not on your life, old man!

IT'S not an atom of use getting on your hind legs to tell me of the thrills of an eight valve "super-het." Nice little row of fairy lights—what! That's all they mean to me.

Besides, I want peace in life. I get just as much fun out of two or three valves and much less trouble and expense.

I want ease of operation, marvellous compactness, ingenious design and guaranteed efficiency, and I'll bet a Brandes means all that.'

Brandes

From any reputable Dealer.

The NATIONAL WIRELESS WEEK
NOV. 7th - 13th
'Let your Friends Listen'

54

THE BRANDESET II.

The new Brandes 2-valve set features simplicity of control and ingenious compactness. Condenser dial, filament rheostat, reaction dial and "throw-over" switch for long or short wave tuning complete the panel controls. Straight line frequency condenser tuning and grid-bias is employed. The standard coil is suitable for Daventry and no "plug-in" coils need be purchased. The L.T., H.T., and grid-bias leads are plaited into one cable from rear of set.

£6 - 10 - 0

(Exclusive of Marconi Royalty and Accessories.)

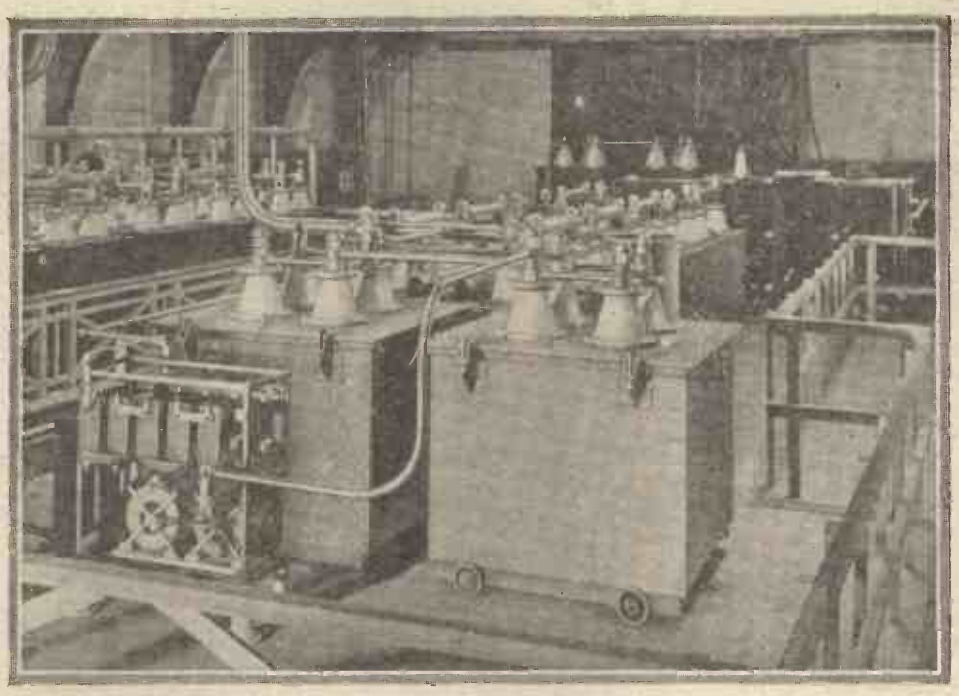
THE BRANDESET III.

The new Brandes 3-valve receiver employs the same ingenious characteristics as the Brandeset II, except that an extra stage of Audio Frequency is employed. It has straight line frequency condenser tuning, grid-bias and is adapted to long and short wave tuning. Both receivers give most excellent loudspeaker reproduction on a number of stations, and are specially designed for this purpose.

£8 - 10 - 0

(Exclusive of Marconi Royalty and Accessories.)

BRANDES LIMITED · 296 REGENT ST · LONDON · W·1 · WORKS · SLOUGH · BUCKS



Specify Dubilier!

Sixteen years ago we commenced manufacturing wireless condensers.

In those days, electrical condensers certainly existed but they were totally unsuitable for wireless purposes. Accordingly we made a minute study of the subject and, as a result of careful observations over long periods, we were enabled to design condensers in which hysteresis losses, insulation leakage and numerous other factors opposed to condenser efficiency were either reduced to the minimum or eliminated completely. The small, hermetically sealed groups of mica and metal plates which form the essential units of the familiar 600 Type condensers are the direct outcome of these observations.

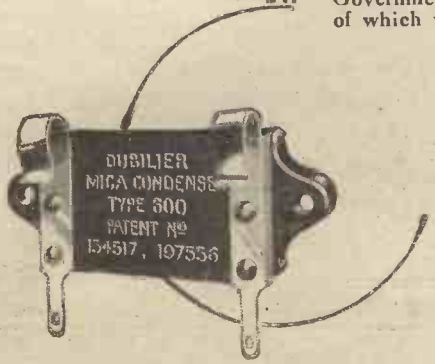
They represent the very high standard of electrical efficiency to which modern science has brought the condenser, and it is interesting to note that these identical units, grouped in their tens of thousands, make up the Condenser Banks of the world's principal wireless stations.

In the Condenser equipment of the Government Radio Station at Rugby, of which we show a view above, there are in each of the large "tanks" over half a million of such mica and metal plates grouped into hundreds of condenser units.

Each of the many millions of plates was individually selected and tested before being collected into groups, and each group was again subjected to frequent and stringent tests during the successive stages of assembly.

This ritual of tests, tests, and more tests is observed in the case of every single product bearing the Dubilier name. Our long experience has taught us that if we are to make condensers which will be satisfactory in service, whether they are designed for High Power Stations or for Broadcast Receivers, we must take precautions to eliminate every possible cause of failure. As Condenser Specialists we know these precautions to be not only desirable but essential. Governments and Manufacturers of Broadcast Receivers all over the world, agreeing with us in this matter, specify Dubilier.

Are there Dubilier Condensers in your set?



Specify—

DUBILIER

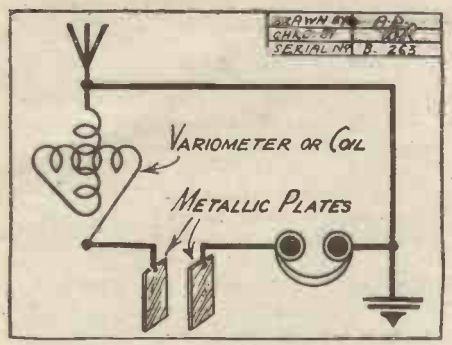
ADVERT. OF THE DUBILIER CONDENSER CO. (1925) LTD., DUCON WORKS, VICTORIA ROAD, NORTH ACTON, W.3. TELEPHONE: CHISWICK 2241-2-3.

E.P.S.238

NOVEL RECTIFICATION

WHAT IS A "PSYCHIC-GALVANIC REFLEX"?
This interesting article will tell you—and other less-known facts about the application of Radio to Human Progress.

"WHAT a piece of work is a man!" exclaims the ever-famous Hamlet. And doubtless he would have had more to say on the same subject if he had been familiar with some of the curious electrical properties of the human body which science in the last quarter of a century has brought to light.



The human body possesses in varying degrees electrical properties very peculiar to itself. One of these of which a great deal of use has been made within recent times is the property which the body possesses of automatically varying its electrical resistance under the stress of conscious or sub-conscious emotion. An instrument working on this principle, and called the "psycho-galvanic reflex," is now quite a perfected affair, and it has been used for many purposes. As an instance of its usefulness, let us suppose that, after many months of patient restraint, you go out and murder the persistent and incurable oscillator next door. Naturally, your crime is found out. You are arrested. And, when subsequently you plead "Not guilty," you are invited to submit yourself to a test on this new instrument of electro-physiological science. Fitted up to this instrument, you cannot tell a lie, and your untruthful plea of "Not guilty" is immediately detected by the instrument.

A Mystery Solved.

Sometime I hope to write a few notes on the subject of the psycho-galvanic reflex apparatus, and its possible applications to radio science, for the benefit of readers who may be interested in the subject, but at the present time, however, I propose to confine myself to a matter which is quite well known, and which, in view of the many different experiments which may be carried out upon the subject, will be of especial interest to crystal-set owners, and experimenters in crystal and other types of radio rectification.

It is the subject of rectification by means of the human body, a subject which forms, incidentally, still another of the many interesting electrical properties of the human body. Many crystal experimenters have, no doubt, noticed that, occasionally, faint signals are heard in the 'phones even when the point of the cat's-whisker is not resting on the crystal surface, but is a short distance above it. People have tried on occasions to explain this phenomenon by ascribing it to some sort of capacity effect set up by the detector and its surroundings. It is difficult, however, to appreciate the truth of such assertions, for close examination of the details of the experiment will elicit the fact that in every case the gap between the crystal and the cat's-whisker has been bridged over in some way, directly or indirectly, by the semi-conducting path of the human body.

Of course, in such a complicated and obscure electrical path, loose contacts must exist, and loose contacts, as the reader will well know, are notorious for the peculiar electrical effects which they give rise to. It is pretty certain, however, that in cases of the above nature, the body itself must be acting as a rectifier, and the following experiments are simple ones which the radio man, interested in the subject, may carry out for himself, and very possibly discover further important facts in so doing.

Preparations for an Experiment.

A very simple experiment in human rectification is as follows: Remove the cat's-whisker from the crystal surface, and grasp the crystal cup between the fingers of the left hand, and the cat's whisker holder between the fingers of the other hand. The grasp on both sides of the detector should be very firm at first. Now listen carefully, and endeavour to determine if any faint sounds are present in the 'phones. If they are

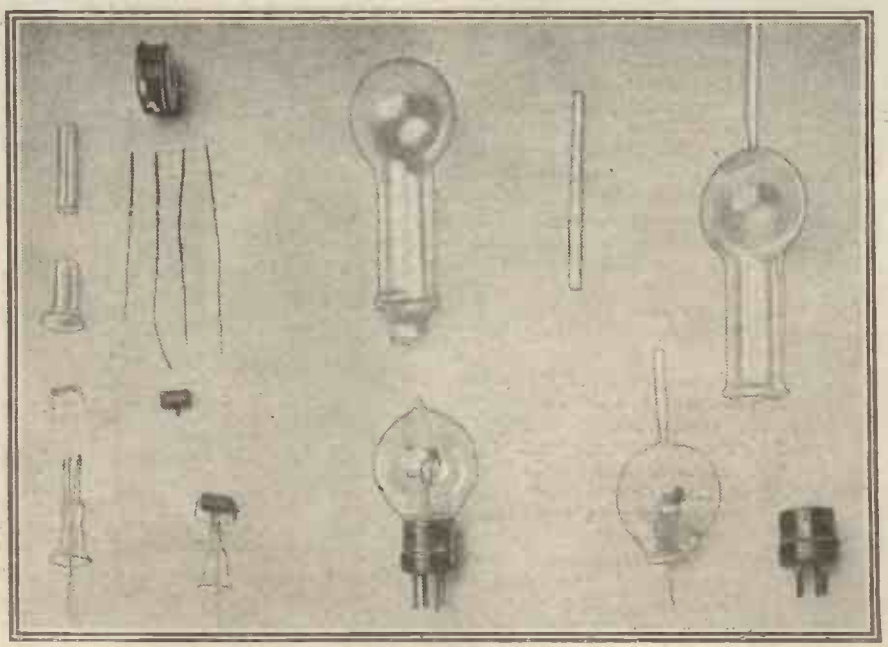
Fig. 2.—The novel method of rectifying radio signals described in the accompanying article.

absent, considerably relax the grasp of the fingers on one of the sides of the detector, keeping the grasp on the remaining side quite firm. Then lighten the grasp on the remaining side of the detector. In many cases rectification will be evident under one or other of these conditions.

A better experiment, however, is the following:

Obtain two perfectly flat copper, zinc, or lead plates and solder a wire lead to each.

(Continued on next page.)



Stages in the construction of receiving valves made by senior students of the Milan radio university.

NOVEL RECTIFICATION.

(*Continued from previous page.*)

The ends of the wire leads are connected to the opposite poles of the crystal detector, so that the whole arrangement in reality possesses a circuit similar to that indicated at Fig. 1.

Now thoroughly wash the hands, using hot water and plenty of soap, and subsequently well rinsing the hands in plenty of hot water. After this process the hands must be thoroughly dried by rubbing them vigorously in front of a fire.

Assuming that the set is tuned in to its maximum extent, and that, under ordinary conditions, the signals which it receives are strong in intensity, we may now carry on with the experiment.

An Unique "Cat'swhisker."

Place the palm of one hand flat upon the surface of one of the metal plates. The fingers should be loosely separated, and the whole hand should press heavily down upon the plate. Next, with one of the fingers of the other hand, make very light contact with the other plate. In very many cases, rectification will be evident, and faint but perfectly clear signals will be heard in the 'phones.

As many individuals are unable to exert very light degrees of pressure by means of a single finger, it may be a good plan for the experimenter to adopt the means of attaining this end which are illustrated in Fig. 2. Rest the palm of the hand upon a book, the fingers being comfortably curved, and the whole hand at ease. Now point one of the fingers downwards so that it just comes in contact with the metal plate placed underneath. Under these conditions quite a considerable amount of control on the finger pressure may be exerted, and this control may be maintained over relatively long periods.

Some Interesting Questions.

Still better rectification by this method may be obtained by using a very lightly copper-plated carbon plate for making the light finger contact upon. A suitable carbon plate may be procured by breaking up the porous pot of an old Leclanché cell. It is copper plated by immersing it in a dilute bath of copper sulphate, together with a strip of metallic copper, and by connecting the carbon plate and the copper strip in circuit with a single dry cell. Only a very light copper plating is required, and the surface of the carbon plate should still retain its black appearance when the plating process has been completed. An immersion for twenty or thirty seconds in the copper sulphate bath is usually sufficient to effect this degree of copper deposition on the surface of the carbon plate, although, of course, the precise length of time is determined by the current strength and the strength of the solution.

Such, in brief, are the experiments which may be made successfully on rectification by means of the human body. I say "successfully" made, but nevertheless there do seem to exist a number of individuals who are devoid of this interesting property. If, after repeated trials, the experiments fail, you may be one of these individuals, but you are certain to find one or other of your acquaintances who will react favourably to the experiments.

There is really a tremendous amount of original research which the average experimenter may carry out. For instance, what is the effect of various bodily states upon this peculiar property of rectification? Does it increase when we are ill? Is the effect the same when we are hungry as it is after we have just completed an eight-course dinner? Do mental states influence the effect? If we are madly in love can we effect better rectification with our bodies than we can if we are sullen, morose misogynists?

There are hundreds of questions similar to these which are worthy of investigation. It is all a matter of time and patience, and, for the interested amateur, especially in view of the approach of the longer evenings, the subject makes an excellent one for original investigation.

Naturally enough, the question in the mind of the reader at this point will be "How is the effect produced?" To be truthful, however, no fully proved explanation is forthcoming. It has been shown that solutions of various metallic salts of definite strengths possess the property of rectification when very delicate metallic contact is made with them under special conditions. And this is quite possibly what happens under the conditions of human body rectification. The body, as we well know, is fairly well full of metallic salts in various states of solution and it is very reasonable to suppose that their presence governs the rectification effect set up by the body. If this theory is true it supports the conventional electrolytic hypothesis of rectification, a theory which many present-day authorities have discarded in favour of molecular and electronic explanations of the phenomena of rectification.

A disc type loud speaker made by an Australian reader. It is stated to give very good results.

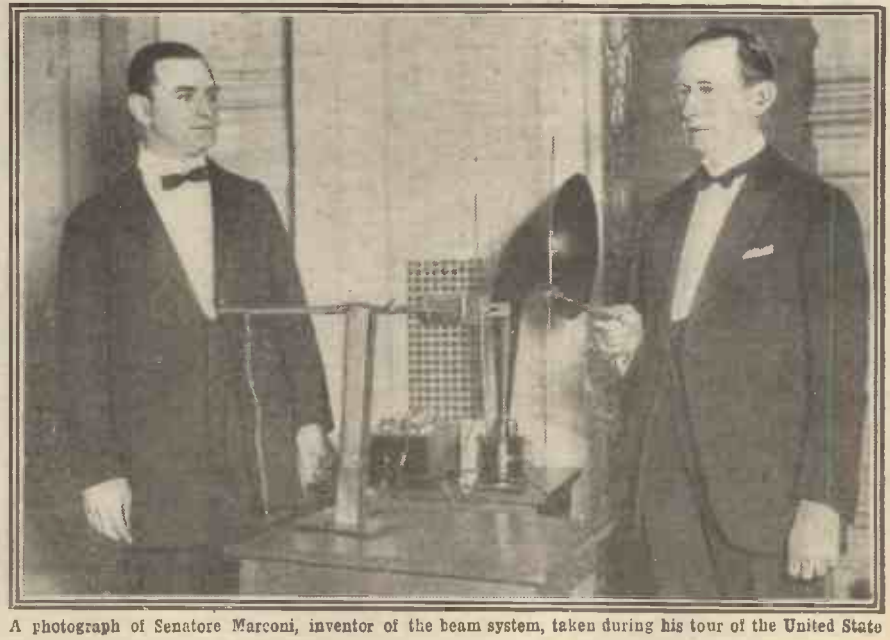
YOUR AERIAL AND HIGH WINDS.

AT this time of the year many aerials break as a result of the strain created by high winds. If, instead of attaching the aerial permanently to the mast, you run it through a pulley and attach the lower end to a weight, the weight will normally keep the aerial taut, but will pull up a little when the wire is strained, thus preventing a break.

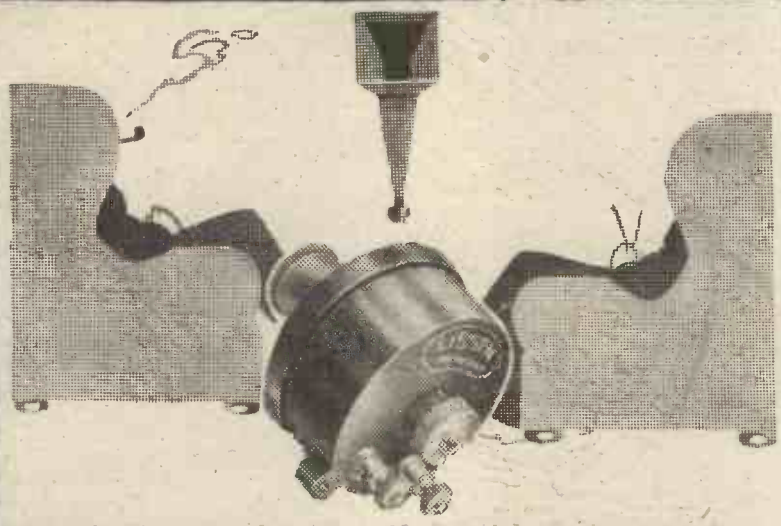
This idea, of course, is old, and many aerials are already fitted in this way, but the problem of the weight itself frequently presents difficulty. The ordinary standard two-gallon petrol can makes an extremely convenient adjustable weight, as it can be filled with water to any level, giving just the weight required.

Two gallons of water weighs approximately 20 lb., so that with the weight of the can you will probably have all you need for quite a long aerial.

Arrangements should be made that the can does not sway against the mast when it begins to blow, for if it does an annoying clatter will result. The improvised weight can, however, very easily be held away by means of a cord fastened to a peg in the ground.



A photograph of Senatore Marconi, inventor of the beam system, taken during his tour of the United State



Build your own loud speaker for the week-end

Do you know you can build yourself a loud speaker for less than the price of a pair of telephones, which will yet be equal to any expensive loud speaker you can buy at any price?

Tens of thousands of people have done this—and what they have done you can also do.

7 DAYS' TEST AT HOME.

Your dealer will demonstrate, but better than all take a LISSENOLA home—put it on your set—put it on your friend's set—try it with the horn of his expensive speaker fitted to it—then if you are not satisfied, or do not find it at least equal to any expensive loud speaker you have heard, take it back to your dealer's or send it back to us.

You can build a big horn for the LISSENOLA yourself for a few pence—easily—from the full-size diagrams and clear instructions given with each unit, thus providing yourself with a complete instrument equal to any loud speaker, and saving you many pounds.

If any difficulty in obtaining send direct to factory. No postage charged, but please mention dealer's name and address. Or can be sent C.O.D.

The "Lissenola" instantly converts any gramophone into a radio loud speaker.

Price **13/6** *each*

Complete directions and full-sized pattern for making this horn are given with every "Lissenola."

A cone diaphragm loud speaker can easily be constructed. The illustration shows one method of mounting to the "Lissenola."

The "Lissenola" Reed Attachment (patent pending) for use with cone diaphragm loud speakers. Price 1/-.

The LISSENOLA

The LISSENOLA—the loud-speaking unit with the golden tones.

LISSEN LTD., 8-16 FRIARS LANE, RICHMOND, SURREY.

Managing Director: THOMAS N. COLE.

SMALL ENERGY-CONSERVING CONDENSERS—

Fit LISSEN—these small condensers deliver all their stored-up energy. The following capacities are made in mica (LISSEN also make the Mansbridge type in larger capacities). Leaky condensers waste energy—fit LISSEN and save it.

Capacities ·0001 to ·001 1/- each (much reduced).

·002 to ·006 1/6 each (much reduced).

Note the new case which enables the condenser to be fitted upright or used flat. At present the new case is available in the capacities most used, but will quickly become standard for all capacities.

ADD 10% MORE LIFE TO YOUR H.T. BATTERY

—merely by using a LISSEN 2 mfd. or 1 mfd. (Mansbridge type) condenser across your H.T. battery. It cuts out all the noise from your H.T. battery when the battery is old, and keeps the energy flow steady and quiet in the meantime. One LISSEN condenser will outlast many batteries, and the lengthened life you get out of your battery will pay for the cost of the LISSEN condenser over and over again. Your dealer will tell you how you can easily connect the condenser when buying it. Use either 2 mfd. or 1 mfd. capacity—the larger condenser is more effective.

LISSEN (Mansbridge type) condenser: 2 mfd. 4/8 1 mfd. 3/10

Other capacities made are:

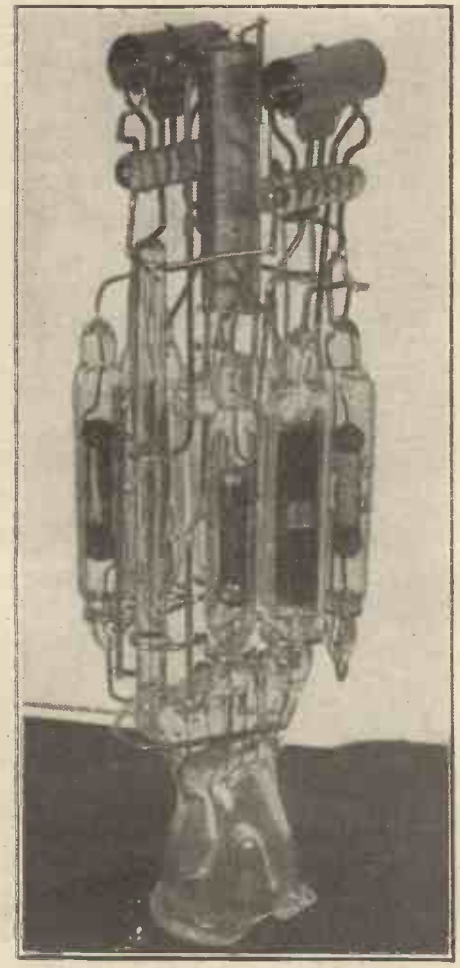
·01	2/4	·25	3/-
·025	2/4	·5	3/4
·05	2/4	1·0	3/10
·1	2/6	2·0	4/8

Instead of a tin case, the LISSEN Condenser, unlike all other condensers of the Mansbridge type, has a specially moulded case which IN ITSELF IS A SOLID INSULATOR. That is why it is impossible for the LISSEN condenser to short circuit on to its case, an important protection for the user when the condensers are being used in a circuit connected straight on to the electric light mains. And due to our new direct to dealer policy of distribution THESE LISSEN CONDENSERS COST YOU NO MORE THAN THE ORDINARY KIND.

LISSEN GRID LEAKS THAT DEFIED BOTH RAIN & SUN—

During the summer of 1925 a case of LISSEN Fixed Grid Leaks was left on our factory roof—soaked by rain and baked by sun, yet the resistance in each grid leak never altered.

All capacities one price, previously 1/8, NOW 1/-.



(Above). A "close-up" of the Loewe triple valve partially assembled.

(Below). A Loewe receiver which incorporates the elements of a three-valve receiver, although using only the one special valve.

THE MULTIPLEX VALVE.

A Brief Description of a very Interesting German Invention.

A RECENT German invention claims to have made obsolete multi-valve sets, especially in cases where several stages of L.F. amplification are required. Dr. Sigmund Loewe has brought out a valve containing all the elements necessary for the operation of a three-valve resistance-capacity coupled amplifier within the glass bulb of the valve itself.

Extremely Compact.

Everything is contained inside three plates, three grids, and three filaments, the resistances and condensers neatly packed away in a bulb only a little larger than that of an ordinary receiving valve.

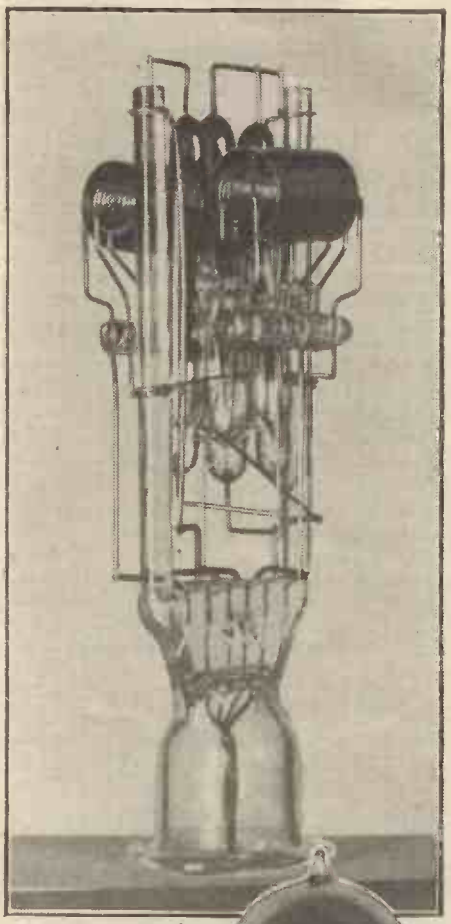
Thus a loud speaker set taking up surprisingly little space can be constructed, the detector being followed by one of the Loewe triple valves, whereby an amplification of about 3,000 is claimed. Lack of distortion is another point claimed by the inventor, so that the constructor has not to worry over lay-out or anything like that. He merely connects up the six tags from the valve socket, and his amplifier is ready as soon as he has plugged in the valve.

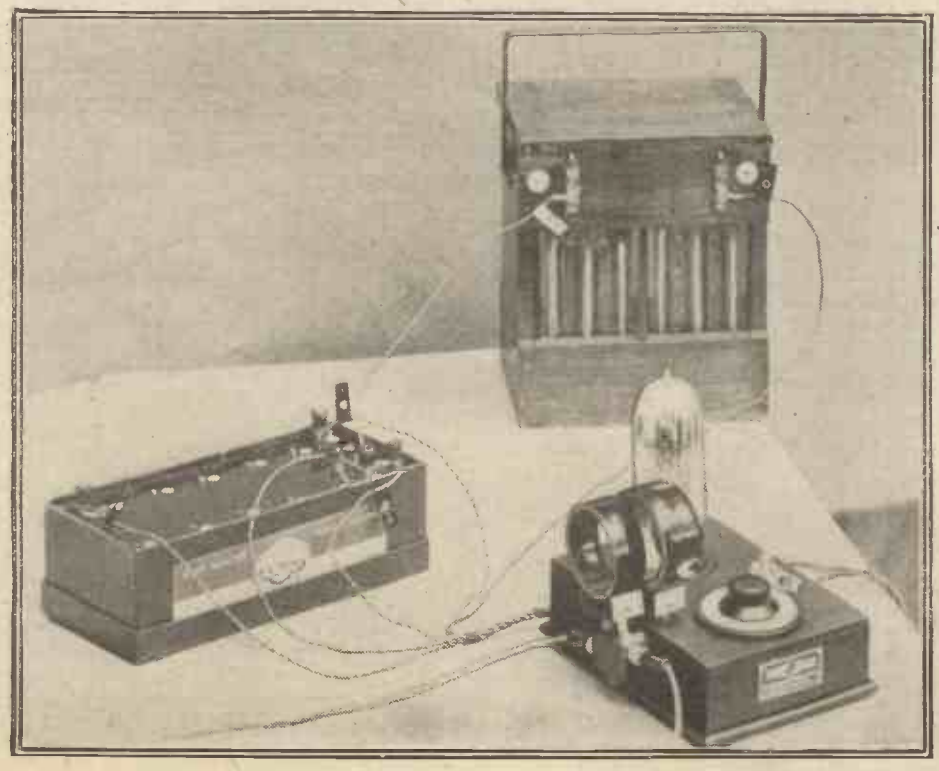
Very Economical.

The triplex valves take about ·7 amp., at 4 volts, so that they are very economical to run. The H.T. consumption works out at about 5 milliamps., a very low figure considering the amplification obtained.

Another valve, the duplex, has also been constructed by Dr. Loewe for H.F. amplification purposes, and this valve promises to become equally as popular as the triplex.

The cost of a Multiplex valve, in Germany, works out at the equivalent of about 27s. 6d., and the cost of repairing one burnt out filament at about 8s.





(Above). Another Loewe multiplex valve of a slightly different nature, partially assembled.

(Right). The Loewe valve fits into a base which is rather reminiscent of American practice.

The above valve is shown again in operation in the photograph on the left. The coils and the H.T. battery are of average sizes and it will be noted that the size of the latter exceeds that of the set itself.

AN INTERVIEW WITH M. YSAYE.

A FAMOUS VIOLINIST ON BROADCASTING.

By "ARIEL."

WHEN on the Continent recently for a short holiday I was lucky enough to run into the celebrated Belgian violinist, Monsieur Eugene Ysaye. Of course I couldn't expect him to think it lucky, but, after apologising and being properly introduced, I reminded him that about eighteen months or two years ago I had heard him broadcasting some violin solos during a concert at 2 L O organised by the Editor of that popular journal "Answers."

There was a twinkle in his eyes as if he suspected that I wanted to interview him; this gave me courage to ask him whether he had broadcast at all since the "Answers" concert, and if so, where. He sighed and shook his head, saying: "No, I'm afraid I haven't."

Monsieur Ysaye making no attempt to escape, we walked a little way together, chatting about this and that, until presently I found to my delight that he was getting reminiscent. I wondered whether the lack of an audience affected an artiste's playing and whether he was able to give his best when broadcasting, and when I put this proposition to him he said, after carefully weighing the question: "The artiste, if well disposed, can play just as well without an audience as he can with one."

"Tell me frankly," I said; "do you dislike broadcasting?" He raised those expressive eyebrows as he said: "Well, I have nothing against it."

Personality Counts.

To my surprise he confessed that he seldom listened in to any of the broadcasting programmes. "Not lack of interest," he explained; "merely lack of—opportunity." I suggested that, nevertheless, his opinion would be interesting as to whether violin music comes over well when a solo is broadcast, and he said he thought that while the sonority was good, perfection was still to be obtained.

I tried to get Monsieur Ysaye's opinion as to the merits of a good broadcast receiving set compared with the best gramophone ever made, but the famous violinist smilingly refused to give a definite opinion. "I must confess I really haven't sufficient experience," he said.

His modesty was charming, but embarrassing to one who was so anxious to get information on this subject. But I was not downcast, and I told him so. He said I might go ahead, but reminded me that to expect him to talk wisely about wireless was almost as cruel as to suggest he should play a sonata on his beloved instrument without strings. "Well, you can tell me this," I said; "do you think broadcasting is adversely affecting the concert industry? I'll tell you why I ask this pointed question—because Mr. William Boosey is reported to have said that broadcasting is very injurious to the concert industry and that it's keeping people at home when they might be going to various concerts.

"Of course, the B.B.C. deny this," I assured him, "and say that the broadcasting of music has made thousands of people in this country more interested in music than heretofore, and that, if anything, the effect on the concert industry has been to the good. Do you agree to this or not?"

Monsieur Ysaye stopped suddenly in his walk and faced me. "My dear sir, nothing can suppress the interest of a personality; personality counts for so much in music and drama, even in business; therefore concerts will always continue. If they don't——" He shrugged his shoulders and made a delightful grimace.

A characteristic portrait of M. Ysaye, the famous violinist.

I asked him what he thought broadcast best; whether, as many other people suggest, it was, in his opinion, either the violin or violoncello. He tried to look severe, told me I was asking too many questions and, I suppose hoping to "dry me up," said: "I don't know!"

This was certainly not very encouraging, but: "One more question," I pleaded, "Would you be prepared to broadcast another series of concerts from the London station. Yes or no?"

"Of course I won't say no—certainly I would."

Before I could say another word, Monsieur Ysaye reminded me my last question had been asked: "Now it's my turn to interview you," he smiled. "What do you think of violinists?"

Ingenuously I told him I thought there was only one!

CALCULATING FILAMENT RESISTANCE VALUES.

A TYPICAL case is when a 4-volt accumulator is used in conjunction with the popular 2·8 volt, ·06 amp. dull emitter valve. Supposing only one valve is to be used, then the correct resistance for the filament rheostat is arrived at as follows:

By Ohm's law,

$$\text{Ohms} = \frac{\text{Volts}}{\text{Amps.}}$$

Now, in this instance, the voltage which we require to drop is 4 volts (that of the accumulator) minus 2·8 volts (that required by the filament of the valve), which equals 1·2 volts. We know the current to be taken by the filament (·06 amp.), and so, by the above formula,

$$\frac{1{\cdot}2 \text{ volts}}{{\cdot}06 \text{ amp.}} = \text{resistance in ohms} = 20 \text{ ohms.}$$

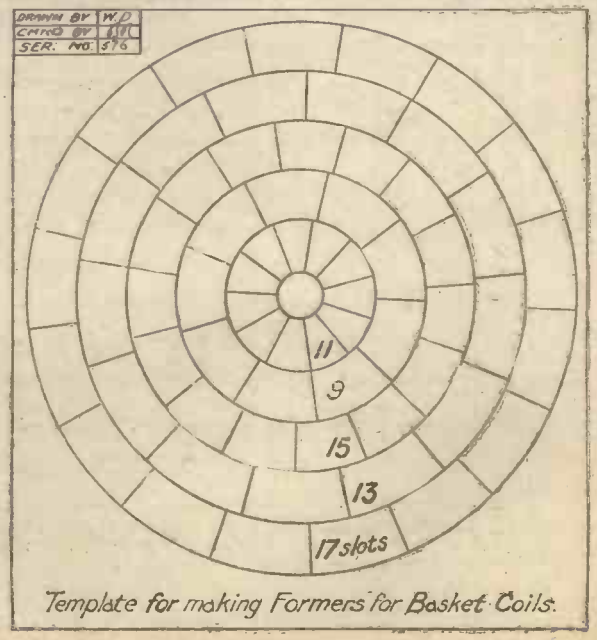
In practice, however, it is advisable to use a resistance of a somewhat higher value than the theoretical, in order to provide control over the valves, and a variable resistance of 30 ohms maximum is suitable here.

When more than one valve of the same type is used, the filament resistance is easily found by dividing that required for one valve by the number of valves.

A USEFUL TEMPLATE.

THOSE who wind their own coils and make their own formers will find the accompanying template very useful, as it will enable them to make formers with from 9 to 17 slots.

A piece of tracing paper at the back of this page may be laid upon the cardboard or fibre from which the former is to be cut, and a blunt-pointed stylus, such as the end of a bone knitting needle, or a sharpened match, used to mark off the points at which the slots are to be cut.



Template for making Formers for Basket Coils.

FROM A CORRESPONDENT.

IT is a commonplace in wireless science that, to a very great extent, the efficiency of a receiving aerial, or of a transmitting one, for that matter, is dependent upon the degree of thoroughness of its insulation. An efficient aerial must, of necessity, be a well-insulated one, and the large numbers of aerial insulators, of different types and patterns, which are to be seen on the market nowadays, testify in no mean manner to the essential truth of this dictum.

When an aerial is first erected, the degree of insulation which is obtained by the use of a single well-made insulator placed at each end of the aerial is, for all practical intents and purposes, quite as effective as the insulation obtained by the use of two or three insulators at each end of the aerial. And, of course, an aerial so constructed has the undoubted advantage of possessing a minimum weight, and of putting less strain upon its holdings.

But is this equality of insulation maintained? The answer, I am afraid, is in the negative, as they like to say in official circles. In the first place, the impure and smoke-laden atmospheres of our modern industrial cities are sworn enemies of effective and prolonged aerial insulation. In the course of time, soot and other atmospheric impurities are deposited on the surface of the aerial insulators, with the result that the aerial currents begin to leak away to earth *via* the dirty insulators.

Leaks.

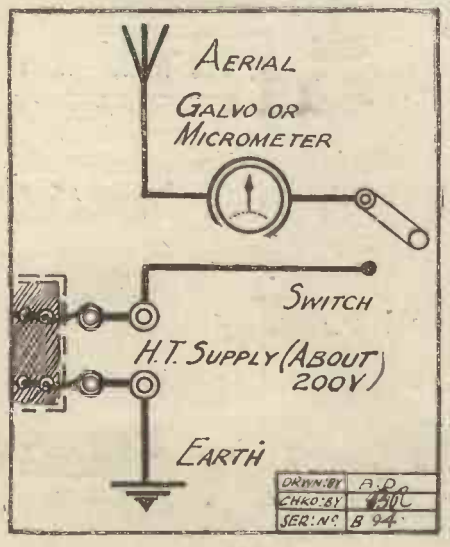
Again, the rain which falls in the neighbourhood of manufacturing towns is generally highly charged with dissolved gases, such as carbonic acid gas. Thus the insulators form a conducting path for the current in wet weather.

Country aerials, however, are to a very large extent exempt from these troubles. For one thing, much less dirt collects on the insulators, and, added to this, we have the fact that the rain-water of country districts is considerably purer than that of the towns, and thus the aerial current is not so liable to leak away over the wet surfaces of the insulators.

However, it is the purpose of this article not so much to discuss the relative advantages and disadvantages of different aerial insulating systems, but to give an indication of a useful method of measuring the resistance of an aerial's insulation to high-tension currents. Whilst, of course, the method to be described does not give the actual resistance of the aerial to oscillatory currents, it is nevertheless sufficiently reliable to afford a good indication of the aerial's efficiency in this respect.

Testing the Resistance.

Many a wireless enthusiast has been perplexed by the apparently inexplicable falling off in efficiency of his favourite receiving circuit, despite the fact that the receiver itself is known to be in good order. And perhaps it may not be very far from the truth to state that the majority of these amateurs seldom, if ever, suspect the



gradual loss in the aerial's insulation efficiency due to the sooting up of the insulators to be the prime cause of the mysterious trouble.

The method of testing the insulation strength of the aerial which is detailed below will, however, do much to trace troubles of this nature.

The diagram shown at Fig. 1 will make clear the circuit which is employed in the method of estimating direct current aerial resistance. A sensitive and calibrated galvanometer, or, better still, a micro-ammeter, is placed in series with the down-lead of the aerial. The terminals of a high-tension direct current supply are also connected in series with the aerial downlead and the earth-wire of the receiving set. A pressure of about 150-200, or sometimes even more volts, is required and, for the sake of convenience, a switch should be inserted in the circuit in the position indicated in the diagram. For the direct current supply, it will be found the most convenient to make use of a series of ordinary H.T. batteries, the employment of the batteries for this purpose resulting in no harm being done.

As an example let us suppose that on connecting up the various parts of the test circuit as shown in Fig. 1, and operating the switch, the microammeter reading corresponds to a current of 1 micro-ampere, the voltage of the H.T. batteries being 200.

Now, applying the well-known Ohm's law equation:

$$\frac{E}{C} = R$$

in which E equals the applied voltage, C the current in amperes, and R the required resistance, we can calculate from this reading the aerial insulation resistance.

Thus,

$$\frac{200}{\frac{1}{1{,}000{,}000}} = 200{,}000{,}000 \text{ ohms, or } 200 \text{ megohms.}$$

(1 microamp. = 1/1,000,000 amp.) (1 megohm = 1,000,000 ohms.)

In this way, the direct current resistance of an aerial insulating system may be determined with a reasonable degree of accuracy, and from it a good estimation of the aerial's insulation resistance to H.F. oscillatory currents may be inferred.

Still, however, I can imagine the reader drawing back from the practical application of this method, and on one account only. Accurately calibrated microammeters *are* expensive instruments, and very likely the amateur may not possess one.

Comparative Tests.

However, if such an instrument is not available, there is still another method of determining the aerial insulation resistance. In this case, it is only the *relative* resistance which is estimated. In place of the calibrated microammeter, employ simply an ordinary sensitive galvanometer of the moving coil or similar type. Then, on operating the switch and allowing the current to flow into the aerial, any small insulation leakage will give rise to a small deflection of the galvanometer needle, and by comparing the amount of needle deflection with that obtained from a test on an aerial of proved efficiency, a fairly good estimate of the relative insulation strength of the aerial under test may be made without any calculation.

Many interesting experiments on the variation of aerial insulation resistance may be carried out by these simple means. The insulation resistance of the aerial circuit will usually be found to vary from day to day, according to the amount of moisture present in the atmosphere, and for various other reasons.

Before conducting experiments by the above methods, however, care should be taken to ascertain that the aerial downlead is well insulated at the place where it enters the room, and also that the entire length of the earthing wire is in a similar well-insulated condition.

The RADIO CONSTRUCTOR

Edited by PERCY W. HARRIS, M.I.R.E.

This valuable eight-page supplement, devoted to the interests of amateur wireless constructors, appears every week in "Popular Wireless." Tell your friends about it, for it is only in "P.W." that they will find radio articles by the leading constructor's expert, Mr. Percy W. Harris.

A WEEKLY CHAT BY THE EDITOR.

I WONDER whether most of us are not being spoilt by the growing efficiency of modern wireless apparatus? The better and more efficient the apparatus becomes, the easier can we get good results without troubling about getting real efficiency. This and similar thoughts occurred to me the other day when passing down a long thoroughfare of suburban houses.

An end view along the neat little gardens revealed a forest of sticks, poles and masts, showing aerials of every conceivable height, size and degree of tidiness. One aerial was so hopelessly inefficient that I doubt whether the listener would note much difference if the whole structure fell down, yet I feel sure that everyone in the road was getting passable results, and probably a great number were fully satisfied.

Is He Careless?

Now, quite apart from the unpleasing appearance of a badly erected aerial, one cannot help coming to the conclusion that the man who is so careless as to allow this kind of structure to serve as his receiving wire, is unlikely to pay attention to many other points of equal importance. Sets designed by writers who specialise in home construction, and factory built receivers of the most efficient type, are frequently blamed for defects which can be traced to sources other than the instrument itself. Many people are getting two-valve results on four or five valve sets, thus using twice the filament and H.T. current they really need. Why allow any such wastes to occur?

False Economies.

When experimenters were confined to crystal receivers and when the signals we were able to obtain were of the weakest nature, we only succeeded in obtaining good results by paying very careful attention to our aerial and earth systems. Again, why use an elaborate multi-valve set purely for local reception? A few miles from a broadcasting station the results from that station given by, say, a five-valve set with two stages of H.F., a detector and two audio-frequency stages, compare quite unfavourably with those obtainable from a detector and two audio stages alone. In nine cases out of ten a set without radio-frequency will give at least equal quality and volume, while the two-valve Hale receiver described in this issue will probably beat both types.

There is far too great a tendency to make one set serve all purposes. In the majority of cases it *can* do so, but where local reception is mainly required, I always advocate the use by the home constructor of a simple and local receiver. Such an instrument is inexpensive to build, and as it always remains tuned to the one station, its operation is simply the matter of an on-and-off switch. Its running, too, is very economical. The long-distance set can then be reserved for its real purpose.

"The King of the Air."

Last week I mentioned my new receiver "The King of the Air," which is now passing from the experimental bench into the practical stage. While I cannot yet give you details of the design I can, at least, indicate a few leading points and novelties.

To begin with, it is a four-valve receiver, of very compact design with a new style of lay-out and a new type of cabinet. The efficiency of the H.F. side is far greater than that of many five-valve sets, while the full round volume of the audio-frequency side will yield all that two good transformers can give. The method of rectification is also novel (grid leak and condenser defects have been avoided as neither of these components are used).

Testing valves for the article "The Assault on Your Battery."

"Bottom bend rectification!" you say.

No, you are wrong, for it is something quite different. You will be interested to hear that the set is a reflex, but really foolproof, there is no crystal, it is non-radiating, and there are but two simple tuning controls. There is not a single component of an expensive nature, there are no double or treble condensers, and the H.T. and L.T. current demands are of an extremely moderate character.

Tuning, I need scarcely say, is razor-sharp, and my friends who have seen the set in the initial stages, say it is at least six months ahead of anything yet published.

In pursuance of my policy of endeavouring to help every home constructor to get the best he can with what apparatus he has, I have arranged the set to use many parts of the kind the average home constructor already possesses. At the same time, those who wish to start afresh with everything new, will find a full list of suitable components in the article, which will appear in "The Radio Constructor" very shortly.

Decorated Panels.

Do you like the idea of decorative panels? My American correspondents tell me that, having tired of the monotony of the jet black or imitation mahogany panels which have reigned for so long, the United States radio enthusiasts are turning to something far more ornate. Some of this season's receivers have panels with most elaborate designs in gold, resembling, in many ways, the gold painted ebony screens which we import from China and Japan.

Other sets have a crystalline finish like the crystallised lacquer we see on some cameras and scientific instruments, while still others disport themselves with panels of engraved metal. So far as the cabinets are concerned, radio sets now hide themselves in Jacobean, Chinese chippendale, Sheraton, and every other kind of "period" furniture, while loud speakers in passing from the "horn" to the "cone" shape are now disguised as fire screens, lampshades, and even pictures. As to the panels of our sets, I am rather in favour of a little more variety. What do you think? Write and tell me.

Percy W. Harris

The GUARANTEED REFLEX

By
PERCY W. HARRIS, M.I.R.E.

In this set, the Hale Circuit is worked out for two valves, so that you can use your existing parts to best advantage, or convert another reflex to the "Hale" if desired.

THE two-valve receiver I am describing this week will offer, I think, a double interest to most listeners. It is, first of all, a very simply controlled set which will give tremendous volume together with quality far above the average from the local station, while possessing that useful reserve of power which enables it to be used fifteen or twenty miles away from a station with only a small indoor aerial.

Thus it will have a particular appeal to the flat dweller and those who, for æsthetic or other reasons, do not wish to erect an outside aerial. The more advanced experimenter, too, will be intrigued by its "distance-getting" qualities, although, as in the case of the one-valve Hale receiver described a fortnight ago in these pages, it is not particularly recommended for general long-distance reception. Such work should be reserved for a set which has, at least, one stage of high-frequency magnification (preferably neutralised to prevent interference with one's neighbours).

Incidentally, much can be done in the prevention of interference and oscillation if receivers with an adequate power reserve are used, for if, as is the case with the receiver to be described, there is sufficient reserve of power good volume is easily obtained without "pushing" the set. I would venture the opinion that most oscillation trouble is caused by people using inefficient sets which require to be worked on the limit of reaction-amplification in order to give the volume they desire.

Use Your Old Parts!

You may perhaps wonder why, in this receiver, I have adopted what some people may call "old-fashioned ideas" by using the conventional two-coil holder and plug-in coils outside the box. This, however, is only part of the story. Look into this set and you will find that there are no special parts of any kind. There are no double condensers, special coils, or, in fact, any components which are not generally available.

The whole object of making the set in the manner described is to enable experimenters to use their present gear, and, indeed, to convert any existing two-valve and crystal reflex into the new circuit. It is quite likely that you may have a two-valve-and-crystal reflex receiver which has never given you the results you desire to obtain. From the parts of such a receiver you can build this two-valve Hale set, and still be left with several useful parts over!

Parts required to build this set:

One ebonite panel, 10 x 7 x ¼ in.
Suitable cabinet and baseboard.
One two-coil holder.
Two good L.F. transformers.
Two anti-vibratory valve sockets.
One ·0005 mfd. variable condenser with vernier.
Small strip of ebonite carrying two terminals for "Aerial" and "Earth."
One fixed condenser, Mansbridge type, of any value from ·25 mfd. upwards.
One fixed condenser, ·0001 mfd.
Ditto ·0003 mfd.
Ditto ·002 mfd.
One dual filament resistance.
One crystal detector.
Stiff wire for wiring up, quantity of flexible wire, and suitable plug-in coils for wave-length range required.

Not Critical.

Remember that several of the older reflex circuits have proved exceedingly critical in the matter of transformers, valves, and crystals. This circuit does not possess such disadvantages, so that if you have an older reflex in which the transformers have proved a source of trouble, you can rely on their working satisfactorily in the Hale receiver.

The fact that the coils are carried on a holder outside the box enables me to make this design more compact than would otherwise have been the case, with a result that I have been able to use a panel measuring 10 by 7 by ¼ in. and a baseboard 7¼ in. deep.

(Continued on next page.)

Extreme simplicity and compactness is a feature of this receiver

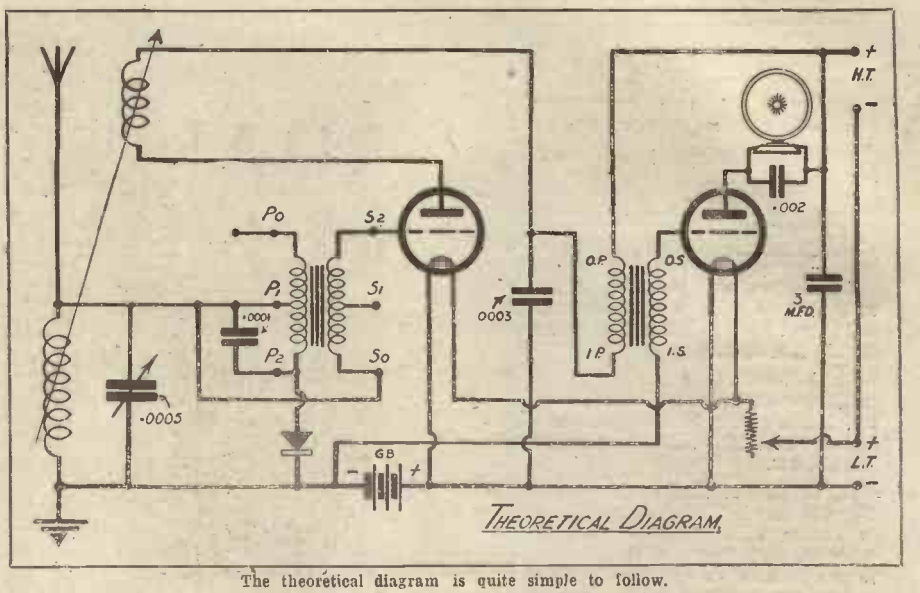
THE GUARANTEED REFLEX

(*Continued from previous page.*)

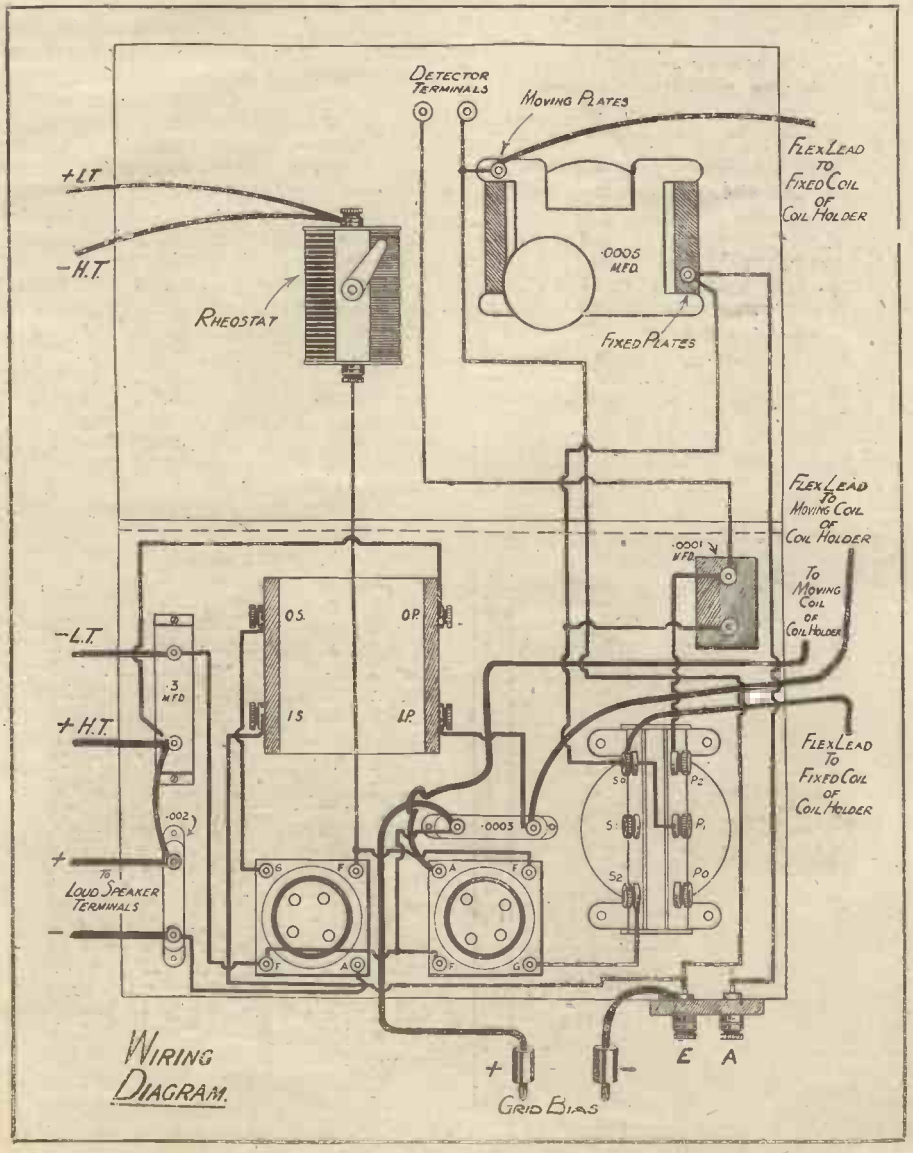
In the set described I have used an Ormond slow-motion condenser, an Efesca dual rheostat, one "Radio-Instruments" tapped transformer, one C.A.V. second-stage transformer. The valve sockets are "Benjamin," and the fixed condensers "Efesca, T.C.C. and Dubilier." The coil holder and crystal detector are "Polar." While these components work excellently, I want to impress upon you that the set will work just as satisfactorily with any other components of equal quality.

Aiming at Simplicity.

I always endeavour to keep the front panel of my receivers as simple as possible, and you will see that in the present case the number of drilled holes is very small. The variable condenser and filament resistance are of the one-hole-fixing variety, while two holes $\frac{3}{4}$ in. apart are required to take the sockets of the crystal detector. As the panel is quite small, I have not found it necessary to use supporting brackets, thus affording another slight economy. Two holes in the bottom edge of the panel and one on each side enable the panel to be secured to the baseboard and box respectively. By releasing the screws in the box the whole apparatus can be slid out for inspection.



The theoretical diagram is quite simple to follow.



Experimenters are becoming increasingly fond of what are called "pigtails" for making connections to the batteries. "Leads" are always required, and in the past we have been accustomed to the use of rows of terminals to which our leads have been attached. In thinking out ways of reducing cost, it has occurred to me that there is no sound reason why permanent flexible connections should not be made to the parts requiring leads, thus dispensing with the need for terminals.

The Use of Pigtails.

For example, in the present receiver you will see three twin leads—one pair for the low tension, another for the high tension, and the third for the loud speaker. For these leads I have used two-colour electric-light flex, made of red and black covered wire. This insulated wire is obtainable at about 2d. per yard, and readers who live in localities where prices are keenly competitive may be able to obtain it still cheaper.

The leads are secured where indicated, and can be left permanently attached to the set. Remember that terminals cost usually about 2d. each. The three twin leads for low and high tension and loud speaker cost exactly 6d. for this set. Terminals would have cost about 1s. and the ebonite strip a few pence more, while to this would have had to be added the cost of the leads themselves. Such savings may not be great, but they are still appreciable.

As aerial and earth leads are frequently of heavy wire, and it is not always convenient to join flexible leads to them, I have provided terminals for earth and aerial in the conventional way. These two terminals, as will be seen, are placed at the back of the box.

Above is shown the theoretical circuit, from which you will see that it is simply the addition of a note-magnifying valve to the previously published circuit. There is, however, one slight modification in the

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THE GUARANTEED REFLEX

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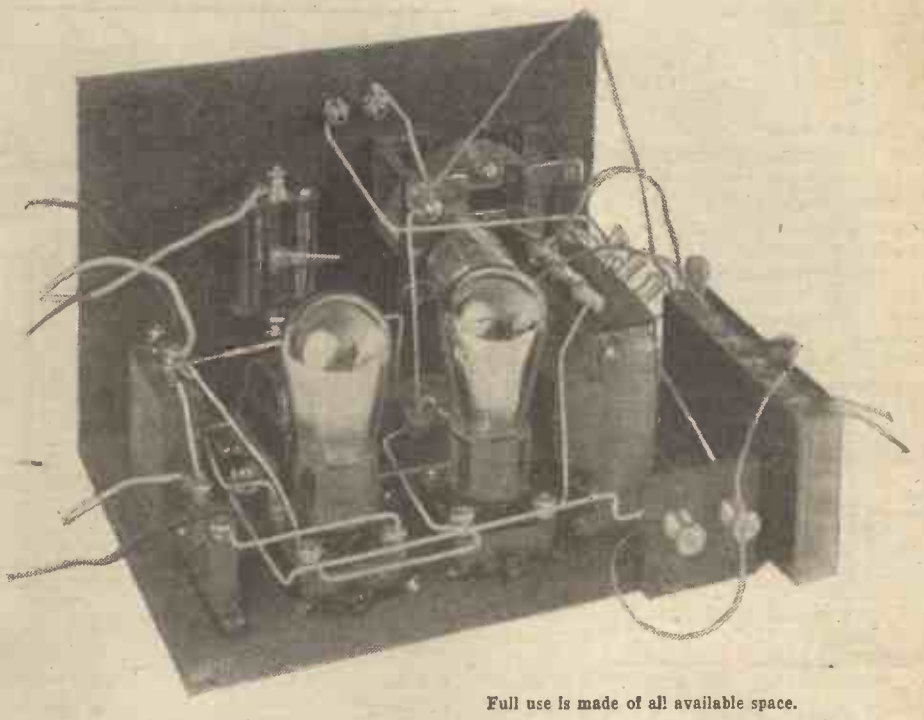

Full use is made of all available space.

POINT-TO-POINT WIRING.

Aerial terminal to fixed vanes of condenser, to ·0001 fixed condenser, and to S.O. and P1 of R.I. transformer. Attach flexible lead to S.O.

Earth terminal to moving plates of condenser, crystal, and flexible lead for coil holder; also flexible lead for G.B. negative and stiff wire to I.S. of second transformer.

S2 to grid of first valve. Join one filament terminal of both valve sockets to bottom of filament rheostat. Join other filament terminal of both sockets to one terminal of Mansbridge condenser and to one terminal of ·0003 fixed condenser. Join flexible lead for G.B. + to this last point.

Join flexible leads of L.T. +, H.T. − to top terminal of filament rheostat. Take flexible leads for coil holder from anode of first valve and from terminal of ·0003 fixed condenser. Join same terminal to I.P. of second transformer. Join O.P. to Mansbridge terminal. Join crystal to P2 of first transformer and to ·0001 fixed condenser.

H.T. positive flexible lead to Mansbridge, L.T. negative flexible lead to other Mansbridge terminal. Join ·002 fixed condenser to Mansbridge. Other terminal of ·002 condenser to anode of second valve holder. Grid of second holder to O.S. of second transformer. Flexible leads for loud speaker taken from terminals of ·002 condenser. Thread coil holder leads through holes in side of cabinet.

inclusion of a ·0001 mfd. condenser across the primary winding of the transformer. With the R.I. tapped transformer the addition of this condenser is a distinct improvement, but in many transformers this condenser will make no difference whatever. I would suggest, in any case, that you try the effect with and without it.

No Soldered Connections.

By using the parts shown it is possible to wire up this set without a single soldered connection, a point which, I am sure, will appeal to many home constructors who have not yet "got the hang" of the soldering iron. So many modern components are provided with good-sized terminals that if the wires are carefully bared, bent round the terminals shanks, and screwed up tightly, a thoroughly satisfactory connection can be made. Indeed, a sound connection of this sort is infinitely preferable to a poorly made soldered connection.

To enable the panel and baseboard to be withdrawn from the cabinet, it is necessary to use flexible leads for the two-coil holder. These leads should be taken as follows: One lead from the transformer at the point where secondary and primary are joined. You will observe that this point is connected to the aerial terminal. A second lead from the point of variable condenser which is connected to earth, a third lead from anode terminal of first valve holder, and a fourth lead from the terminal of the fixed condenser across the primary of the second transformer. The first two of these flexible leads go to the aerial (fixed) socket of the coil holder, and the other two to the moving or reaction socket of the coil holder.

The two flexible leads for the loud speaker are taken from the two terminals of the ·002 mfd. condenser shunted across the loud-speaker connections. High-tension positive goes to one terminal of the Mansbridge condenser, and high-tension negative goes to one terminal of the filament resistance.

Use of One Terminal.

This same terminal has connected to it the low-tension positive lead, while the low-tension negative lead goes to the second Mansbridge terminal, which you will find is connected to the negative filament. You can finish off these flexible leads with spade terminals, or in any other way you desire, and when the panel and baseboard are slid into the case the flexible leads can be taken to the batteries in an unobtrusive fashion.

There is no "on-and-off" switch, but

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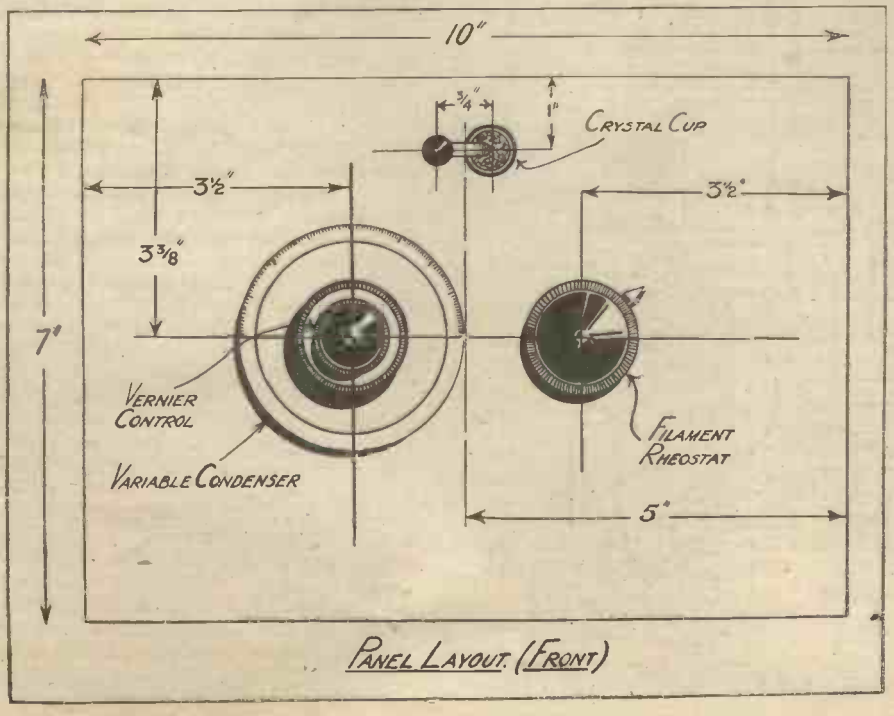


PANEL LAYOUT. (FRONT)

DRILLING HINTS.

By P. W. H.

MANY home constructors waste a lot of time by using old and blunt drills for their panels. Such drills are not expensive, and should be replaced when they get really blunt, for a blunt drill is not only slow and difficult to use, but often breaks away the ebonite on the other side of the panel as the point passes through.

The cheapest drills are by no means the most economical, as they blunt rapidly and are generally unsatisfactory. The best, although the most expensive, are known as "high-speed steel" drills, and are probably the most economical in the long run, as they keep their edge almost indefinitely.

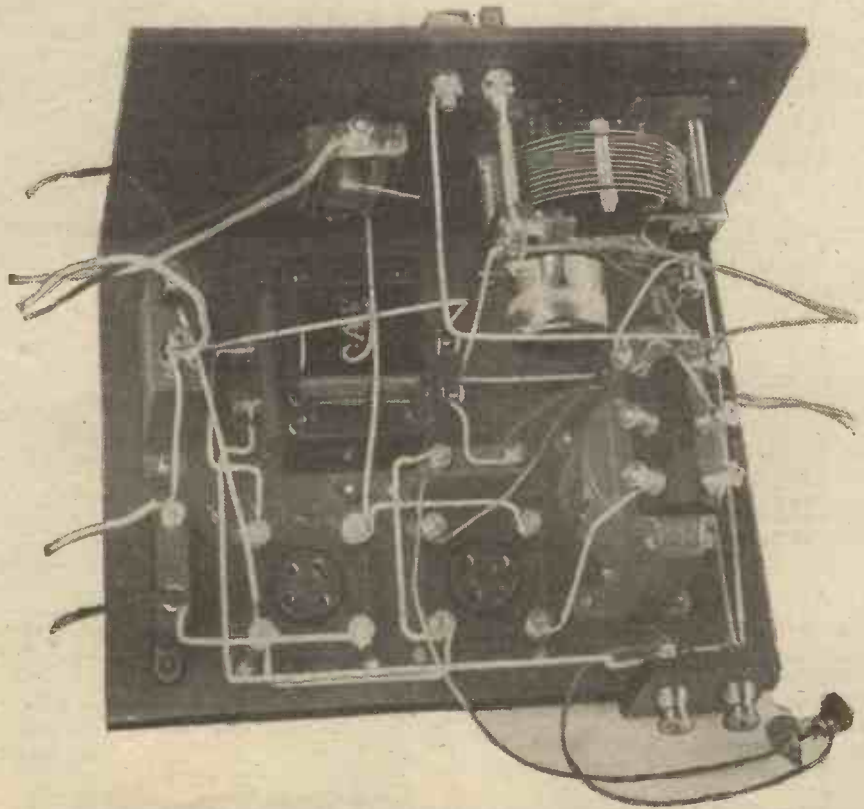
Tool Outfits.

When drilling a number of holes in a panel do not attempt to save time by working too quickly. The drills will very easily heat up in the ebonite, and when very hot lose their temper and become blunt. It is really quicker to drill at medium speed, for this reason.

Excellent radio tool outfits are sold by the "Yankee" tool people, and also by C.A.V. Small Tools. In both of the outfits you will find a special tool for widening holes in ebonite panels, and this proves very useful. For instance, many of the jacks sold for panel mounting require a hole larger than $\frac{3}{8}$ in. (the largest drill the average home constructor uses). By drilling first of all a $\frac{3}{8}$ in. hole and enlarging it by the aid of the special device mentioned, the jack can be fitted in a very few moments.

Always use a centre-punch to give a depression for the point of the drill. This saves drill wandering and inaccuracy.

In mounting large instruments, such as voltmeters, many home constructors outline the hole size on the panel, drill a number of holes round the edge until the centre drops out, and then finish off the aperture with a round-faced file. I prefer to use a fret-saw.



By a careful arrangement of parts, room is found for the inclusion of any size and type of low-frequency transformer, condenser and valve holder.

THE GUARANTEED REFLEX.

(*Continued from previous page.*)

you will see that one filament resistance controls both valves, so that this itself can be used as the on-and-off switch, care being taken not to burn the valves too brightly. The Efesca, and many other filament rheostats, have a dial on which you can note the best reading for the valves you are using, and you can then arrange, when you turn on the set, not to advance the pointer beyond the reading which gives you the best results with your particular valves.

Aerial Coil.

Your aerial coil size will, of course, depend upon your aerial and the wave-length range you wish to receive. This set does not differ from others using plug-in coils, and you can use the coils to which you are accustomed. For example, a 35 will probably suit you for wave-lengths below 400 metres, and a 50 for the shorter wave-lengths above this. For my reaction coil I generally find a 50 or 60 very suitable on the outdoor aerial, while on the small indoor aerial a 30 is generally big enough.

This set works excellently with any type of valve, although, as mentioned in the previous article, better results are obtained with low-frequency valves of the small power type. For the local station this set possesses such a reserve of power that at Wimbledon, seven miles from 2 L O, full loud-speaker strength is obtainable on the earth lead alone.

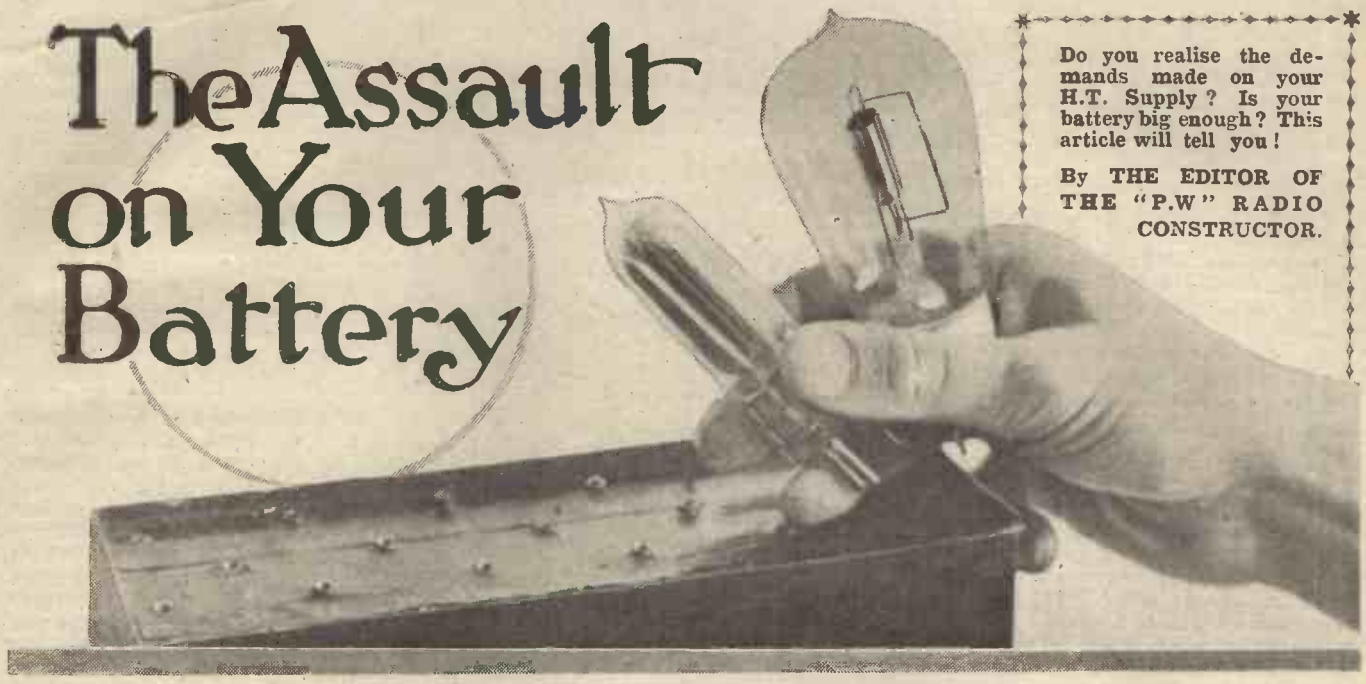
The Set for Listeners.

A large number of stations other than the local are audible in the telephones using an outside aerial, with the set well below the oscillation point, and on the first evenings of trial (most of the broadcasting stations had shut down at the time) I was able to receive Radio-Catalana, Barcelona, at adequate loud-speaker strength for a small room. The Madrid stations (Union-Radio and Radio-Iberica) are frequently audible in the later hours of the evening on the loud speaker with this receiver.

Grid bias is adjusted to suit the valves used, which should both be of the same type.

In order to test the reliability of this circuit, using widely different components, I have rung up several friends on the telephone and described the theoretical circuit to them, whereupon they have built it up with their own parts, and with no further advice from me. In every case complete satisfaction has been obtained at the first trial, so that I can unhesitatingly recommend the circuit to all listeners who want a really powerful and economical set for local work.

The Assault on Your Battery

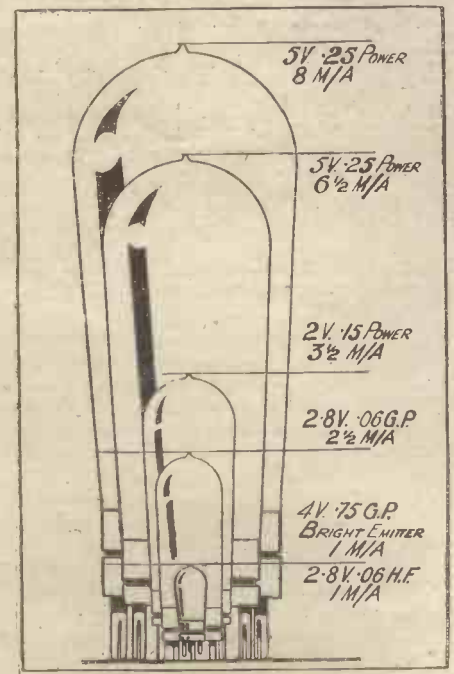


Do you realise the demands made on your H.T. Supply? Is your battery big enough? This article will tell you!

By THE EDITOR OF THE "P.W" RADIO CONSTRUCTOR.

YOU will find it pays to understand your high-tension battery, whether it be of the dry-cell type or the increasingly popular high-tension accumulator. By this I do not mean that you should make a life-long study of its chemical actions, its actual structural formation, and other such matters. Rather, I wish to impress upon you that half an hour's study of a few essential facts may save you pounds in the course of a year or two.

The H.T. supply in your set stands in the same relation to the incoming signal as the gunpowder in a cartridge to the pull on the trigger. The amount of energy necessary to release the spring and thus fire the cartridge in a sporting gun, is far less than that required to impel the shot through the air and bring down the bird. I am told you can buy all kinds of cartridges at all kinds of prices and that such a selection will guarantee you all kinds of results. This is also the case with the H.T. battery.



A pictorial comparison of the H.T. demands of various valves.

Far too many people ask for a "60-volt H.T. battery" or a "100-volt H.T. battery" without paying any regard to the maker of the battery, his reputation, or their own previous experience with the same make.

Volts and Power.

Possibly, owing to a rather loose way of using the word "volts" in the newspapers many people look upon the voltage as the only essential factor when purchasing an H.T. battery. To see how one may be misled in this way, let us consider what you actually want to buy when you purchase a battery.

An H.T. battery, as you know, is connected to the plate or anode of the valve, and causes a current to flow across the intervening space between the plate and the filament of the valve. The action of the signals on the grid of the valve sets up a current variation in this supply, and it is these variations which give you the signals in the telephones or loud speaker. So, when your set is working, current drawn entirely from the H.T. battery will be flowing continuously across the vacuous space in the valve, through the various windings and through the telephones or loud speaker. According to the kind of valves you are using and the way in which you are using them, a certain pressure will be needed. This pressure is measured in volts.

In some circuits it may not be necessary to have more than 30 or 40 volts, while others using, say, a power amplifying valve in the last stage, may require 120 or 150 volts.

Whatever voltage you need, you must also have current, and it is the H.T. battery which supplies this current. I have in my laboratory here a large number of accumulators, both high and low tension. There stands in front of me, as I write, a large glass jar with sides 6 in. wide and 8 in. deep.

This illustration shows how the sizes of H.T. batteries differ. The smallest in size has the highest voltage.

This is a two-volt battery. Alongside of it, reminding one of the famous picture, "Dignity and Impudence," stands a tiny celluloid box, also possessing two terminals. This is a two-volt battery! What, then, is the difference between them? Simply this—the large jar will deliver current at two volts in far greater quantity or for a much longer time than will the small battery. We say the *capacity* of the large accumulator is greater than that of the small accumulator.

We speak of the capacity in "ampere-hours," that is to say, a battery which has a capacity of 40 ampere hours will give 40 hours' supply of current at one ampere

(*Continued on next page.*)

THE ASSAULT ON YOUR BATTERY.

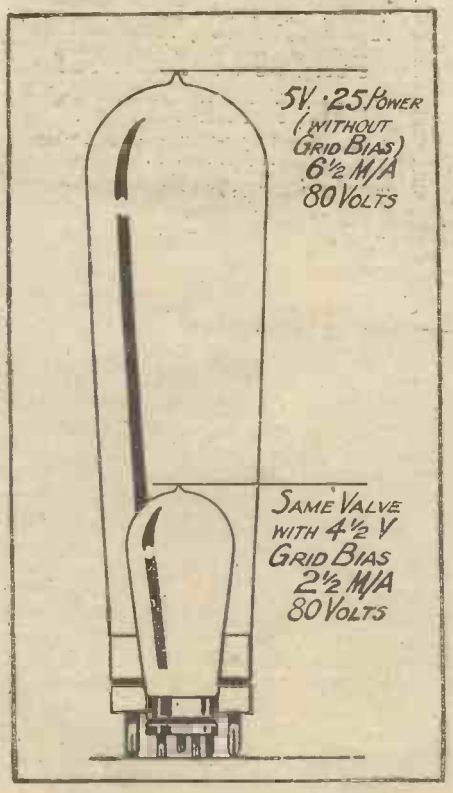
(*Continued from previous page.*)

before it needs recharging, or 20 hours' supply at two amperes, and so on.

Because the current supply taken from any H.T. battery is relatively small, experimenters have been liable to overlook the fact that a definite current is really taken, and with modern power valves this may be very appreciable. A milliampere, as you know, is a thousandth part of an ampere, and some of the dull emitters now used, consume for filament current only 60 milliamperes. You will know, if you have used these valves on a small accumulator, that in spite of their small current output, the accumulators still require re-charging.

What you may not know is, that some of the multi-valve sets now used take as much as 30 milliamperes total plate current from the H.T. battery. Expressed in another way, the H.T. battery may be required to give a current half as great as that taken from some L.T. accumulators!

Now H.T. dry-cell batteries, although they appear to you as oblong boxes with little sockets into which you push your "wander plugs" are really made up of a number of small cells joined in series. Each of these cells contain a carbon and a zinc electrode, the carbon being the positive and the zinc the negative, together with certain chemicals. The constitution of the cell is such that when the carbon is joined to the zinc through an electrical circuit chemical action takes place in the cell and current is generated. This is the current we use for supplying the plate circuit of our valves.



A pictorial lesson in the value of grid bias

What I wish you to bear in mind in considering the problem of the H.T. battery is that each particular size of cell (each cell, by the way, gives approximately one and a half volts) has a definite limit to the current which can safely be drawn from it. A new H.T. battery can be made to give a very strong current, even enough to light the filament of the valve, but the effect on such a battery is deadly. The faster you take current from any H.T. dry battery (over a certain stated figure) the more rapidly does the cell deteriorate, far out of proportion to the demand made upon it.

A few typical high tension accumulators of modern type.

For example, you may have a particular H.T. battery which can be relied upon to have a good life if you do not take more than six milliamperes, and you might imagine that if you take 18 milliamperes you will obtain a third of the life. In point of fact, taking 18 milliamperes from such a battery may bring the life down to as low as a tenth, so you see how very wasteful it is to take too high a discharge from your H.T. battery.

The average size 60 or 72-volt H.T. battery serves excellently for a one, two, or even three-valve set, provided you are not using power valves. For multi-valve sets where small power valves are being used, you should buy the larger size H.T. battery. For example, a super heterodyne will work for a short time on small H.T. batteries, but almost from the first night there will be a drop in voltage, and before long you will have to discard your batteries as quite useless.

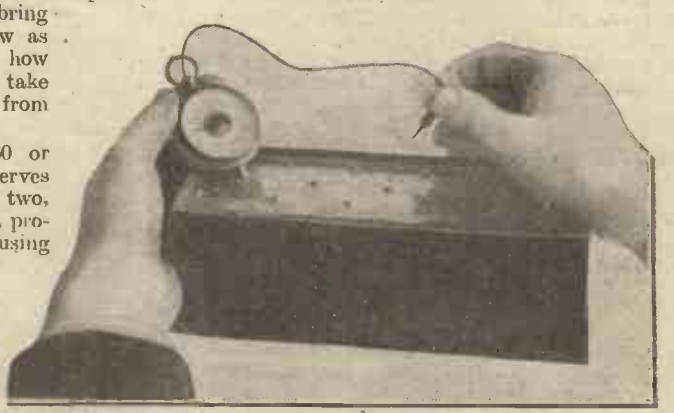
If you buy the larger sizes, which may cost three or four times as much, you will not only get infinitely better signals after the first night or two, but your H.T. battery bill for the year will be considerably lower than by buying a number of the cheaper and smaller batteries and replacing them more frequently.

Although I have a number of H.T. accumulators in my laboratory, I also make good use of the very large size dry cells, and I have a set at the moment which takes eight milliamperes regularly, and is used by the family for many hours each day, frequently until midnight. It is running with three 45-volt H.T. batteries in series, is occasionally left on (by accident) all night, yet the batteries at the end of about eight months' service have dropped only 20 volts. The voltage is now about 115 instead of its original 135. The small-size H.T. battery if used on this set would have had to be renewed several times in the same period.

You will now understand why I have headed this article "The assault on your battery," and before closing it I want to emphasise the importance of grid bias, not so much for improving quality (although with loud signals you will notice a marked improvement by using it), but on the life of your H.T. battery. Let me give you some actual figures which I have just taken on my valve-testing set with a well-known type of valve, very popular for loud speaker use.

With 90 volts on the plate and without grid bias the current taken from the H.T. battery is 9½ milliamps. With this valve the grid bias recommended by the makers brings down the current to 3½ milliamps. or just about a third of that consumed without grid bias. You will thus see, particularly on a multi-valve set, that the correct adjustment of grid bias will quite conceivably make your H.T. batteries last at least twice as long.

My own practice, and one I can strongly recommend for economical reasons, is to adjust your grid bias as negative as possible without sacrificing signal quality. Very often it is possible to use more negative bias than that recommended by the makers before a noticeable distortion is produced, with the result that you reduce the drain on your H.T. battery even more.



Do not test your H.T. battery with a low resistance voltmeter. This will injure it.

Finally I would like to draw your attention to the pictorial diagrams accompanying this article. Valves are drawn in such a way as to indicate by their comparative heights the comparative drain on the high tension battery. In the figure on the previous page a few typical valves were tested at zero grid volts. On this page the value of grid bias is very clearly proved.

Note.—In this section Mr. Harris will discuss each week interesting points from the large correspondence he regularly receives. Readers are invited to write to him on matters of interest, and extracts from their letters, together with Mr. Harris' comments, will be published from time to time. It must be pointed out, however, that general and technical queries cannot be answered in this section, but should be addressed to the Technical Query Department, complying with the conditions laid down under the heading, "Technical Queries" in each week's issue of POPULAR WIRELESS.

PERSISTENT and uncontrollable oscillation in a neutrodyne or other neutralised circuit, about which one of my correspondents is worried, can be due to such a variety of causes that it is impossible to put one's finger on the trouble without careful examination of the set. Many troubles arise on the constructional side, so that a few notes here may be of use to this correspondent and other readers.

In the face of a certain amount of early opposition to my views, I have preached for years the importance of considering the actual physical lay-out of components and wiring in a wireless receiver. Every experienced home constructor is aware that the same theoretical circuit is capable of working in a number of different ways if made up with different arrangements of parts. In neutralised sets the actual disposition of parts is of paramount importance.

Two Objects.

In such a receiver we have to consider the two main objects to be achieved. First of all we must allow for an efficient transfer of energy from one stage to another and, secondly, we must counteract undesirable feed-back of energy from one stage to another. This feed-back of energy can take several paths, one being the feed-back due to the capacity between the electrodes of the valve, another the capacity between adjacent wires (a very important path), and, still further, a leakage of magnetic fields between circuits.

In the Hazeltine neutrodyne arrangement, so largely used in the United States, the H.F. transformers are placed at a certain angular relation to one another, so that the interaction between the fields shall be at a minimum. Whatever other balancing arrangements are made in the circuit if we alter the angular relation of these fields to one another, the set will burst into persistent oscillation, and none of the methods provided in the receiver for neutralising will be effective. Possibly this is one of the faults my correspondent has met.

Again, if you were to take a carefully designed factory built neutrodyne receiver, leaving the components exactly in the position as manufactured, but altering the lay-out of the wiring, you would probably find that uncontrollable oscillation would again appear. Even in neutralised sets, using screened or astatic coils, an alteration in wiring lay-out may make a tremendous difference.

A Warning.

If you are copying an already worked out design, remember that the disposition of wiring and components is vitally important. If you are endeavouring to design a receiver for yourself from a theoretical circuit (not such an easy task as it appears), remember that numerous experiments may be necessary to find the best position for the various wires. Last year a well-known American manufacturer of a neutralised set told me that it took many weeks of experiment in their laboratories to determine the best position of one of the grid-return wires!

A correspondent in Manchester asks me a number of questions regarding screening and screened coils which could only be answered by a lengthy article and the result of practical experiments rather than theoretical assumptions, which are often so very misleading. Generally speaking, however, I am inclined to the view that the best effects of screening can only be obtained by screening the whole apparatus, as well as each H.F. stage separately.

While the screening of coils has produced marked improvement, very similar results are obtainable with "astatic," "binocular," or, as they are often called, "fieldless" coils. It must be remembered that shielding is designed to avoid both interaction between stages and direct pickup of signals through undesired channels. For example, it is very annoying if your aerial circuit and the correct path through the stages are arranged to be very sharply tuned, giving high selectivity, while signals are picked up directly on the wiring and detector stage.

An Analogy.

It is very similar to police supervision at the gates of a football match to prevent people entering without paying, while, simultaneously, thousands of people slip through unguarded gaps in the fence! It must be remembered that not only will coils pick up signals; with highly sensitive apparatus, the connection wires between stages and even the valves themselves, can be quite efficient collectors of energy.

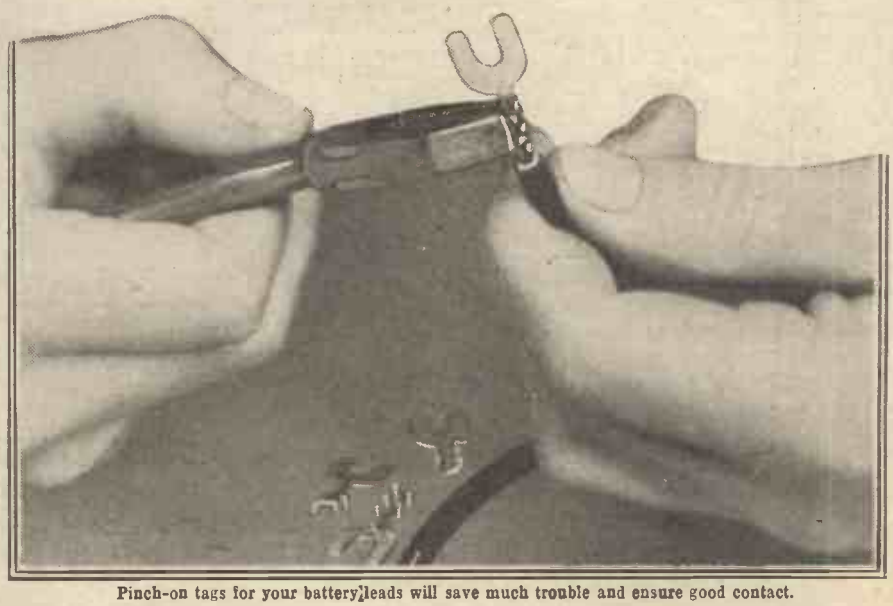
The Western Electric Company in America have long shielded their apparatus most carefully, both as a whole and between stages. This season's American receivers show many examples of complete screening.

Special Features in Next Week's "Radio Constructor"—

A RESISTANCE AMPLIFIER FOR YOUR PRESENT SET

"MEET THE METER!"

A valuable and helpful talk on measurements in your receiver.



Pinch-on tags for your battery leads will save much trouble and ensure good contact.

A new and better transformer is sweeping the country.

The heart of your amplifier is your transformer. Now LISSEN gives you a transformer which surpasses anything ever before available—users everywhere are learning that it is no longer necessary to pay a high price to get a high-grade transformer. This new LISSEN is being tried and tested under all conceivable conditions everywhere—it is being enthusiastically and largely bought by the trade for their own made-up sets. Throughout the whole range of audible frequencies this new LISSEN amplifies fully every note, every harmonic, every overtone. That means realistic reproduction. In the purity and power of its volume the results are remarkable. You will appreciate at once the clearer tones and greater volume.

Expensively made in all its details, traders at this year's National Exhibition at Olympia, asked to name the price at which they could sell it, invariably named a price close to £1. Many said 25/-, and many even more than that.

TEST IT FOR 7 DAYS AT HOME.

If it fails to satisfy you after 7 days' test, take it back to your dealer's or send it back to us. Do this, too, if you are not convinced it is equal to any high-priced transformer you try it against.

8/6

GUARANTEED FOR 12 MONTHS.
7 DAYS' TEST.

Turns ratio 3 to 1.
Resistance ratio 4 to 1.

Suitable for every set and every valve you will want to use.

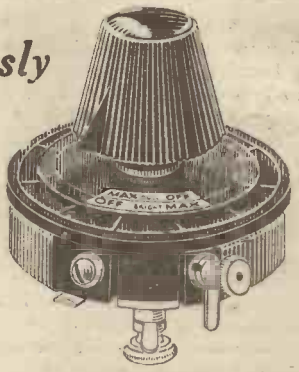
Use it for 1, 2, or 3 stages L.F.

Compare it against any for tone purity and power. You can get it at your dealer's, but if any difficulty send direct to factory. No postage charged, but please mention dealer's name and address. Or can be sent C.O.D.

N.B. So good is this new LISSEN that we have unhesitatingly withdrawn all our previous high-priced transformers.

QUALITY RHEOSTATS

previously 4/- NOW 2/6



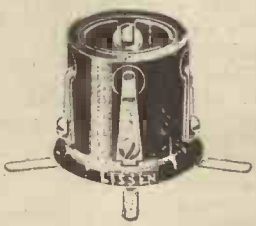
LISSEN quality—look how they are made—the wires cannot move and short circuit—the contact brush rides firmly yet smoothly—the heat-resisting former cannot soften—there are accessible terminals—and the combined knob and pointer will fit flush with the neat photo-engraved dial when mounted. Lastly, note the irresistible appeal of the price, made possible by our big production programme backed by our new direct-to-dealer distribution policy which cuts out all wholesale profits.

	Previously	NOW
LISSEN 7 ohms rheostat, patented	4/-	2/6
„ 35 „ „ „	4/-	2/6
„ Dual „ „	6/-	4/6
„ Potentiometer, 400 ohms	4/6	2/6

EVERY ONE LISSEN ONE-HOLE FIXING, OF COURSE.

Baseboard mounting type same prices as above.

A VALVE HOLDER FOR CLEARER, BETTER SIGNALS.



Because of its low loss and low capacity qualities, the LISSEN Valve Holder plays its part in getting clearer, louder signals. Sent out ready for baseboard mounting, as shown, it can also be used for panel mounting by bending the springs straight.

LISSEN VALVE HOLDER,

patented, previously 1/8

NOW 1/- each

IMPORTANT TO THE TRADE.—Retailers who have not already been notified of our new direct-to dealer policy of distribution should, in their own interests, communicate with us without delay. All orders must now be sent to us at Richmond, and not to usual wholesale factor.

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Managing Director: Thomas N. Cole.

BUILD WITH THE BEST PARTS.

L. 101

CURRENT TOPICS.

BY THE EDITOR.

Square Pegs in Round Holes—The New Commission—That £4,000 a Year—A Question of Nationality—The 14-Valve Set—Not a Stunt—2 L O's New Announcer.

BRITISH Governments seem to have an unhappy knack of fitting square pegs into round holes. A glance at the new Broadcasting Corporation which we discussed in these columns last week will support this contention. The "Daily News" has pointed out that the members of this new commission, to say the least of it, are middle-aged. Only one of the "Big Five" is under forty and the average age of the others is round about sixty. And curiously enough, only the youngest of them, Mr. J. C. W. Reith, who is thirty-nine years of age, knows anything about the technique of running a broadcasting service.

It is really amazing that when selecting members for the new commission which is to control broadcasting in the future, the Government did not show a little more imagination and a little more sympathy with the needs of the public. They have appointed people to this commission who are undoubtedly in their own sphere of life very distinguished, and in many cases very brilliant, but a more unsuitable list to appoint in connection with running a broadcasting service it would be hard to imagine.

A Young Man's Job.

It would have been a much happier selection if the Government had chosen one or even more members of the commission of a younger age. Broadcasting, it has been pointed out, is a triumph for post-war ideas and post-war inspiration, and it is undoubtedly a young man's job. For four years young men have made it the best broadcasting service in the world, and it seems more than unfair to scatter well-paid jobs to others of another generation. The chairman of this new commission is to get £4,000 a year. At this rate of pay, Mr. Reith is worth at least £10,000 a year, but we don't suppose the Government will pay him that.

There has been a good deal of criticism regarding the nationality of the members of the commission. It has been suggested that a Scotsman and a Welshman should have been included in the list. Scotland, it is true, is taking a pioneer part in the linking of radio with social and religious problems, and perhaps in the future the Government will be kind enough to allow Scotland to participate in the control of broadcasting. Wales, too, must not be feeling particularly happy at the omission of a Welshman from the Board.

But politics, as Emerson has pointed out, is a deleterious profession like some poisonous handicrafts, and politicians have their own ways of appointing commissions and filling nice comfortable jobs with their own particular protégés.

But the Government has blundered and upset thousands and thousands of listeners by the appointment of the new commission, and this cannot be gainsaid. We only hope that readers of POPULAR WIRELESS will make a point of writing to their respective Members of Parliament and urging them to demand a discussion of the matter in the House before a commission takes over the control of broadcasting at the New Year.

* * *

Our readers must have noticed a good deal of publicity in connection with our fourteen-valve set and Mars in the newspapers during the last few days. It is indeed amazing that the Press should have devoted so much space to this topic of the reception of signals from Mars. We must confess that we are a little to blame for this excessive publicity in connection with Mars and wireless.

Some time ago, Mr. Dowding, the Technical Editor of POPULAR WIRELESS, worked out a fourteen-valve set for the purpose of reception, his aim being to control the set efficiently on thirty metres as well as on thirty thousand metres. And then, as time progressed, we saw in the newspapers statements that Mars was again in a favourable position for observation.

The Tefag "Neutroflex" a popular German five valve receiver.

Now, publicity is very essential these days, and when we sent out invitations to the Press to inspect this fourteen-valve set it was inevitable that some reference should be made to the possibility of this set detecting signals from a great distance, possibly from Mars.

"Picking up" Australia.

But the main idea of this set has not been a stunt one in connection with Mars. We would impress upon readers that this set has been designed for something much more important and much more serious, viz., the reception of broadcasting from Australia.

On preliminary trial, the set has given such extraordinarily satisfactory results that we are now planning a series of experiments in an attempt to pick up broadcasting signals from the Antipodes, and should these experiments prove successful, we intend approaching the B.B.C. in the matter and asking them whether they would care to try it out at Keston with a possible view to broadcasting, via the British stations, concerts, etc., picked up from Australia.

But the Mars stunt seems to have filled the public eye to such a great extent that we are rather afraid the main object of this fourteen-valve set will have been missed, and the fact that Dr. Mansfield Robinson sent out a special message from Rugby to Mars created such hilarious interest that we think we ought to make it quite clear in this editorial that we did not associate ourselves in any way whatsoever with the attempts made by Dr. Mansfield Robinson to communicate with Mars.

* * *

However, our readers will appreciate the joke, and we feel sure they will not lose sight of the main object of this fourteen-valve set. Further details of the experiments we are conducting with the receiver will be published in due course in this journal.

A New Announcer.

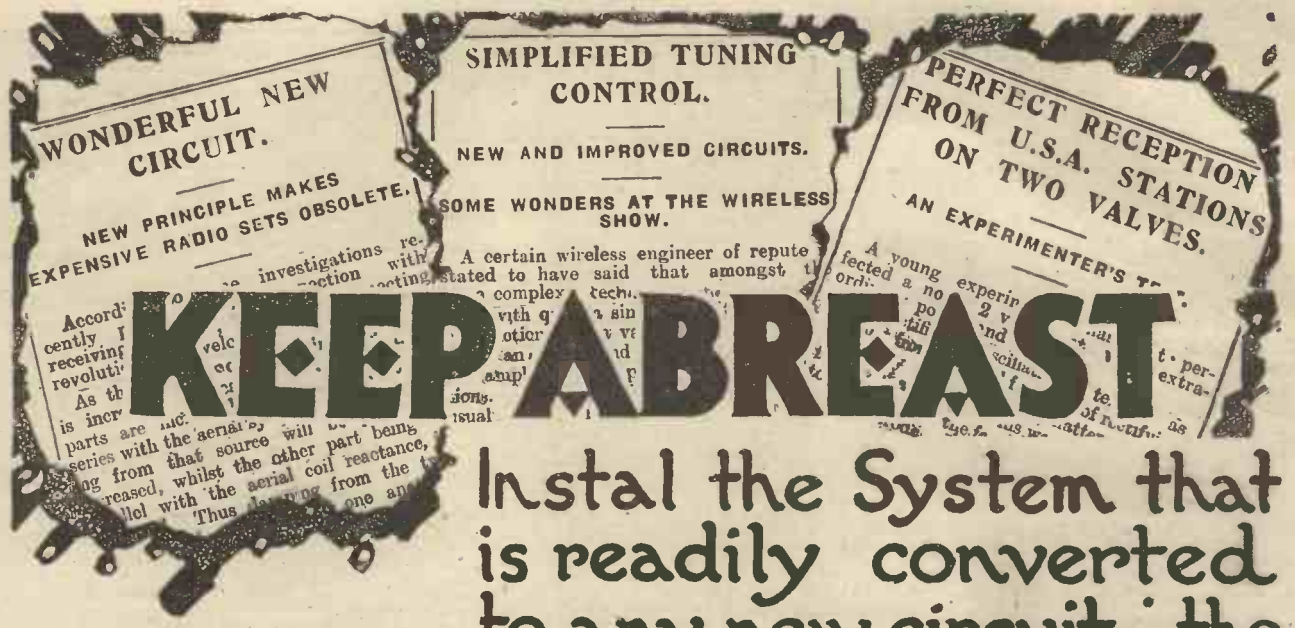
The new announcer at 2 L O, the Honourable David Tennant, brother of Lord Glenconner and nephew of the Countess of Oxford and Asquith, cannot be said to be a great success. We cannot help wondering why the Hon. David Tennant has been chosen for this new position. It is true that he is twenty-four years of age and an accomplished musician, and that he is keenly interested in broadcasting; but honesty compels us to say that his voice is not at all suitable for the rôle of announcer. There must be many other young men in less envious positions than the Hon. David Tennant who would welcome the opportunity of proving their worth as an announcer for the London station.

We have listened to the Hon. David Tennant broadcasting announcements several times, and it seems that he has still a very great deal to learn about the art of elocution. It is surely not necessary to read out a weather report in a declamatory way reminiscent of Sir Johnston Forbes Robertson reciting "To be, or not to be . . ."

But still, there it is, and we can only hope that the Hon. David Tennant will, in due course, pick up a few tips from his less fortunate brethren at 2 L O, and that he will in time become worthy of the very important rôle which he has to play in the conducting of 2 L O.

"FURTHER EXPERIMENTS WITH THE 'P.W.' 14 VALVER,"

Is the title of an article by Mr. Dowding which will appear exclusively in an early issue. Some very important data in connection with this set will interest every valve user.



Instal the System that is readily converted to any new circuit—the BLACKADDA

RADIO BUILDING SYSTEM

A FASCINATING METHOD.
The simplicity of this system will appeal to all wireless enthusiasts. The ability to build up any circuit with the greatest ease, and then to alter when desired to other circuits, to conduct numberless experiments, without wastage or scrap, renders the "Blackadda way" a boon to the novice as well as the expert.

THE ECONOMY OF THE SYSTEM.
As mentioned in the above paragraph, parts can be used over and over again; even the wiring is supplied in six standardised lengths fitted with terminal loops. For connections the loops are simply slipped into position and held by nuts. No soldering is required.

TOOLBOX NOT NECESSARY.
A strong point for many is the entire doing away with the use of small tools. Construction of the most intricate set is accomplished by the aid of a small box spanner we supply. Constructing or dismantling is possible with a minimum of labour and in the shortest space of time.

CONSTRUCTION BY NUMBERS.
We have devised this method so that the veriest amateur can, without previous technical knowledge, at once build an efficient receiving set from a simple crystal to an 8-valve Supersonic Heterodyne, acquiring a thorough knowledge, at the same time, of the principles of wireless which will prove invaluable. The advanced experimenter, too, will appreciate the ease and rapidity of our system. Starting with, say, a one-valve set, complete in itself, additions can be made from time to time, and a multi-valve set finally evolved at an extremely low cost.

BLACKADDA COMPONENTS.
We supply all the materials and components required to build up sets, and these are of the highest grade. Should the constructor, however, already possess parts or desire to use those of any particular make, we can furnish a series of adaptors for this purpose

Any Circuit Constructed Without technical knowledge

BLACKADDA RADIO BUILDING SYSTEM

Each component is given an Adda Number. The moulded panel serving as base and standing on four brass legs, has 140 equally spaced holes, also numbered. To construct, the components are fitted through indicated holes and nutted up on the back of the panel. Wiring is effected by joining from point to point in accordance with plan of circuit. That's all!

BLACKADDA SERVICE SHEETS.
We issue a series of Service Sheets, in loose leaf form, enabling the expert or amateur to keep abreast of the times. For describing the various new circuits and method of construction these will be found of the greatest value and easily understood and followed. Price 3d. each.

BLACKADDA CIRCUIT BOOK.
This publication, besides describing and illustrating our system and giving prices of all components, includes much radio information and *details of over fifty up-to-date circuits*. A most useful handbook. Price 1/-

Results from Blackadda sets, constructed according to our instructions, are equal to any on the market.

If your local dealer is unable to supply, we will forward direct on receipt of remittance or C.O.D.

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THE INTERPLEX.

By J. ENGLISH.

PART II (Continued).

UNIT No. 2 is the smallest of the units, all components being mounted on a panel 6 in. by 2 in., but the size of the unit is no measure of its usefulness, as it is applicable to all experimental work with contact detectors.

Fig. 4 is the composite drilling and wiring diagram, the disposition of the two detectors, terminals, and jack being shown in the photograph. Before assembling components, a locking device should be constructed and fitted as described for No. 1.

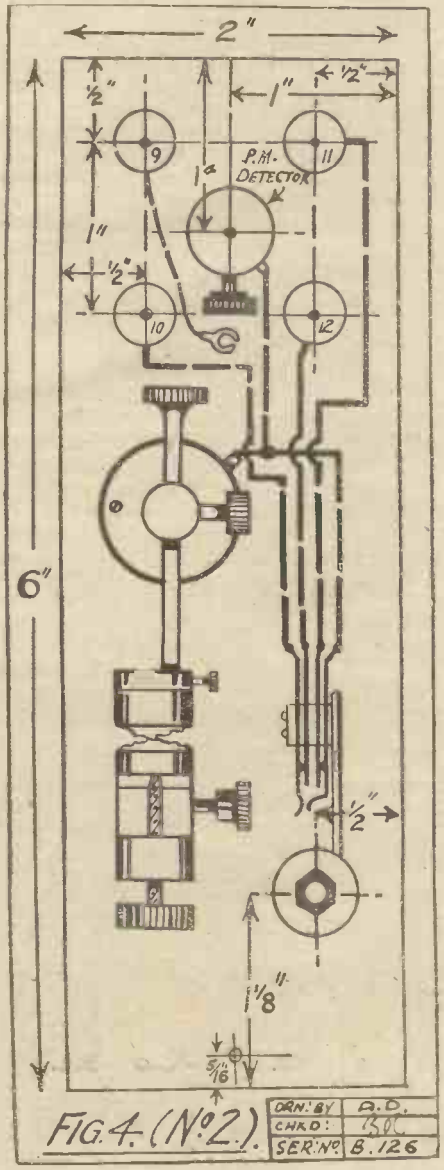


FIG. 4. (No. 2.)

The high potential terminal No. 9 of Fig. 4 has soldered to it a length of flex terminating in a spade terminal which can be connected to either detector. For this purpose, one side of each of the detectors is wired to a terminal behind the panel. If the panel mounting type of P.M. detector, as illustrated, is used, then the terminal nut at the end serves to secure the spade terminal. From terminal 9 the circuit is completed through the detector, and the output terminals 11 and 12, to input terminal 10.

The 'phones, or the input of an audio-frequency circuit can be connected either to the output terminals 11 and 12 or to a plug which, when placed in the jack (D.P.S.T.), cuts out the connection to these terminals. Regarding input connections, when this unit is used in conjunction with Unit No. 1 to form a simple crystal set, the aerial end of the coil is connected to 9 and the earth end to 10.

We now come to the construction of a very useful class of unit, No. 3. This comprises a variable condenser panel, three units being used in the complete system, but, apart from the capacities of the condensers, all three are identical in design and construction.

The constructional work for this unit is very simple, a panel 6 by 4 inches being drilled as indicated in Fig. 5 and the condenser mounted in the exact centre of the panel. Six terminals and one locking device are required, and when these have been mounted, the unit is wired as indicated in Fig. 5. Connections should be as short as possible consistent with proper spacing, as crowded, untidy wiring will increase the minimum capacity of the condenser.

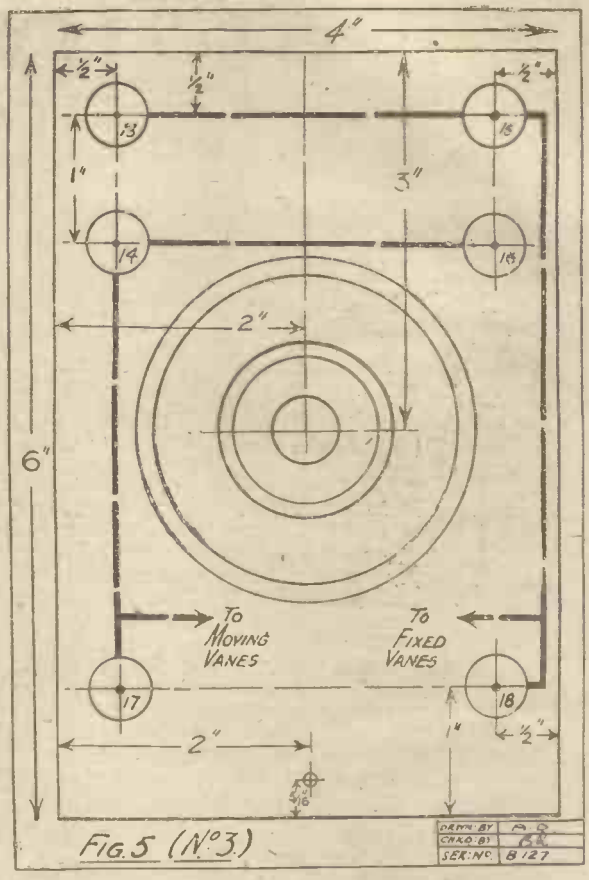


FIG. 5 (No. 3.)

Condenser Capacities.

As indicated in Fig. 5 there are three terminals connected to each side of the condenser. Terminals 14, 16, and 17, which are wired to the moving vanes, will generally be connected to points of low or earth potential, and, as the high potential terminals 13, 15, and 18 are connected to the fixed vanes, no undue difficulty is experienced from hand capacity effects when using the unit in sensitive circuits. Full details of the uses of this class of unit will be dealt with later.

Regarding the condenser capacities, constructors can use such condensers as they may have at hand, but for general work, two ·0005 mfd. and one ·0003 mfd. will be quite suitable. The addition of some slow motion device such as a vernier dial is a valuable addition to the unit.

(*Continued on page* 635.)

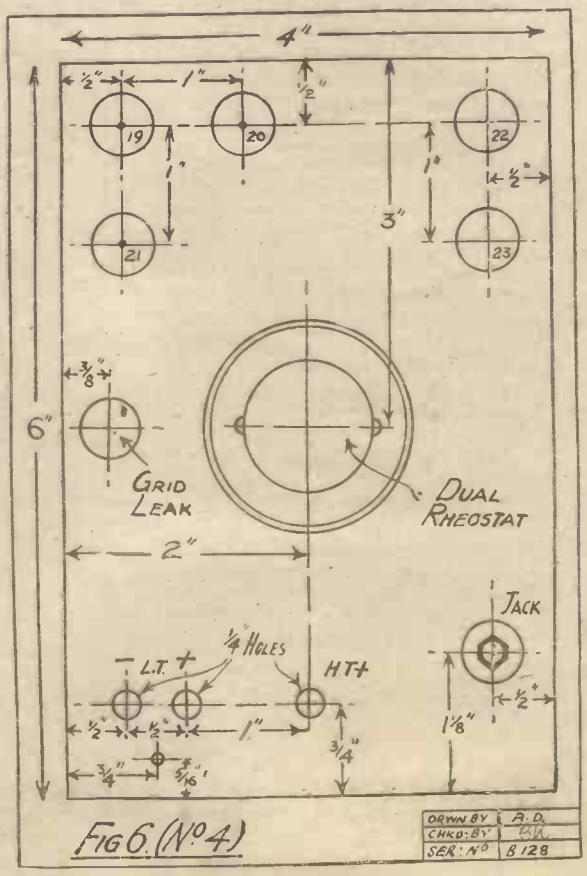


FIG. 6. (No. 4.)

Why Your Set

(1). *The Name behind them.*

They bear the imprint of John Scott-Taggart and all that this name has come to mean in the valve world.

(2). *Possess the right Dynamic curves.*

They are designed and tested on the basis of Dynamic characteristic curves. The common method is to have regard only to the static or ordinary curve. The ordinary curve, while valuable for some purposes, ignores working conditions, since it is taken with a fixed anode voltage. Every valve in a wireless receiver has, however, a constantly fluctuating anode voltage, which, when the grid is made more positive, becomes less than the H.T. voltage, while when the grid is more negative, the anode voltage rises to a value higher than that of the H.T. battery. This is due to the variation in current through the impedance always in the anode circuit of the valve. This impedance may, for example, be an H.F. or L.F. transformer, a choke, a resistance or a loudspeaker.

This phenomenon is generally overlooked by both manufacturers and many valve users. Every type of S.T. valve, however, is designed to give the right Dynamic curve which represents the conditions with the impedance in circuit. The valve, moreover, is *tested* dynamically, *i.e.*, under operating conditions.

(3). *It is their curves that count.*

All the operating merits of a valve, whatever the type may be, are reflected in the characteristic curves of the valve—provided, of course, that the right curves are taken. The effect of electron emission, the shape, sizes and spacing of electrodes, for example, all produce an effect on efficiency which is noticeable in the characteristic curves of the valve. That is why S.T. Ltd. lay so much store by the curves of their valves. Anyone can claim perfection and this or that merit, but in the end the curves show defects or merits. The Dynamic curve of a valve cannot lie. It's the curve that counts!

(4). *Like the Pyramids, they last.*

However well a valve may work and however good a curve it may have, this is no consolation if the valve only lasts a few days or a few weeks. This brings us to what many people regard as the most important factor—the life of the valve. About 50 per cent. of the valves sold use thoria in their filaments and often the power of emitting electrons seriously falls off. The valve remains alight, but the emission falls below the safe limit and signals become—to many—unaccountably weak, and distortion also arises. The S.T. valve has a *torodium* filament and has a very long and useful life. If you buy your valves on the basis of the length of service they give, you will always choose S.T.'s. for they are built like the Pyramids—to last.

(5). *The Torodium filament.*

The secret of the long life of the S.T. valve lies first in the filament and secondly in the vacuum. The filament is made of torodium, a recently invented alloy of precious metals which gives off, when heated, a copious stream of electrons. This power of emitting a generous supply of electrons remains throughout the life of the valve, and, moreover, breakages through the brittleness of the filament are unknown, as even after being used for a long period it retains a strength

2 VOLT.	4 VOLT.	6 VOLT.
S.T.21 (H.F.) 0·1 amp. - - - **14/-**	S.T.41 (H.F.) 0·1 amp. - - - **14/-**	S.T.61 (H.F.) 0·1 amp. - - - **18/6**
S.T.22 (L.F.) 0·1 amp. - - - **14/-**	S.T.42 (Power) 0·1 amp. - - **18/6**	S.T.62 (Power) 0·1 amp. - - **18/6**
S.T.23 (Power) 0·15 amp.- - **18/6**	S.T.43 (Super Power) 0·25 amp. - - **22/6**	S.T.63 (Super Power) 0·25 amp.. - **22/6**

Clamours for Them

and pliability comparable to that of a steel cable. The life is also largely attributable to the fact that the torodium filament operates at so very low a temperature that it gives no visible glow.

(6). *Extremely high vacuum due to the Barguet process.*

The vacuum in a valve is a feature which greatly influences not merely the initial operation of the valve, but also its life. After a time, there is a tendency for gases absorbed or " occluded " by the metal electrodes in the valve to leak out into the space in the bulb and partially spoil the vacuum. It has been proved beyond question that the slightest traces of oxygen, water vapour and other gases greatly affect the electron emission and the life of the filament. In the case of S.T. valves, the electrodes are heated to a very high temperature to drive out every particle of gas. These gases are then withdrawn from the bulb by the Barguet process of evacuation, which produces the highest vacuum known to science. This high vacuum is retained, and is a potent factor in giving the S.T. valve a long and efficient useful life.

(7). *Economical, as they take very little current.*

Economy in upkeep is a vital factor in the choice of a valve. Hence the great popularity of dull-emitter valves. Many so-called dull-emitters are, however, very extravagant in current consumption in comparision with the S.T. valves, which only take 0.1 ampere in most cases and 0.15 ampere in the case of one of the power valves. Work out how much this saves you in the cost of accumulator charging and the fatigue of carrying accumulators to be charged. The smallest increase above these figures means greater cost and trouble.

(8). *Not critical to work.*

One of the most delightful features of the S.T. valve is the fact that it is not critical to work. You can, in fact, be careless. For example, the torodium filament will work efficiently with or without a rheostat or resistor. Many valves are very critical on filament voltage but the 6 volt S.T., for example, will work off any voltage between about 4.5 and 6 volts. Some valves only work at their best when the accumulator is absolutely fully charged and signals " go off " after a time. The S.T. valve, however, will continue to work until the accumulator runs down.

(9). *Non-microphonic and robust.*

The S.T. valve is non-microphonic. You can tap it with impunity. It is very strongly made. Built like a chronometer for accuracy and uniformity, it is yet robust. Each electrode is supported in several places to give strength.

(10). *Every valve certified O.K. by John Scott-Taggart.*

Every valve is tested under Mr. Scott-Taggart's supervision and every carton is personally initialled by him to certify the satisfactory characteristic of the valve. The valves are uniform and every one is a " picked " valve. Any valve not coming up to the required standard is destroyed.

If you cannot buy a valve from your local dealer, write direct to us. Send for folder containing full description and curves to :

S.T. LIMITED, 2, Melbourne Place, London, W.C.2.

Telegrams : Esteevalve, Estrand, London. Telephone : City 7269.

THE INTERPLEX.

(*Continued from page 631.*)

The Universal Valve Unit No. 4 is one of the most important of the units, being in fact the keystone of the system. Although it is small in size and of simple construction, its relative importance from an experimental point of view will be realised when we come to consider its many applications in association with other units.

This unit comprises a panel 6 by 4 inches, screwed to a baseboard, 5½ by 3¼ inches,

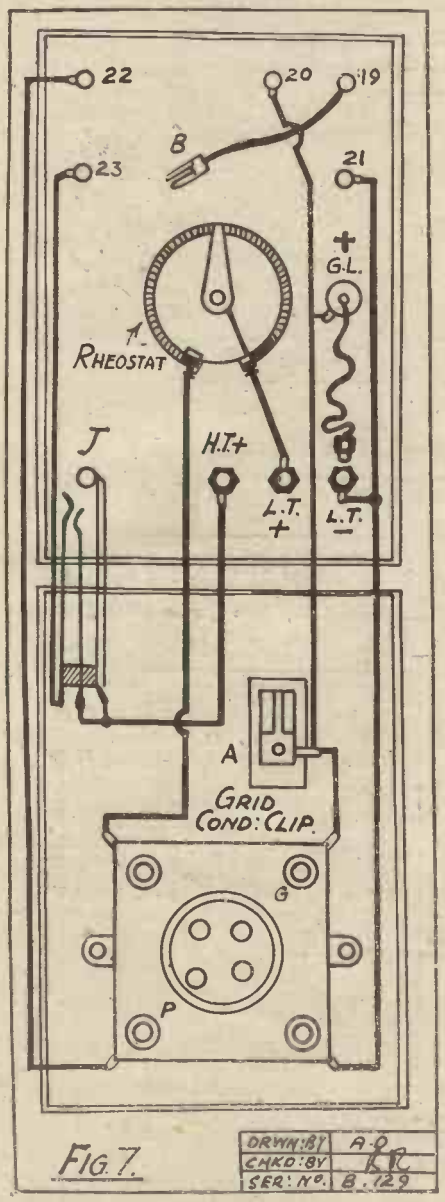


FIG. 7.

the piece of ebonite forming the locking device being fitted as indicated previously. Fig. 6 is the drilling plan of the panel and Fig. 7 the wiring plan. On the panel are mounted five terminals, three sockets, and a jack (single circuit closed), while in the centre is the dual rheostat, with a variable grid leak on the left. The baseboard carries at the rear an "Antipong" valve-holder and a grid condenser. Interchangeable types of the latter are used here, one clip being mounted on a piece of ebonite screwed to the baseboard, while the other clip is joined by a flexible lead to terminal 19. This provides a connection to the grid through a condenser of any desired capacity. Terminal 20 is connected straight to the grid and 21 to L.T. negative, these three terminals, 19, 20, and 21 being the input terminals.

The grid is also wired to the end of the grid leak furthest removed from the panel, the other end being connected to a flexible lead terminating in a wander plug which can be put into the *back* of either L.T. socket so that the leak may be to negative or positive. Terminal 22 goes to the anode and 23 through the jack to the H.T. positive socket. These two output terminals are provided preferably for connections to any circuit or component comprising the *radio frequency* portion of the anode circuit, and any *audio frequency* circuit or component is introduced into the anode circuit by means of the plug and jack.

Withdrawal of the plug does not break the anode circuit, but terminals 22 and 23 must be shortened if no coils, etc., are connected.

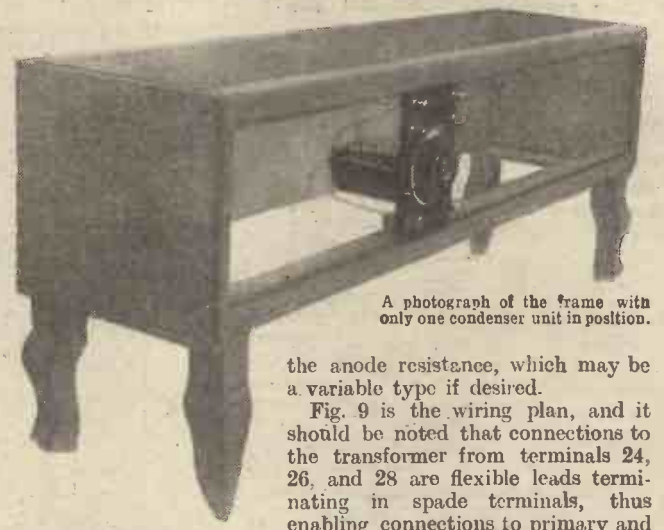
When wiring up, connections should be made as short as possible consistent with good spacing so that interaction between various leads may be reduced to a minimum. If wires to the valve-holders are soldered to the tags thereon the terminals also provided may be reserved for any further experimental connections, but the terminal connections on the panel have proved quite sufficient for all purposes no matter how the unit is used.

For Unique Circuits.

It should be noted that the rather peculiar mounting of the grid condenser is the one position in which unwanted capacity effects are minimised, and the constructor should not alter this position unless absolutely necessary. The method of connecting and using this unit will be dealt with more fully later. In passing it may be mentioned that this unit can be adapted to four-electrode valves by providing an extra terminal for a free connection to the second grid. Such an addition will be necessary when experimenting with Unidyne circuits.

The construction of Unit No. 5, the audio-frequency coupler, presents no difficulty, its design being quite straightforward, and the disposition of components is clearly shown in the photographs.

The body of the unit comprises a panel, 6 by 3½ in., drilled as indicated in Fig. 8, and screwed to the baseboard, 8½ by 3½ in., underneath which the locking device is fitted as described for Unit No. 4. The transformer is screwed down in the centre of the baseboard with a fixed condenser-holder on each side. Between the transformer and the panel is the holder for



A photograph of the frame with only one condenser unit in position.

the anode resistance, which may be a variable type if desired.

Fig. 9 is the wiring plan, and it should be noted that connections to the transformer from terminals 24, 26, and 28 are flexible leads terminating in spade terminals, thus enabling connections to primary and secondary to be readily changed. Also, the leads from terminal 29 and from one terminal of the secondary going to the grid bias battery are also flexible, and terminate in wander plugs which are so connected that

(*Continued on next page.*)

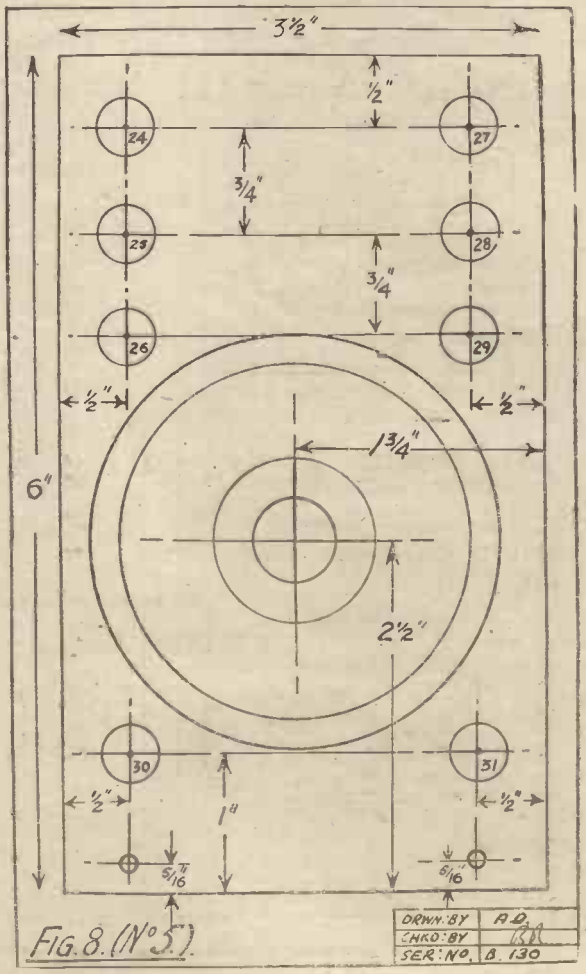


FIG. 8. (No 5).

THE INTERPLEX.

(Continued from previous page.)

they may be plugged together when no grid bias is needed. The grid bias battery is held in position by clips screwed to the baseboard behind the transformer.

When using the unit as a simple transformer coupler between two A.F. valves, one Unit No. 4 is placed on each side, and the output terminals 22 and 23 of the first valve unit joined to terminals 24 and 26 respectively. Output terminals 28 and 29 are then connected to 20 and 21 of the second valve unit, and the grid bias plugs of unit 5 adjusted as required. If the grid leak of the second valve unit is left in, it acts as a high resistance across the secondary of the transformer, as sometimes required in amplifiers. When used as a choke-capacity coupler, input connections are made to terminals 24 and 26, and a lead taken from 27 to 19 of the following valve unit, the grid condenser of which is changed for one of suitable value, while the grid leak plug is placed in the negative L.T. socket. To change from choke to resistance-capacity coupling, all that need be done is to remove the input connection to 26 and place it in 25.

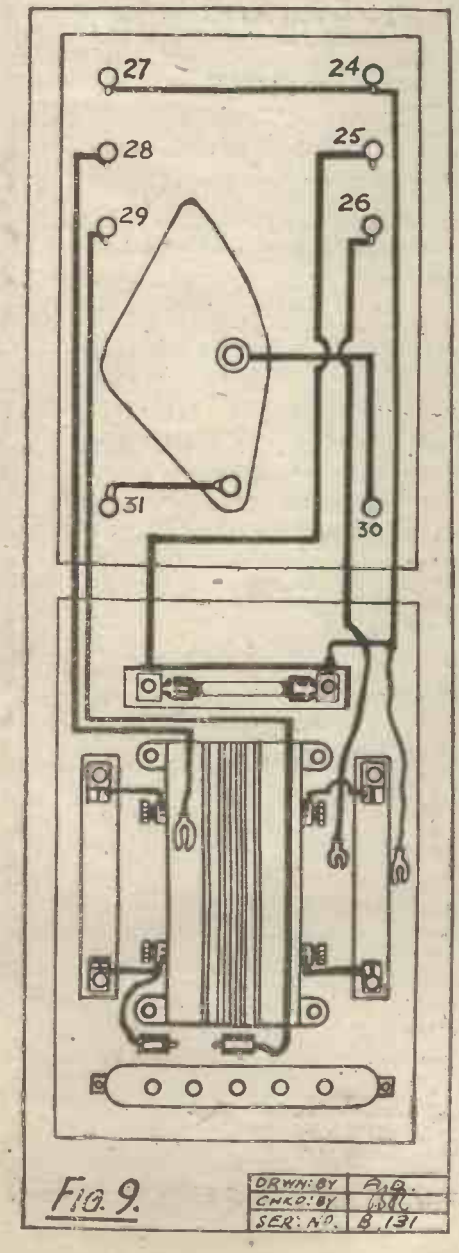


Fig. 9.

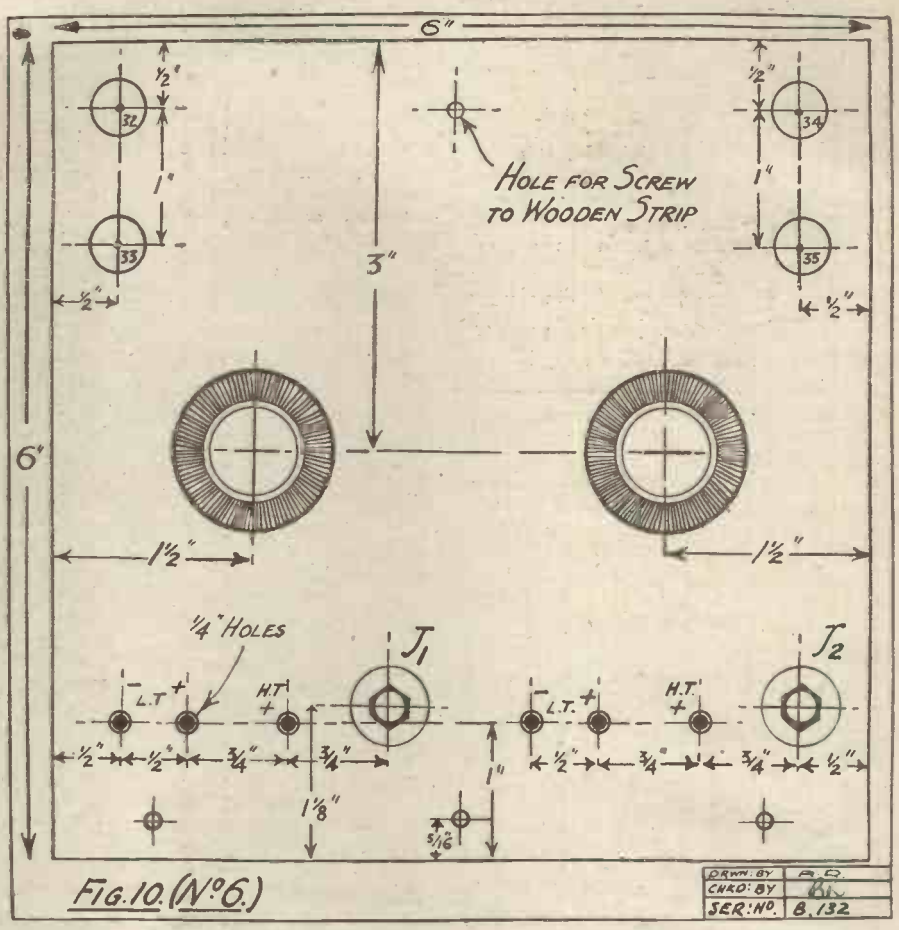


Fig. 10. (No. 6.)

This unit also provides terminal connections to a choke, one or two fixed condensers, a high resistance or a variable grid bias battery, and the necessary arrangement of connections can be easily worked out from Fig. 9. The ·0001 mfd. variable condenser is really included to fill up panel space, but is of use where a small variable-coupling condenser is required, the terminals for which are 30 and 31.

The Two-Valve Amplifier.

The last of the units to be constructed is No. 6, the two-valve amplifier which is quite a compact little unit for its size, and although components may appear to be rather crowded together, it certainly works admirably. The dimensions of this unit were intentionally reduced to the lowest limits, so that ample cabinet space would be available for the other units. Hence a little extra care will be necessary here when mounting and wiring up the components.

The frame of the unit consists of a panel, 6 by 6 in., and a baseboard, 5¾ by 8½ in., underneath which is fitted the locking device. A strip of wood is screwed to both panel and baseboard as shown in the photograph, and this prevents the baseboard from sagging beneath the considerable weight of components mounted on it. Also, the addition of this strip makes the unit as a whole quite rigid, and it can be lifted in and out of the cabinet without fear of straining anything.

On the panel, which is drilled as indicated in Fig. 10, are mounted four terminals, two rheostats, two jacks (D.P.S.T. and

(Continued on page 651.)

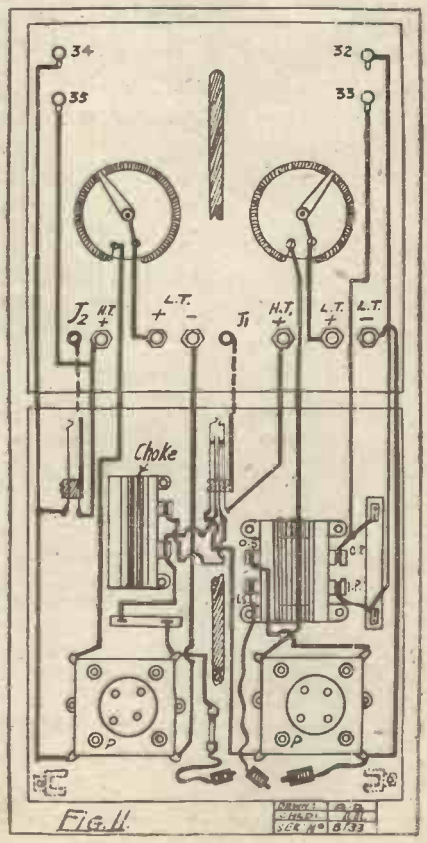


Fig. 11.

Traders and manufacturers are invited to submit wireless sets and components to the "P.W." Technical Dept. for test. All tests are carried out with strict impartiality in the "P.W." Test room under the supervision of the Technical Editor, and the general reader is asked to note that this weekly article is also intended to provide a reliable and unbiased guide as to what to buy and what to avoid.—EDITOR.

PHILIP'S H.T. UNIT.

IF the Board of Trade laid down rules and regulations regarding the use of H.T. and L.T. units on house lighting mains, we wonder how many of those on the market would obtain a certificate. As a matter of fact, it is, in our opinion, high time some central authority did undertake the responsibility of framing such "safety first" laws and of seeing that they were adhered to. Anyway, wireless amateurs and listeners would be well advised to obtain their main units only from trustworthy manufacturers—manufacturers whose very names are an indication of reliable apparatus. There is no doubt but that the Philip's H.T. supply unit would fulfil the "safety" requirements of the most critical authority. As is usual Philip's practice, the unit is enclosed in a fireproof metal case, and is designed on true "safety-first" lines.

The unit embodies a half-wave rectifier and, using a dull emitter valve of special design, it is very economical. A feature that appeals to us is the neat little metal plate which, fixed permanently to the case, gives detailed instruction as to the use of the unit.

Two H.T. plus tappings are provided, and a considerable variation of voltages is obtainable by a filament adjustment. An earthing terminal is provided, and proves very effective and greatly assists in stabilising the unit and in cutting out "hum."

On test, this Philip's unit gave excellent results, and, as previously indicated, current consumption proved to be practically negligible. Sufficient H.T. current was available to operate a receiver employing two L.F. power valves and reception was practically as silent as with batteries, and decidedly was the supply of H.T. *more* constant and reliable than with *some* batteries.

The first cost of such a unit is heavy—in this case it runs to £7 10s., but running costs are so light that the far-seeing amateur will see that in the long run this method of obtaining H.T. is an economical one all through. Certainly it is a trouble-free method, and one no more likely to let a listener down than the very supply mains from which it derives its current.

DX PLUG-IN COILS.

Mr. John T. Nichols recently sent us some of his DX coils wound to the "Spider" specification. They gave excellent results—results just as good as those given by our original coils.

The special aerial coil, which is provided with a tapping terminal nicely placed on the top of the coil, is priced at 4s., at which figure we consider it good value for money, considering the special nature of its windings. It deviates slightly from our specification in that the two windings are wound multi-layer fashion one above the other, but this does not appear to cause the trouble that might have been expected. It will be remembered that Mr. Nichols wound all the coils used in our special fourteen-valve receiver.

ANOTHER MULLARD VALVE.

Every valve in a multi-valve receiver is a very important item, but none is so vital as that last one, the one that precedes the loud speaker. It is in the last L.F. stage that really fearful distortion can occur, more especially if the valve used is unsuitable for the task imposed upon it. An inefficient H.F. valve will probably cause a great loss in sensitivity, but an inefficient

(*Continued on page* 640.)

APPARATUS TESTED.

(*Continued from page* 638.)

last stage power valve may not mean only a mere difference between strong and very strong signals, but the difference between harsh, grating reproduction and pure, mellow speech and music.

Of course, a good valve used incorrectly may give as bad results as a bad valve with every refinement in the way of ample H.T. and grid bias. But one must start right, and that brings us to the real point of this discourse—the Mullard D.P. 425, a power valve with which we have obtained excellent results.

Rated at 3·8 volts, ·25 amps., and requiring from 75 to 150 volts H.T. with from 5 to 22 volts grid bias, this Mullard valve is suitable for use with large loud speakers. It has an impedance of some 3,500 ohms and can handle very large inputs without causing distortion.

It operates at an extremely low temperature, and there is practically no glow at all from its filament. For the power that it can deal with it is an extraordinarily economical valve, and in view of its very "dull" nature it must have a very long life. We can thoroughly recommend this Mullard D.P. 425 power amplifying valve as a "last stager" that will pass all tests.

DUBILIER UNIVANE VARIABLE CONDENSER.

The Dubilier "Univane" Variable Condenser is an extraordinarily ingenious component. The vanes are more or less conventional in shape, and number twenty-six in all. The thirteen moving ones operate in sequence. For instance, supposing all the vanes are "in" (maximum capacity). One revolution of the dial causes the first vane to move; on the commencement of the second revolution of the dial the second vane is picked up and moved from a minimum to a maximum setting, and so on. Reversing the direction of the dial rotation the same thing happens in a reverse direction. Thus the dial must be turned thirteen times in order to cover the min.-max. range. Throughout the whole of this the control is never on more than one plate, so that when any one is in gear it can be carried to its max. or min. position independently of all the others.

An indicator at the edge of the dial plainly shows which vane is in use and thus exactly at what point the variable is being operated.

Despite the novel results the mechanism is very simple and cannot jam or get into trouble.

The movement is a true "vernier," and as it can be so accurately calibrated, experimenters will appreciate its value.

The "Univane" is beautifully constructed and well up to Dubilier standard in general design and finish. It is not the sort of variable we should use on a broadcast receiver for it takes so long to get from the max. to min. settings, but doubtless it will appeal strongly to the "precisionist." The price is 25/- and the rated capacity, ·0005 mfd.

* * *

The American Radio Corporation, Ltd., Bond Street, London, inform us that they handle the Cone speaker and other Radio Foundation, Inc., products in this country.

A demonstration of the process of manufacturing Mullard valves given recently at Selfridge's.

RADIOTORIAL

All Editorial Communications to be addressed to The Editor, POPULAR WIRELESS, The Fleetway House, Farringdon Street, London, E.C.4.

The Editor will be pleased to consider articles and photographs dealing with all subjects appertaining to wireless work. The Editor cannot accept responsibility or manuscripts and photos. Every care will be taken to return MSS. not accepted for publication. A stamped and addressed envelope must be sent with every article. All inquiries concerning advertising rates, etc., to be addressed to the Sole Agents, Messrs. John H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4.

As much of the information given in the columns of this paper concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and the trader would be well advised to obtain permission of the patentees to use the patents before doing so.

Readers' letters dealing with patent questions, if sent to the Editor, will be forwarded to our own patent advisers, where every facility and help will be afforded to readers. The envelope should be clearly marked "Patent Advice."

TECHNICAL QUERIES.

Letters should be addressed to : Technical Query Dept., "Popular Wireless," The Fleetway House, Farringdon Street, London, E.C.4.

They should be written on one side of the paper only, and MUST be accompanied by a stamped addressed envelope.

Queries should be asked in the form of the numbered questions : (1), (2), (3), etc., but may be accompanied by a short letter giving any necessary additional particulars as briefly as possible.

For every question asked a fee of 6d. should be enclosed. A copy of the numbered questions should be kept, so that the replies may be given under the numbers. (It is not possible to reproduce the question in the answer.)

BLUE PRINTS. A series of 20 Blue Prints can be obtained from the Query Dept. price 6d. per Blue Print.

Only a limited number of circuits are covered in this series, and full details of the circuit arrangement, available in Blue-Print form are published fortnightly in the advertisement columns of this journal.

All other back-of-panel diagrams are specially drawn up to suit the requirements of individual readers at the following rates : Crystal Sets, 6d. ; One-Valve Sets, 6d. ; One-Valve and Crystal (Reflex), 1s. ; Two-Valve and Crystal (Reflex), 1s. ; Two-Valve Sets, 1s. ; Three-Valve Sets, 1s. ; Three-Valve and Crystal (Reflex), 1s. 6d. ; Four-Valve Sets, 1s. 6d. ; Multi-Valve Sets (straight circuit), 1s. 6d. Except SUPER-HETERODYNE DIAGRAMS, all of which, irrespective of number of Valves used, are 2s. 6d.

If a panel lay-out or list of point-to-point connections is required an additional fee of 1s. must be enclosed.

Wiring diagrams of commercial apparatus, such as sets of any particular manufacture, etc., cannot be supplied. (Such particulars can only be obtained from the makers.)

Readers may submit their own diagrams, etc., for correction or for criticism. The fee is 1s. per diagram, and these should be large, and as clear as possible.

No questions can be answered by 'phone.

Remittances should be in the form of Postal Orders.

Questions and Answers

Panel and Baseboard Lay-out.

"2-VALVER" (Hanwell, Middlesex).—I am going to build a 2-valve receiver to receive London on a small loud speaker and distant stations (Continental and B.B.C.) on the telephones. The circuit that I wish to use is on the lines of that given by the pictorial blue print, No 11, but instead of building a flat panel set, like that illustrated on the blue print, I wish to make a receiver with an upright panel,

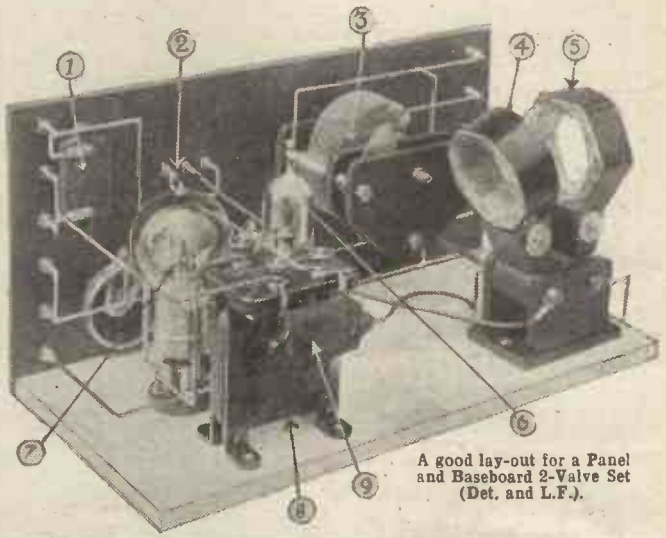
(*Continued on page 644.*)

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from page 642.*)

so that the valves and coils are enclosed in the case, out of harm's way. What is the best method of arranging the components on the baseboard and panel?

The accompanying photograph shows a good arrangement for a set of this type. It will be seen that the coil holder is placed behind the variable condenser and the L.F. transformer is fixed alongside it in such a position that when the moving coil is "all out," there is room for it to lie down on the baseboard without fouling the transformer. The numbered components represent (1). Telephone condenser (the use of this is optional). (2). The switch for one or two valves. (3). Variable condenser. (4). The reaction coil (moving). (5). Aerial coil. (6). Detector valve. (7). L.F. amplifying valve. (8). L.F. transformer, and (9). Fixed condenser across the primary terminals of the L.F. transformer (if used).



A good lay-out for a Panel and Baseboard 2-Valve Set (Det. and L.F.).

AM I OSCILLATING?

J. S. (London).—Being a beginner as regards valve sets, I should be pleased if you can give me any information with regard to reaction and oscillation. My set, I am informed, has a reaction coil fitted, and I do not wish to cause any interference to my neighbours' sets. How can I tell when I am oscillating? And if so, how is it cured?

We cannot do better than to quote the following paragraphs taken from a circular letter addressed to listeners in Canada by the radio branch of the Department of Marine and Fisheries of the Canadian Government and published in "The Times" of recent date:

The principle of regeneration, as used in radio receiving sets, is that part of the output of the detector valve feeds back into its own input, and thus greatly increases the volume of the signal. The electric waves reaching the receiving set from the transmitting station travel down the aerial wire, through the primary coil in the set, and so to earth down the earth wire. The weak electric current resulting from this influences the valve in such a way as to set it functioning.

The resulting output from the plate circuit of this valve is fed back in such a manner as to set up a "field" or influence, in the part of the circuit connected to the input (the grid) of the valve. This field induces in the input circuit a current of electricity

(*Continued on page 646.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page* 644.)

of the same frequency as that of the received electric waves. The energy therefore, which comes down the antenna wire is automatically strengthened by an impulse from the output of the detector valve. Unless controlled, this action will continue until the saturation point or climax is reached, the valve being then said to be in a state of oscillation. When a receiving set is in oscillation, it causes howling and squealing, both in itself and in neighbouring receiving sets. Regeneration should therefore never be allowed to proceed to this point, as it then constitutes a public nuisance.

(1) It causes whistles in radio receiving sets of all types which are tuned to the same station. This interference may be heard up to a distance of several miles.

(2) It distorts the quality of the music.

(3) It uses more H.T., and therefore the life of the H.T. battery is reduced.

(4) It tends to reduce the life of the detector valve.

When a radio receiving set in a state of oscillation is exactly tuned to a broadcast station, it is said to be in the state of "zero beat." This distorts the broadcast reception, and also interferes with neighbouring receiving sets which are tuned to the same station. In a word, regeneration carried to oscillation causes great annoyance to neighbours, poor reception and expense to the owner of the set, and has no advantages whatever.

For the Constructor

No. 8.—WORKING EBONITE.

(a) Don't use pencil to mark a panel. Unless thoroughly cleaned off with a slightly oily cloth, there is a tendency for leaks to occur along the pencil-marks.

(b) When the marking has been done, a light tap with a centre-punch will ensure that the drill starts properly.

(c) Ebonite can be cut perfectly square if a tenon saw is employed.

(d) If a hacksaw or (for big panels) a rip-saw is used, the "cut" should not be along the line marked, but just outside it. Otherwise the panel will be too small.

(e) Use a coarse file to trim panel edges. Fine files become choked.

(f) "Metal-working" drills should be chosen, and only a light pressure employed.

(g) Keep the bench clear whilst working, or the panel will be disfigured by scratches.

(h) When "breaking through" with the drill, relax the pressure, or the panel surface may chip.

(i) When withdrawing the drill, do *not* reverse, but continue turning slowly.

(j) Ebonite melts under heat, so terminals will need tightening after they have been soldered.

The interfering whistle which is heard in a receiving set may originate in the set itself, or it may be interference caused by a neighbour. In order to determine this point, the following test may be made:

Leave the regeneration control (reaction handle) in a fixed position, slowly rotate the tuning dial, and note particularly the change in sound of the whistle. If the whistle rises and lowers in pitch sympathetically with the movement of your tuning dial, it indicates that your receiving set is in a state of oscillation, and probably causing interference to other sets. On the other hand, if the whistle does not change in pitch corresponding to each movement of your tuning dial, but simply varies in volume, the whistle is not caused by your receiving set, but is interference produced by some other oscillating receiving set in the neighbourhood.

WHAT SET SHALL I NEED?

A. E. G. (The Hyde, London, N.W.9).—I am wanting a circuit for a 2-valve set for use with loud speaker in Bromley (Kent). The essential feature must be simplicity in circuit and panel surface. This you will readily understand on learning that the set is intended for a blind man. Perhaps something with a variometer would be most useful?

As the distance would be about twelve miles, you really need more than two valves for good loud-speaker work. If the set must be a 2-valver, and as simple as possible, we should use a straight detector and L.F. amplifier. One or both of the valves should be of the "power-valve" type, and plenty of H.T. would be required, unless the set is used in conjunction with a very good outdoor aerial. A circuit of the type named (straight Det. and L.F.) is given on the "P.W." 6d. Blue Print, No. 11.

(*Continued on page* 648.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 646.*)

2-VALVE UNIDYNE.

J. B. (Dublin).—In which number of "P.W." was the 2-valve Unidyne set described (Det. and L.F.) that appears on the "P.W." Blue Print No. 12?

The particular set in question was not described in a how-to-make article in "P.W.," though several similar sets have been described constructionally. The numbers of "P.W." containing these articles are now, without exception, out of print.

THE SIMPLIFIED P.W. COMBINATION SET.

E. R. (Brixton Hill, S.W.)—I have recently taken to pieces an old 1-valve "P.W." Combination set which had given excellent loud-speaker results, but which I wish to rewire into a simpler and smaller set. As it was generally switched over to the "dual" position, can I do without the switches and build it on a flat panel, 1 valve and crystal for loud-speaker results? Has such a set been described in a back number of "P.W."?

The full constructional description of a similar set appeared in the free supplement given with "P.W." No. 229 (October 23rd issue). The details of a set of this kind are available also in "P.W." Blue Print form; the required Blue Print being No. 7. (See Blue Print announcements in this issue.)

SELECTIVE REACTION.

(*Continued from page 603.*)

The magnified H.F. impulses in the anode circuit of V_1, being impeded by the choke L_3, are by-passed to the grid circuit of V_2. On this brief journey, however, they are greatly intensified by the magnetic feed back from the reaction coil, which is also the path of the rectified L.F. currents. As reaction is increased a point is reached where the detector valve becomes *saturated*, and a howl is set up.

If C_5 is now increased the H.F. load delivered to V_2 is reduced in the first instance by the amount of the H.F. energy fed back to the aerial circuit. This stimulates or energises V_2 to deliver a stronger anode current, and approaching the pre-oscillation stage becomes more sensitive. It appears that some of the energy fed back from the anode of V_2 finds its way back through C_2 and C_5 to the aerial circuit. Thus the effect of the two reactions would appear to be that the H.F. flow automatically balances itself between V_1 and V_2, so that both valves are held as it were on the brink of the stage of *saturation* or pre-oscillation.

Wide Reaction Range.

It is well known that the grid circuit of a detector valve requires re-tuning after each variation of the reaction coupling or other feed back. In this receiver the reaction coil may be moved through 45 degrees without apparently affecting grid-tuning, provided the capacity reaction is simultaneously adjusted. The fact that this independent adjustment of magnetic reaction is possible must be responsible for the wide wave-band over which changes of reaction make it possible to tune. The actual receiver in question incorporates a feed back of L.F. impulses to the H.F. valve which is reflexed, the feed to the grid being via iron-cored transformer and H.F. choke, whilst a third valve is used as a choke coupled low-frequency amplifier.

It is one of the most satisfactory circuits experimented with over a matter of some four or five years. The final arrangement is shown in Fig. II.

2-VALVE SETS

Sets complete with following accessories.

Long distance 2-valve L.F. and Detector Receiver in handsome polished cabinet. Includes set as shown: 1 power, 1 ·06 D.E. valves, tuning coils, H.T. 60-v., L.T., Aerial Equipment, H.T. & L.T. Leads, 2 pairs of 4,000 ohms 'phones, or LOUD SPEAKER. (Marconi Tax Paid.) £4/19/6 the Lot Carr. and Pack., 5/-.

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BRITISH HEAD PHONES. Brown's Featherweight, 20/-. Brown's A Type (Reed) 30/-. B.T.H., 15/-. Sterling, 20/-. Western Electric, 20/. All makes stocked.

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5-pin 9/6

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3-3·5 ·06 ... ... 6/11
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CHOKES.—Cosmos H.F., 6/6; Lissen H.F. or L.F., 10/- each. Success L.F. or H.F., 10/- each. A.J.S., 15/-, with unit 20/-.

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"Yours faithfully,
"JOHN F. DREW."

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Terminals with N. and W., 1d.; Nickel, 1½d. Spade Tags, 6 a 1d. Soldering, 3d. doz. Ebonite Bushes, 1d. Screw Wander Plugs, 2d., 3d., 4d. pair. Plug and Socket, R. or B., 3d. Staples 4 a 1d. Valve Pins, 2 a 1d. 4 or 2B.A. Rod, 3d. each. Earth Tubes—Copper, 2/3; Climax, 5/-. Fine 7/22 Aerial, 100 ft. 1/11; Special Heavy weight, 2/3. Phosphor Bronze, 49 strands, 100 ft., 1/- (limited). Twin Flex, R. & B., 12 yds., 1/4. 1/6, 2/-. Miniature Silk Twin Flex, 6 yds. 6d. Maroon Lighting Flex, 6 yds. 9d. Insulators, 2 for 1½d. Tinned Copper, 1/16th sq., 1d. 2 ft. D.C.C. Wire, ½ lb. reel, 20g. 9d.; 22g. 10d.; 24g., 11d.; 26g. 1/-; 28g. 1/1. Battery Boxes, with clips, covered leatherette, 2/11; Metal, 3/9. Ebonite, Grade "A" cut while you wait. 3/16th is ½d. sq. inch; ¼ in. is ¾d. sq. in. Stock sizes cheaper: 7 x 5, 1/3; 6 x 6, 1/3; 8 x 6, 1/9; 9 x 6, 1/11; 10 x 8, 3/-; 12 x 9, 4/- Also cheaper quality for crystal sets. Special offer in Crystal Sets, 6/11, 7/6, 8/11, 9/6, 12/6. Also in enclosed cabinet, wonderful value, 18/11. AMERICAN Type Oak Cabinets, with baseboard, take 12 x 8 ebonite, 10/6; 12 x 9, 11/9; 16 x 8, 16/11, 18/11. Any size in 3 days. Handsome panel switches, DPDT., 1/6; SPDT, 1/- (Highest quality).

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Lightning Arresters, 1/-. Wave-length Permanent Det., 6d. Red Diamond Perm. Detector, 2/-; Liberty, 3/6; Brownie, 3/-; R.I., 6/-. Crystals: Shaw's Genuine Hertzite, sealed, 8d.; Neutron Wyrnalite, 1/6; Dayzite, 2/6. Splendid enclosed Crystal Detectors, on base, 1/-, 1/3, 1/6. Micrometer, 1/9; Service do., 2/9 (with crystal). P. & P. Switches, 1/-. Non-microphonic V.H., 1/3. Solid Rod Eb., 1/-. Baseboard, 8d. 2-way Geared Coil Holders, 2/11. 3/11. Fenton, Lotus, Polar, Newey stocked. Back of Panel, W.L.S., 4/11; Kay Ray, 3/11. 20-v. H.T. Accumulator Unit—the top and all plates are removable, can be replaced or cleaned. The world's greatest bargain, per 20 volts, 8/6. ¼ drills for 1 h. fixing, 1/3. 'Phone Cords, 1/-, 1/3. L.S. do., 1/6, 1/9. H.T. & L.T. Leads, 4-way, 1/11. Our old friends, Crown "Polo" H.T. Batteries, 60-volt (not one in a 1,000 has to be returned) I will change any faulty. Price 6/11. Adico, Everready, Siemens, Hellesens, 60-v. & 100-v., all 15 Batteries here (Columbia always stocked). Roll up in your thousands!

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THE INTERPLEX.

(*Continued from page 636.*)

single circuit open), and filament and H.T. sockets for each valve. The general arrangement of components on the baseboard can be seen from the various photographs. It will be observed that a second transformer, a spare telephone step-down transformer, has been used here as the iron-cored choke, for which any reputable make may be used, provided its inductance is about 40 to 50 henries. The "Antipong" valve holders are mounted behind the transformer and choke, the space left at the rear of the baseboard being for the grid bias battery, which is held in position by two clips. A fixed condenser holder is provided across the primary of the input transformer, while a fixed grid leak of ·5 M.O., mounted on its own connecting wires, will be seen between the valve holders.

Operating the Amplifier.

If Fig. 11 is followed carefully, wiring-up should not present any difficulty, due care being taken with the spacing of wires carrying high and low tension currents. The input terminals 32 and 33 are connected to the transformer primary, and terminals 34 and 35, which are wired in parallel with the second jack, constitute an alternative output connection.

Regarding the grid bias connections, three flexible leads terminating in plugs are needed, one being soldered to filament negative lead, a second to I S of the input transformer, and a third to the free end of the grid leak.

As this unit is complete in itself, it will be more advantageous to consider here a few points regarding operation. The type of valve used will depend, of course, upon the voltage input at each stage and the degree of amplification required. Generally a power valve will be needed for the second stage, with suitable grid bias tapped off the bias battery at the back of the baseboard, this battery being common to both valves. If the slab type of battery, tapped every 1½ volts, is used, there is sufficient room for one having a maximum voltage of 18, which is ample for power valves dealing with quite large input voltages.

Always Useful.

The control of filament and anode voltages is separate and distinct for each valve, and this, in conjunction with other features described above, constitutes a reasonably distortionless and powerful amplifier which, moreover, needs little attention. Once having made and noted the necessary adjustments of filament, anode, and grid bias voltages, all that need be done to bring the amplifier into operation is to connect up the input terminals, place the output plug in jacks 1 or 2, and turn on the required rheostats.

Although this unit is more or less fixed in design, a considerable amount of experimental work on A.F. amplification can still be undertaken with it, and, as a whole, it is quite a useful unit. In fact, the advantages of having such an amplifier always ready at hand are so great that the system could not be considered complete without it.

CORRESPONDENCE.

Letters from readers discussing interesting and topical wireless events, or recording unusual experiences, are always welcomed; but it must be clearly understood that the publication of such does in no way indicate that we associate ourselves with the views expressed by our correspondents, and we cannot accept any responsibility for information given.—Editor.

"P.W." "ULTRA" ONE-VALVER.

The Editor, POPULAR WIRELESS.

Dear Sir,—Re the "P.W." Ultra Auto Coupler Selective 1-valver, POPULAR WIRELESS, dated September 4th.

I have assembled this set, and I consider the circuit is an ideal one for the all-round listener.

On test Bournemouth and Cardiff came in excellent at 35 and 45 miles respectively, Swansea, Dublin and Newcastle at reasonable strength, and twelve oversea stations at audible strength. I consider the set, if well-built, will be useful for the occupier of a flat, or in other spots if an aerial cannot be used, more especially if the owner is situated within 5 to 10 miles of the nearest transmitter. I have obtained, at 35 miles, audible results without an aerial or earth. Of course this is mostly due to the Igranic Auto Coupler Coil (Ultrynic). These results, without aerial, were brought in on 24 volts H.T. and 2 L.T. on a Marconi D.E.2 valve.

Yours truly,
R. J. HANSFORD.

203, Marston Road,
Sherborne, Dorset.

CONGERNING DE GROOT.

The Editor POPULAR WIRELESS.

Dear Sir,—With the passing of De Groot we poor "low-to-medium-brows" are deprived of one of our only too few sources of wireless enjoyment.

Some of the money which the B.B.C. expends on "stunts" might well be devoted to the retention of the services of one who has given delight to thousands of licence holders. Let us have less of divers-at-the bottom-of-the-sea, mushy relays of American programmes, and the like, and more of rational music and song which the plain man can appreciate.

To "write to your M.P. about it" would probably produce but meagre, if any, results. We can, however, write to the B.B.C. about it, so please urge your readers to write en masse—at once; a postcard would suffice, and make it clear to Savoy Hill that a large section of us is very fond of what it likes!

We count on the active support of "P.W." to help us through what appears to be the initial stages of an acute crisis in the affairs of those whose only medium of expression is through the columns of "Britain's Favourite Wireless Journal."

Yours faithfully,
J. WAYMAN.

167, Trinity Road, S.W.17.

INTERESTING TESTS.

The Editor, POPULAR WIRELESS.

Dear Sir,—I was extremely interested to read Mr. Leslie Miller's letter in your recent issue, and as I have had totally different experience with the same class of test, I think it may interest you to have the results thereof.

The apparatus, consisting of a D.E. 5B valve (which, as you know, has an amplification factor of 30) together with, first, a Weston galvanometer and, secondly, a Weston milliammeter registering on full scale deflection 5 milliamps. by tenths, was set up on a glass plate resting on a wooden table on a floor covered by linoleum, so that there can be no question of insulation. The H.T. was taken from an Exide accumulator of 50 volts.

The tests were made with varying lengths of *dry* wood, ranging from about 2 in. to 3 ft., and in each case there was hardly any deflection of the needle. The effects of static charges were negligible, and I, therefore, suggest that Mr. Miller was using damp wood for his tests, because in my experience dry wood is almost as good an insulator as ebonite. There will be a slight leak, of course, but nothing like that experienced by Mr. Miller, and if the wood is at all damp, the leak will be greater in proportion to the dampness of the wood.

Was Mr. Miller using insulated or bare wire for his tests? If the latter, the deflection of the needle would probably be caused through contact with his body.

Yours faithfully,
E. H. WOOD.

"Broadway House," Sandown, I.W.

EFFICIENT INDOOR AERIAL.

The EDITOR, POPULAR WIRELESS.

Dear Sir,—I enclose full particulars and instructions how to make and fit up a novel and very excellent indoor aerial, which I have made and used with excellent results.

I hope that this will be of some use to you, and of interest to some of the readers of your very useful paper.

(Continued on page 654.)

CORRESPONDENCE.

(Continued from page 652.)

Firstly, I purchased at a garage an old "Ford" ignition coil: this article may be purchased at most garages for about eighteenpence.

The first step is to take it carefully to pieces. Having done this, there will be found a small oblong article embedded in the pitch inside (apart from the coil). This is a condenser which consists of two strips of tin-foil (each piece of foil being between two pieces of waxed paper), rolled up. This is the only material needed, except a few rubber bands and some nuts and bolts and washers.

The condenser must be carefully unwound, care being taken to keep each piece of foil between two pieces of waxed paper. This being done, it will be found that each strip of foil between the waxed paper is of considerable length, long enough to stretch across a moderate-sized room.

A hole should be made right through the strip. This should be carefully made, to avoid tearing the strip. A screw with a washer next to the screw-head should be inserted in the hole, a nut is screwed on the screw with a washer. These washers are put on to prevent tearing the paper. A rubber band is next fixed to the screw. This is to suspend the strip from the picture-rail or wall.

At the other end of the strip a hole is made, a screw with a large washer at its head is threaded through the top layer of waxed paper, a tight-fitting washer, or, better still, a small piece of brass tapped the same B.A. as the screw is screwed up tight on to the waxed paper. This is to make contact with the foil. The screw is now put through the hole in the foil, and, as before, a piece of brass or washer is screwed up as tightly as possible without tearing the foil; and lastly the screw is put through the waxed paper and a washer and nut put on.

A rubber band and a piece of wire is fixed to the screw; the wire is for the lead-in, and the rubber band to suspend the strip.

The other strip is prepared in the same way, the lead-in is taken in the same manner as from a twin-wire aerial. The finished article will be found most efficient. I get excellent results with this aerial here at Hendon with a one-valver using reaction.

Yours faithfully,
J. S. LONGSTAFF.

"Westoe,"
Brent Green, Hendon,
London, N.W.4

A "P.W." ONE-VALVER.

The Editor, POPULAR WIRELESS.

Dear Sir,—I was rather interested in your reply to B. P. S. (Warrington), on October 9th, when he says he can only hear 6 L V and 2 Z Y on his 1-valve set. Is he living in an unfavourable spot or is the circuit he has used not so good as it might be? Since I made up a 1-valve set, published in "P.W." No. 193, I have discarded my 2-valve set, for I can plainly hear with four sets of 'phones connected London, Bournemouth Cardiff, Daventry, Birmingham, Newcastle, Manchester, Glasgow, Aberdeen Hamburg, Brussels, Radio-Paris, Hilversum, San Sebastian, Madrid, Dublin, Rome, Oslo, and several other foreign stations which I cannot discern!

Yours faithfully,
W. F. WILBEE.

Botley, Hants.

RESULTS WITH THE "RANGER."

The Editor, POPULAR WIRELESS.

Dear Sir,—Would you be good enough to allow me a little of your valuable space in which to congratulate you on your production of the "Ranger" 2-valver?

Of all the sets of 2 or 3 valves I have tried, I can honestly say that the "Ranger" beats them all. Here are some of the results obtained on Wednesday night, October 27th: Edinburgh (local), excellent on L.S.; London, good on L.S.; Hamburg, very clear on L.S.; Bournemouth, fairly good, but liable to fade; Glasgow, excellent on L.S.; Frankfort-on-Main, good and very clear on L.S. Dundee also comes in on L.S., but is jammed by the local station.

I may say I did not have to resort to the use of 'phones to tune in any of the stations, and all could be heard anywhere in the room, which is roughly 12 ft. square.

Perhaps a few particulars of my set might be of interest:

A.T.C.—Ormond square law, not low loss.

Grid leak.—Dubilier ·25 v. is found to be the best for all-round work (DX included).

Choke coil.—2 hank wound coils of 250 turns each, 28 S.W.G. wire, and connected in series.

Valves.—Det. is Ediswan A.R.D.E. L.F. Cossor Power, old type, takes ·5 amp.

Also two fixed condensers, one ·006 and the other ·01, are connected in parallel and are across the loud-speaker terminals.

Wishing "P.W." every success.

Yours sincerely,
"A RANGERITE."

Edinburgh.

TECHNICAL NOTES.

(Continued from page 602.)

place (whether it were originally good, bad or indifferent), its life will be considerably shortened, for a "dry" battery is one in which—although it is not strictly "dry"—there is a very limited amount of moisture. As soon as this moisture is all dried out, and the dry battery is really dry, its useful life is at an end. Special precautions are taken by the makers to prevent, or at any rate to retard, the drying out of the moisture in the batteries; these methods include the employment of special chemical ingredients, and the use of particular means for sealing up the cells when completed. The batteries will dry out quite rapidly enough in ordinary use, but if they are kept in a warm place, the drying will naturally be greatly accelerated. Therefore, always keep your dry batteries in a cool—though not in a damp—place.

Life of H.T. Battery.

Of course, the life of the battery will also depend upon the amount of current which is drawn from it. A dry battery, like an accumulator, has a definite "ampere-hour capacity"; this depends to some extent upon the actual discharge rate, and upon the "rest periods" between discharges. But it can only deliver a total quantity of electricity which depends upon the nature and quantity of the chemicals within it. A battery used with a set consuming 12 milliamps. in the plate circuits will not last as long as in one consuming a smaller plate current, other things being equal. In this connection, I would again remark upon the importance of using correct grid bias, which may have the effect of greatly economising H.T. battery current.

Concerning Lay-out.

In laying out the components of a set, although compactness is greatly to be desired, it is important to remember that this should not be secured at the expense of efficiency. There is a danger, when packing the components close together, of unwanted interaction being encountered, and of loss of efficiency from that and from other causes.

The necessity of arranging coils and transformers at right angles to one another is well known and does not need to be emphasised here.

Unexpected Losses.

The efficiency losses due to the presence of conducting masses in too close proximity to coils are not, however, always so carefully borne in mind by the amateur designer. This is particularly important in the case of the H.F. components, such as the H.F. coils. If any considerable amount of metal is present, either in the construction of the coils or in their immediate vicinity, eddy-currents will be set up in the metal, and these currents will represent loss of energy from the H.F. coil which may make all the difference between efficient and poor working of the set as a whole. It should also be remembered that the metal of other components, for example the shield of an L.F. transformer, will likewise act as a "sink" of energy from the H.F. coils if in too close proximity.

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R.R

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"MEET THE METER"—By P. W. HARRIS

Popular Wireless

Every Thursday PRICE 3d.

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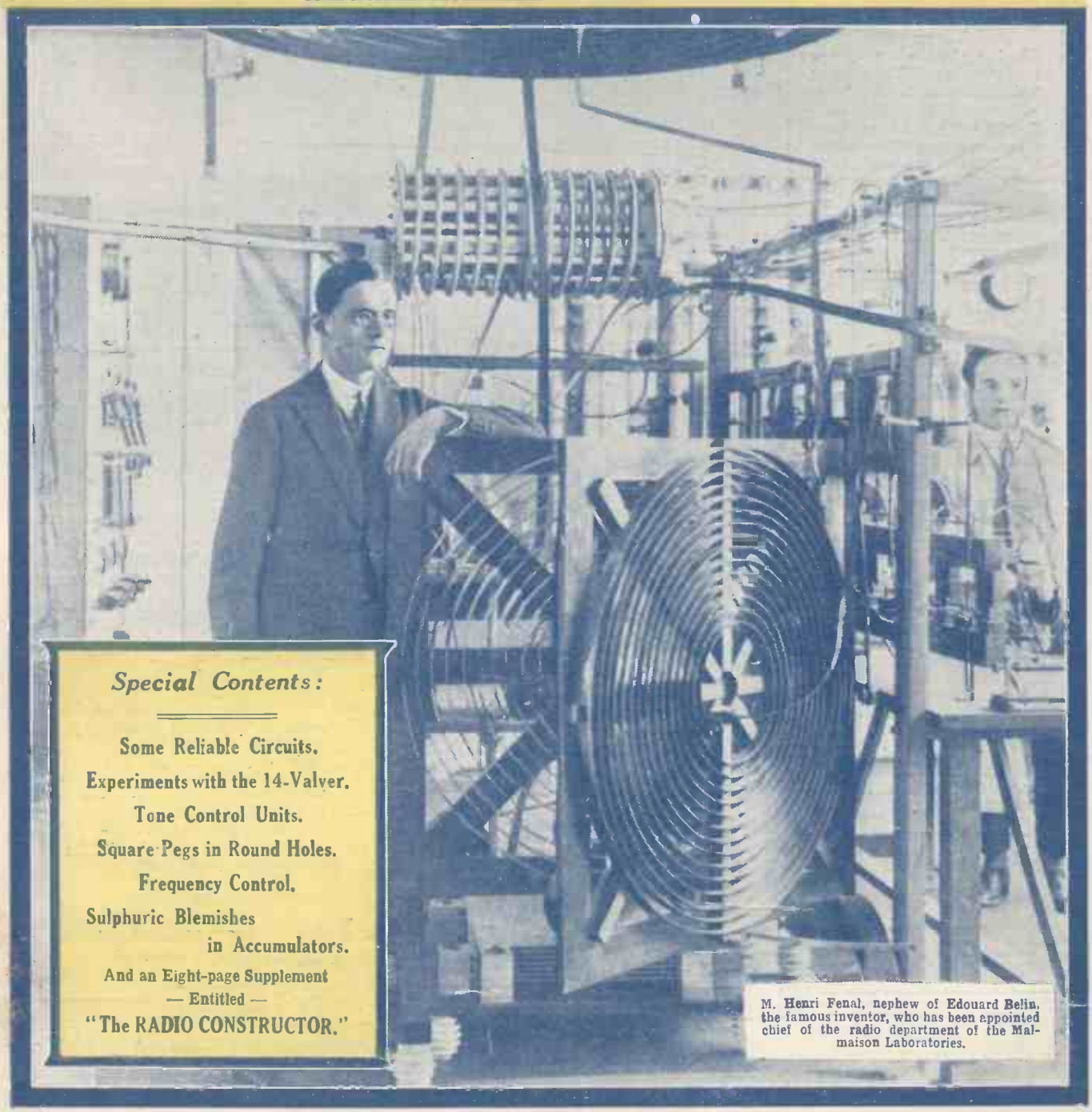

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Some Reliable Circuits.
Experiments with the 14-Valver.
Tone Control Units.
Square Pegs in Round Holes.
Frequency Control.
Sulphuric Blemishes in Accumulators.
And an Eight-page Supplement — Entitled — "The RADIO CONSTRUCTOR."

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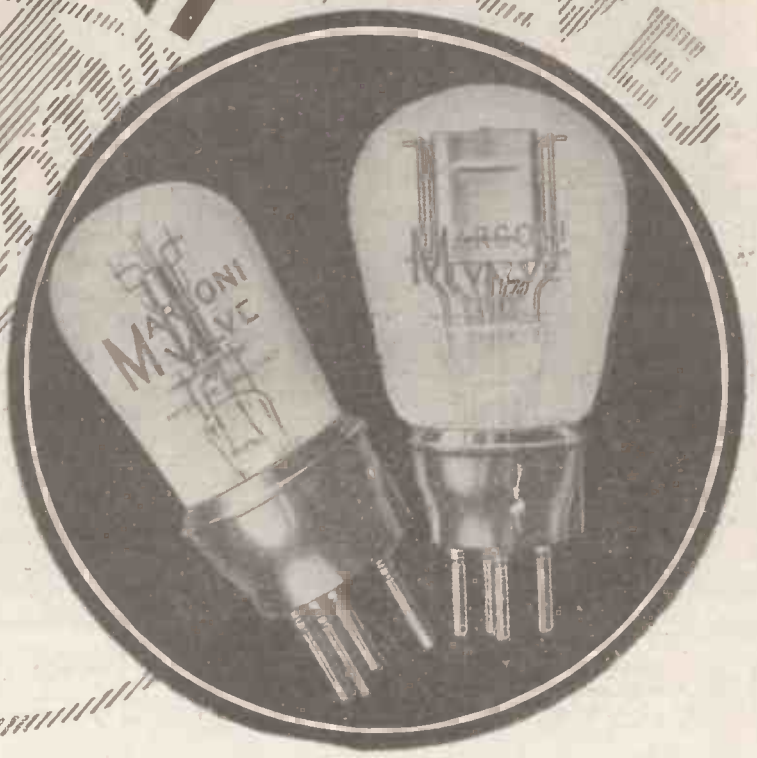
MARCONI VALVES



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	D.E.2 H.F.	Det.	1·8	0·12	+2	60	1·0	
6	D.E.2 H.F.	Det.	1·8	0·12	+2	60	1·0	2 v. acc.
	D E.2 L.F.	L.F.	1·8	0·12	−4·5	80	1·2	
15	D.E.2 H.F.	H.F.	1·8	0·12	0	60	0·8	
	D.E.2 H.F.	Det.	1·8	0·12	+2	60	1·0	2 v. acc.
	D.E.2 L.F.	L.F.	1·8	0·12	−4·5	80	2·0	
17	D.E.8 H.F.	H.F.	5·8	0·12	0	80	1·1	
	D.E.8 H.F.	Det.	5·8	0·12	+2	80	1·6	6 v. acc.
	D.E.8 L.F.	L.F.	5·8	0·12	−6	100	3·0	

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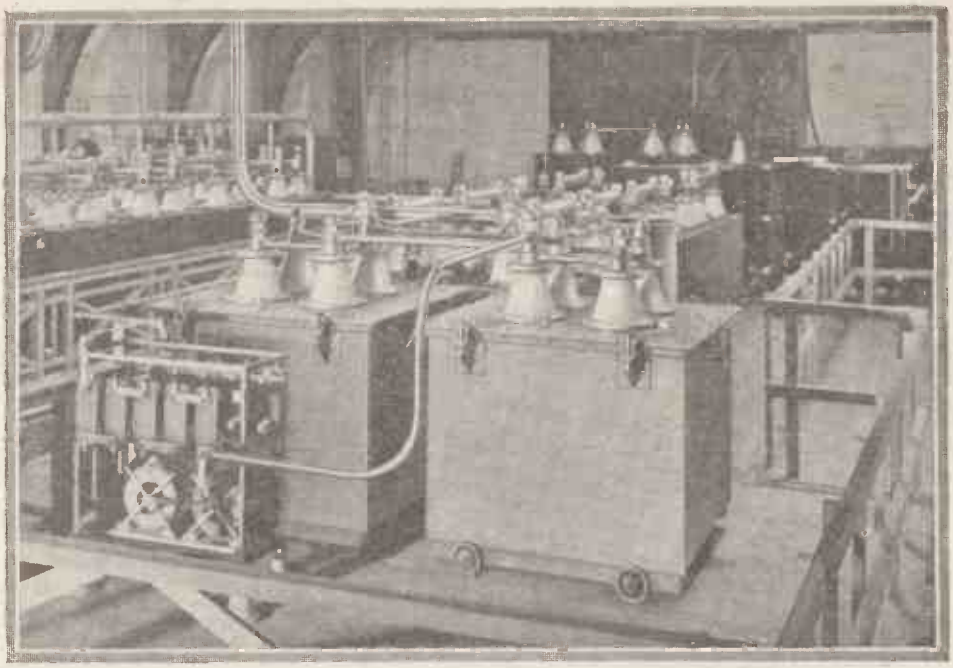

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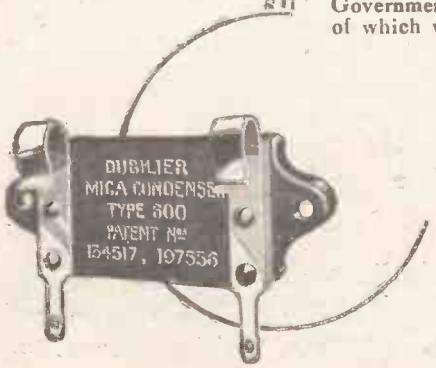

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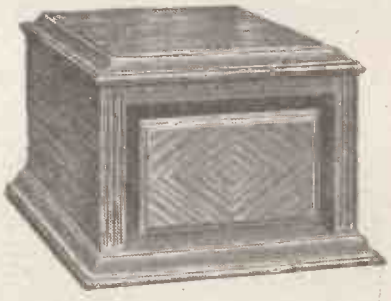

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Q

In addition to the Cabinet, there are eight other Brown Loud Speakers—a type for everyone from 30/- to £15 15 0.

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Gilbert Ad. 6366

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Power Valve
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THE merry-go-round—a symbol of wasted 'horse' power! In almost every branch of Industry waste plays a dominant part. The smoke pall which hangs over our big cities is wasted energy. Scientists tell us that in ten years' time the waste gases from our factory chimneys will be harnessed and converted into power. In your own home perhaps, you may have a grate which burns a lot of coal yet does not heat the room. Another case of wasted energy.

Again, take your own Wireless Set. Your valves may consume a lot of current and yet not give you good results. If they are bright emitters it will be necessary for the working temperature of their filaments to be raised to a white heat—otherwise the vital stream of electrons will not be emitted. Clearly a case of wasted energy because now a new filament has been invented by Cossor which gives off a terrific emission practically without heat. When the new Cossor Point One Valves fitted with Kalenised filaments are working not the slightest glow is visible.

Great heat, therefore, in a valve is no longer essential. Its destructive influence has been eliminated in all the new Cossor valves. Heat causes crystallisation. After a little while the filament becomes brittle—the constant stretching and contracting has altered the molecular structure of the metal. Eventually it snaps—and your valve is useless.

The Cossor Kalenised filament is one of the greatest advances in valve manufacture. Not only does it mean an abnormally long life, but it cuts current consumption down to a tithe of what was necessary a year ago, For example, the accumulator large enough to last a 2-valve Set for 10 hours with bright emitters would last more than 200 hours when Cossor Point One valves are used.

Think! 190 hours free broadcasting every time your accumulator is charged. Charge your Accumulator once every two months instead of each week. Surely this worth-while economy will make you change over at once.

But even economy and long life do not exhaust the advantages of these new Valves. You'll obtain a volume and mellowness of tone which will surprise you. Owing to the low specific resistance of the Kalenised filament, an exceptional length is used. This in turn means obviously a greater area of emission surface. And a prolific emission, properly controlled, means a better valve.

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Popular Wireless

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RADIO NOTES AND NEWS.

The New Wave-lengths—Radio Programmes on Telephone Lines—Community Singing—Murder Trial Broadcast Stopped—Radio Fund to Go like Road Fund?—The Piccadilly Programmes.

The New Wave-lengths.

WHEN announcing that the Geneva Wave-length Plan would come into operation upon November 14th, the B.B.C. notified listeners that reports upon the working of the scheme would not be required for two weeks. In other words, they expected a pandemonium fortnight, during which the black sheep amongst Europe's 200 broadcasting stations would stray off their own wave-length into pastures forbidden!

"John Listener."

AT the end of the fortnight probably, we shall all have requests from our local stations for reports upon reception. Till then it's a waste of time to write, but as soon as the word "Go" is given, the reports from listeners will doubtless prove of very great value. For, however well the B.B.C. engineers do their job, they can never hope to keep such a sharp look-out as "John Listener"!

"N" Circuit in N. Devon.

WRITING in praise of the 2-valve "N" circuit, described in "P.W." No. 224 (Sept. 18th issue), a Parracombe, N. Devon, listener says that for 5XX he uses a 525 coil (500 will do) in the N position, with a 200 in the ACE position. "In conjunction with B5 and B6 valves, the set produces far more volume from an Amplion A.R. 19 L.S. than any straight 2-valver I have come across," he says, "and the quality is very pure."

Radio Programmes on Telephone Lines.

ANY Dutch telephone subscriber can now listen to broadcasting without a receiving set for thirty shillings a year. The Paris, Daventry or Hilversum programmes are picked up centrally, and "laid on" to all telephone users who subscribe to the service.

If, in the middle of the programme the 'phone is needed, the broadcasting is automatically cut off.

Aerial Slashing.

"AERIAL slashing is still going on in Norwood," writes a "P.W." reader from that salubrious suburb. "But," he adds darkly, "if I find anybody trying to slash my aerial, I'll slash him to earth!"

Community Singing.

COMMUNITY chorus singing, by an Albert Hall audience, is to be broadcast on Saturday next (November 18th). The concert is to inaugurate a National Community Singing Movement, and in addition to the chorus singing by the entire audience, there will be the added attraction of the Royal Albert Hall Orchestra under Sir Landon Ronald, Miss Florence Austral, Mr. John Goss, and Mr. Norman Allin.

A Presentation Wireless Set. The three-valve receiver presented to Mr. J. Eccles (right) on completion of 50 years' service as organist at Farnworth.

All London Hospitals Now Have Radio.

"HATS off" to the "Daily News" Wireless for Hospitals Fund. Opened in May, 1925, to provide wireless for each individual patient in the voluntary hospitals of London, it has equipped 122 hospitals, the total number of beds provided with programmes being 15,781. A total of £25,436 0s. 4d. was subscribed, and every penny has been expended upon equipment, bar £128 13s. 9d., which balance is being presented to the Home Secretary for the wireless equipment of Borstal establishments.

Magnificently conceived, and brilliantly executed, the Fund proves that the spirit of Charles Dickens, founder of the "Daily News," still lives to alleviate suffering.

Better Terms for Radio Artistes.

A SCHEME has been evolved to make broadcasting artistes independent of the stage. In future, engagements may be made for a week's microphone "turn." instead of just for half an hour. The artiste's first night will be at, say, London, the next Glasgow, and so on, the salary paid being as good as the halls can offer.

WPG.

SIT-UP-LATES who were combing the ether at midnight a couple of months ago, reported that WPG, the American broadcasting station, was coming over exceptionally well. The call-sign letters stand for World's Play-Ground, and the station itself is situated half a mile out in the Atlantic Ocean, at the end of the pier at Airport, Atlantic City, N.J. Just recently all the trans-atlantics have been more elusive, but even so I occasionally hear from "P.W." readers who can get WGP quite clearly on a couple of valves.

The Piccadilly Programmes.

DE GROOT'S disappearance from the programmes raised a controversy that continues to flare up. Recently Mr. J. H. Squire—whose Celeste Octet is another prime microphone favourite—came out with the statement that the B.B.C. had created him fairly enough. In fact, Mr.

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

Squire stated "the members of my Octet get for 30 minutes' broadcast three times the amount they would earn in a theatre for three hours' work. After all, fair's fair!"

A Queer Coincidence.

A QUEER radio coincidence has just recently been reported from Antwerp.

A listener there switched on his wireless set (which was tuned to 5 X X), and then picked up a South African newspaper to read. As his eye took in the words "The Gila Monster wears a flashy suit of orange and black," those identical words were spoken to him by the loud speaker!

It gave the listener quite a creepy feeling, to sit in Antwerp and hear an English voice speaking exactly the same words as he was reading from the South African paper in his hand!

The Explanation.

THE explanation shows how all the world is inter-woven nowadays. Originally the words were from an article by L.G.M. in the "Daily Mail," and the South African paper has quoted the story.

As L.G.M. himself is a once-a-week uncle at 2 L O and 5 X X, he also quoted his own work one day to the kiddies, with the result that a man sitting in Belgium, and reading a South African newspaper, heard by wireless the very words he was reading being spoken in England.

"Ariel's" Announcements.

I HAVE been asked to make the following announcements:

A Radio Exhibition has been organised by the Canterbury and District Radio Society. It will be held in Canterbury on November 25th and 26th.

CALL-SIGNS: 6 N G, Mr. N. E. Haigh, 16, Fairfield Road, Bridlington, 45 metres, 10 watts; 5 X H, Mr. L. W. Hooke, 87a, Haverhill Road, Balham, S.W.13, 90 and 150/200 metres. (Now testing.)

Radio for the Blind.

THE British idea of allowing blind listeners to receive radio programmes without a licence has been carried a step farther at Danzig. Here the fee is remitted, and the G.P.O. has organised a fund to provide sets for the blind. Boxes for voluntary contributions have been installed at the post offices.

Silver Cup for Constructors.

TWO silver cups are being presented by POPULAR WIRELESS in connection with the Amateurs' Competition at the Hull Wireless Exhibition. This show is due to commence upon December 4th, and to close seven days later, and full details will be announced in due course.

Hearin' Erin.

THE Irish Free State Minister for Posts and Telegraphs (Mr. J. Walsh) stated recently that within the next fifteen months every home in the Free State would be within crystal range of a broadcasting station. Cork Gaol, which has not accommodated prisoners for some time, has been chosen for one of the sites.

It's All Wrong.

SIR THOMAS BEECHAM, despairing of English music, English opera, British audiences, concerts, *everything* musical, in fact, puts the whole trouble down to one thing—broadcasting!

"When the Government subsidises anything, what does it do?" quoth the good Sir Thomas. Not waiting for a true answer, he goes on: "It subsidises a mechanical invention. Broadcasting!"

As musical instruments are mechanical inventions, and the Government does *not* subsidise broadcasting, Sir Thomas seems to have "missed the boat" somewhere!

Canada Calling.

THE total number of radio transmitters in Canada is now 543. Of these, 67 are broadcasting stations, another 67 communicate with points abroad or in the Dominion, and 356 are operated by amateurs or experimenters. The remaining stations are operated for communication with ships, or to provide an "aid to navigation" service.

Murder Trial Broadcast Stopped.

EVEN American listeners were surprised when it became known that arrangements had been made to broadcast a murder trial there. The long-postponed trial of Mrs. Hall and her two brothers, for the murder of the woman's husband and Mrs. Mills—his "soul mate"—had aroused public interest to an unprecedented degree.

But although listeners were morbidly fascinated by the arrangements to put the trial "on the ether," it was generally felt that such a use of broadcasting was a debasement of the science of radio, so the proposal was dropped.

Everywhere the Same.

THE Berlin magistrates recently fined nearly two hundred listeners for operating or owning wireless sets without licences. If the fine was not forthcoming because the listener could not find the marks, he had to go and mark time at the gaol for fourteen days!

Radio Fund to go like Road Fund?

THE wireless League is doing good service in calling attention to the manner in which licence money is being appropriated. The League estimates that by the end of the year a little matter of £900,000 will have been retained by the Post Office, just at the time when all the licence money is really required to develop the service for which listeners have paid.

If a fraction of this amount were to be spent on a short-wave station, to keep our overseas kin in touch with Britain, it would not seem so unjust. But will the money be spent wireless-ly at all? It seems unlikely—and unfair.

Wireless on the Coffee Stall.

AN enterprising stallkeeper in South London is attracting customers by radio. He has a wireless set and loud speaker mounted upon his coffee-stall—and no "grounds" for complaint the customers say.

Welcome for Wrong Man.

QUITE a comedy of errors arose out of the visit to London of Dr. Richard Strauss, to conduct his own music at the Albert Hall.

B.B.C. officials were waiting at Liverpool Street for the boat-train, and later the German ambassador turned up and waited too.

When the train pulled in the ambassador welcomed a distinguished-looking arrival, and was taking him to the Embassy car when the B.B.C. officials approached and asked where Dr. Strauss was going. "This is not Dr. Strauss," explained the ambassador. So there was a rush down the platform, and eventually the great composer was found in company with a porter, struggling with luggage and the English language!

SHORT WAVES.

"Mr. Henpeck has a filament switch on his four-valver. He makes full use of its cutting-off powers when a talk is being made by a lady lecturer. He says that it is the only means he knows of to cease female eloquence."—"Popular Radio Weekly."

* * *

A suggestion was recently made that London should have a radio theatre, in which one could dine and dance and listen to the wireless. We thought there would be a catch in it.

* * *

"A scientist says that plants can be tickled. A suburban correspondent asserts that his aspidistra laughed outright at something said on the loud speaker."—"Humorist."

* * *

"Cost of ruining a wireless set." (Headline in Electrical Paper).

A fairly cheap way is to give it to the youngest son to play with.

* * *

"Owing to lack of space, the radio programme is postponed until next week." (American Paper).

The American ether is a bit overcrowded.

* * *

The "Evening Standard" states that when asked to name his favourite piece to be broadcast, Lord Hawke confessed an affection for an old-fashioned ballad entitled: "Where is another so sweet as she?" adding: "I was a bit of a warbler myself."

Which bit?

* * *

Headline in "Glasgow Weekly Herald." "How you miss your stations." This would be a good title for a "Talk" to railway passengers.

* * *

'Not too familiar. It's all right to have a loud speaker in the house if you are not married to it."—"Cincinnati Enquirer."

* * *

"The licence fee is not a tax, but it is voluntary payment by the individual listener for the services which the Broadcasting Authority renders, and we feel that no Government has the right to take such fees."—Newcastle Daily Journal and North Star."

That's just what we think.

* * *

"Somewhere a face is calling." (Headline in "Daily Mail.")

Even this might be preferable to some of the voices which do.

TECHNICAL TERMS ILLUSTRATED.

The Plate.

A LADY got very irate
Because her old man
stayed out late,
So she sat up one
night,
And gave him a fright,
By hurling at him a big

ARIEL.

SQUARE PEGS IN ROUND HOLES

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

HOW often we come across the phrase, "Square pegs in round holes," that I have chosen for the title of this article. It obviously signifies that there is a misfit, either intentional or unintentional, and it is really surprising how many misfits we find in connection with the problems of wireless reception. It may be argued that a receiver is as good as its components, but this will not be true unless the components are correctly laid out and wired to a definite prearranged plan, and thus made to perform their respective functions in a satisfactory manner.

Each portion of your set must act in harmony with the other portions, and to further this ideal we must choose that all-important component, the valve, so that the work it is called upon to do will be executed efficiently. The beginner, or for that matter the average wireless enthusiast, is often at a loss to decide on the valves to purchase for use in his latest receiving set, and there is, perhaps, a justifiable excuse when we think of the vast number of valves on the market, most of which boast of particular markings or designations which give little indication of their specific purposes. However, this is mitigated to a certain extent by the more complete data now being furnished by valve manufacturers, and which should be studied carefully by all prospective purchasers of valves.

Valve Characteristics.

Some designers prefer to choose the valves to suit the components incorporated in the receiver, while others vouch for the principle of designing the circuit, choosing the valves and then buying the components to match the valves. Whichever method is adopted, there are certain fundamental principles which must be clearly borne in mind in order to get the best results.

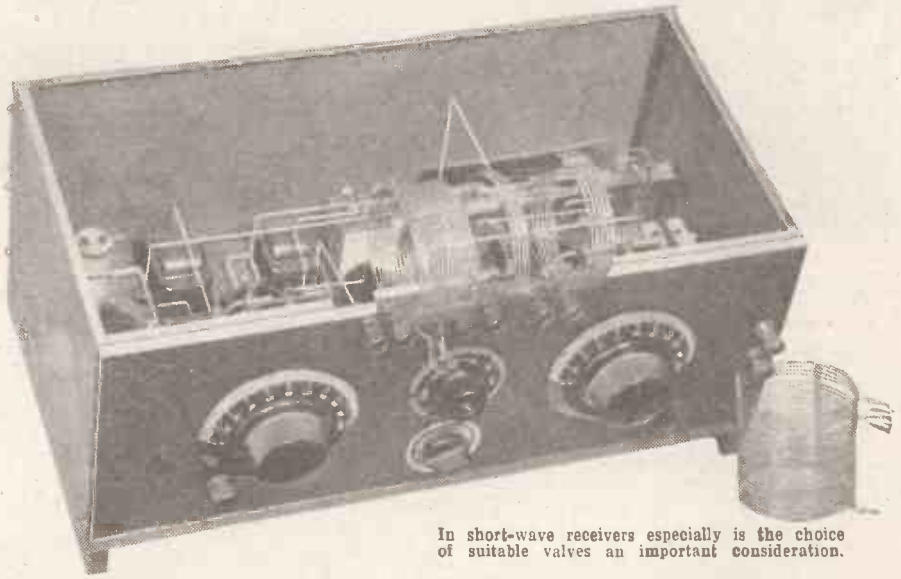
There are two main constants to consider quite apart from details of filament current and voltage, plate current and voltage, etc., although, of course, these last-named details must not be overlooked when the capacities of the batteries and accumulators have to be reckoned. The two terms which I have in mind are impedance and amplification factor, so let us digress for a moment to see what they actually mean. When a current is passed through a valve filament an enormous number of minute particles of negative electricity are "boiled off" from the filament surface, and if the plate or anode is given a positive voltage with respect to the filament a large number of these minute particles will be attracted to the plate to form the plate current. Now this plate current is influenced by the voltage variations brought on to the grid when receiving the wireless signals, and this change in plate current is greater than would be the case if the signal voltage was applied in the plate circuit.

The Valve's Three Functions.

It is this increased change which gives us a measure of the amplification brought about by the valve and its associated apparatus, and has been popularly called the amplification factor.

The impedance may be regarded as the "resistance" offered to the flow of these minute particles of electricity between the filament and the plate, and although it is just a simple value expressed in ohms, the factors influencing the final determination of this quantity are somewhat complex. As a guide to the expected performance of a valve both these quantities must be considered *together* in their proper relationship if the best results are desired.

Let us consider the main functions of valves—to detect wireless signals and also to amplify them either before rectification takes place (i.e. H.F. amplification) or after rectification (i.e. L.F. amplification). Dealing with the first-named, it is usually found with most British valves that they will detect best (if the grid leak and condenser method is employed) when the end of the grid leak remote from the grid is joined to the filament leg connected to L.T. positive. This brings the valve to its most sensitive condition.



In short-wave receivers especially is the choice of suitable valves an important consideration.

Useful Rectifiers.

Valves which are included under the heading of general purpose valves are frequently used for the rectifying position, and the amplification factor varies between about 6 and 10, with an impedance generally within the limits of 17,000 to 30,000 ohms. If the rectifier is followed by a transformer-coupled L.F. amplifier of low step-up ratio use the higher impedance valve, but if the step-up ratio is high, then a lower impedance can be chosen. For the anode current or anode bend method of rectification, which is

(*Continued on next page.*)

SHORT-WAVE NOTES.

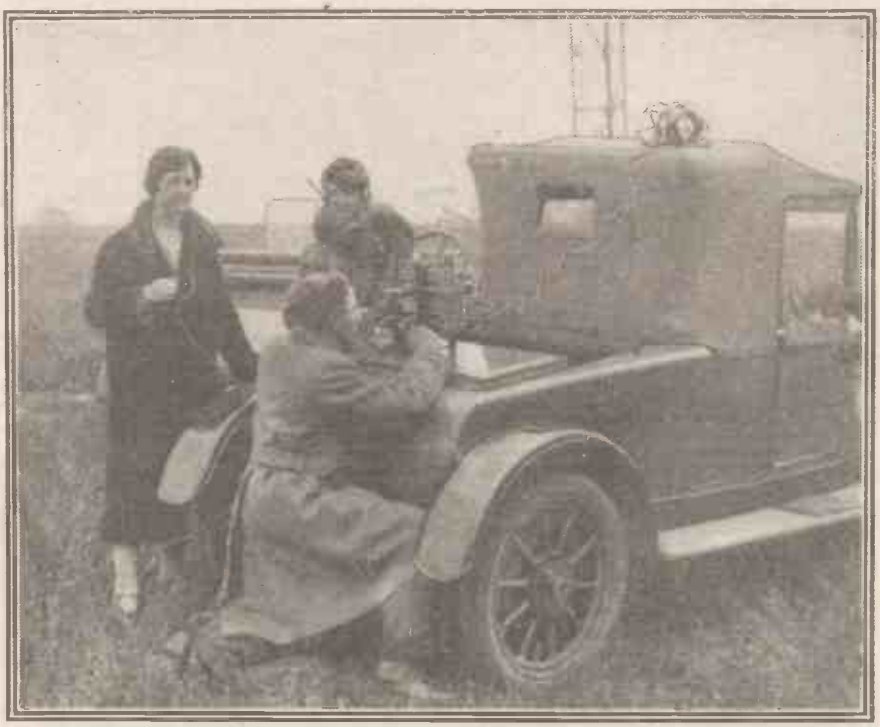
By E. J. SIMMONDS, M.I.R.E., F.R.S.A.
(Staff Consultant.)

DURING the past month the reception conditions on short waves have been passing through a period of great irregularity characterised by periods of intense atmospheric interference not usually experienced at this time of year, and the "skip" distance phenemona has also been modified in an unusual manner.

Observers have often noticed the great weakness of received signals from *local* stations transmitting in the 30 to 40 metre band, and this is the *normal* conditions to be expected from such frequencies. Take, for example, the test signals which have been sent out from the writer's station, G 2 O D, on 32·25 metres for some considerable time.

The large volume of reception reports to hand indicate that the signals are practically inaudible in this country after a range of from 15 to 20 miles from the station, and doubtless the reception obtained within the 20-mile area is by virtue of the horizontal ground wave, which, as we know, is quickly absorbed.

Beyond the range of 20 miles, therefore, there comes a wide zone where normally no reception of these signals is possible, until the zone is reached where the first reflection of the angular ray from the Heaviside layer occurs. This distance from the transmitter varies seasonally from approximately 500 miles in full summer to 2,000 miles in mid-winter, the reason being that during the winter months the ionised upper layers of the atmosphere which bend the angular wave from the transmitter back again to the earth, are normally much higher and this condition favours longer "skips" and better reaching out for low-power transmitters. Now, during the past month, these conditions have been considerably modified and reports have been received from stations in the British Isles *outside the 20-mile zone, who normally hear nothing* of the 32-metre transmissions from G 2 O D.



A portable crystal set that was used with great success during a recent test—*underneath* 5 X X's aerial.

DX Difficult.

Many of these reports are on telephony transmissions, which is all the more remarkable, inasmuch as they emphasise the extreme clarity of the speech, and strength.

All this points to a reflecting ionised layer very close to the earth, which has temporarily cut out the usual "skip" distance, and it is also worthy of note that during these conditions the writer has had considerable difficulty in working over *long distances*, say, to New Zealand, Australia, etc., We do know that during this period electrical storms have been unusually active throughout Europe and also Northern America, and there may be some obscure connection between the recent abnormal behaviour of these high-frequency radio waves and the electrical storms. Incidentally, those readers who so kindly from time to time forward detailed reports on my transmissions will see how useful they are under these circumstances.

SQUARE PEGS IN ROUND HOLES.

(*Continued from previous page.*)

sometimes employed when strong signals are possible and greater purity is desired, special valves are generally used of the Q.X. and D.E.Q. class, but for the more usual method of rectification many come to mind such as' the D.E.R., D.E.11, B 3, H.L. 310, D.E.8 H.F., A.R. ·06 (red line).

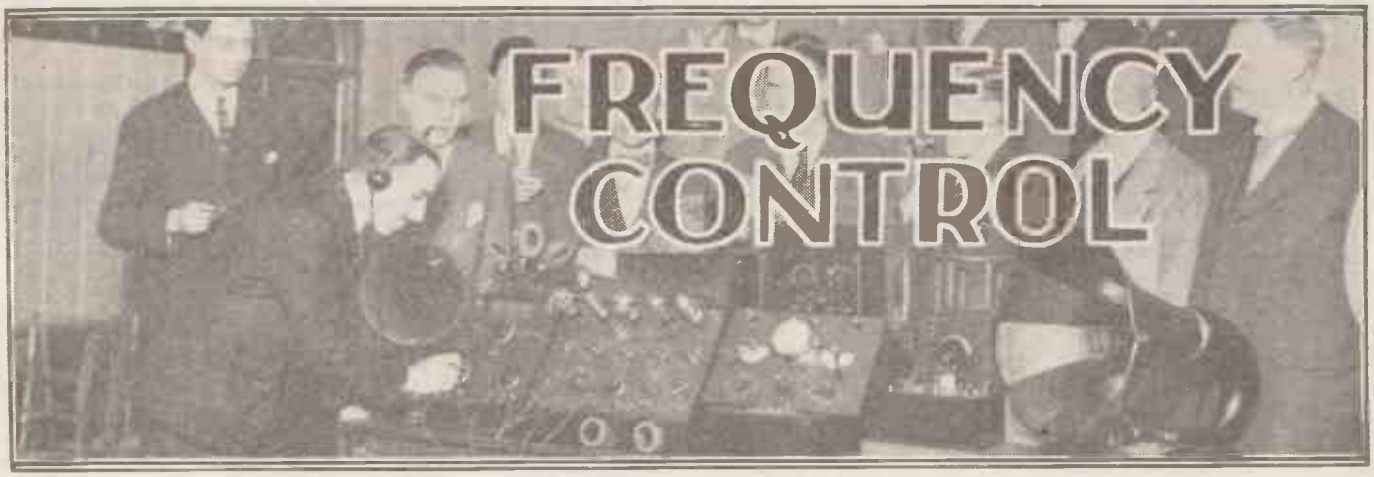
Coming now to H.F. amplification, it is safe to say that the chief requirements are a comparatively low self-capacity and a fairly high impedance to avoid uncontrollable oscillation. Too high an impedance is somewhat of a disadvantage, as it necessitates the use of high plate voltages, but on the other hand too low an impedance renders the set unstable unless special precautions are taken, so that a happy medium is generally chosen between 30,000 to 50,000 ohms. The amplification factor rules higher than in the case of the general purpose valves, since the object is to secure the maximum amplification of weak signals, and most of the valves will be found to fall within the limits of 10 to 17. Suggested valves are the D.E.2 H.F., D.E.8 H.F., A.R. ·06, S.P. 18 (green spot), H. 512, etc.

It now remains to deal with L.F. amplifiers, and perhaps the main problem is the avoidance of distortion. To this end it should be borne in mind that a good power valve should have a low value of impedance and amplification factor. It is often thought that a "power" valve is one which will make signals very much louder, but the true conception is that the valve will deal with louder signals without any accompanying distortion.

Resistance Coupling.

The application of grid bias is essential to bring the working point of the valve to the condition when *no grid current will flow*, otherwise the incoming signal will be upset, and the valve must possess a long, straight portion of the characteristic to deal with the powers handled. By making the impedance low the resultant anode current is of sufficient magnitude to operate the loud speaker. For transformer-coupled low-frequency amplifiers the amplification factor usually lies between 5 and 7, with an impedance between 5,000 and 8,000 ohms, and suitable valves are P.M.4, L.525, B.4, L.S.5, S.P.18 (red spot), P.V.5 D.E., D.F.A.O, etc., with, say, an L.S.5A for very large powers.

In the case of resistance capacity and choke-coupled amplifiers the problem is modified somewhat, as there is no transformer step-up effect present, and consequently the valve must be called upon to furnish a higher voltage step-up than in the previous case. For this purpose the valve *followed* by resistance or choke amplification should have a high amplification factor, but the impedance must not be too large, otherwise the H.T. value becomes excessive. The amplification factor is generally of the order of 20, with an accompanying impedance of about 30,000 ohms or slightly higher, and suitable valves may be chosen from the D.F.A.4, D.E.5.B., D.E.3.B.; etc.



FREQUENCY CONTROL

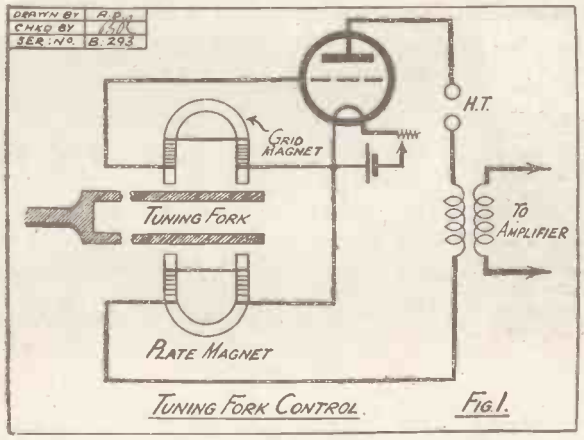
The Importance of Stabilising the Carrier Wave at a Constant Frequency is Dealt with in this Interesting Article.

By SEXTON O'CONNOR.

LISTENERS who anticipate a time when it will be possible to enjoy any programme, far or near, without interference, are apt to overlook the fact that this is not simply and solely a question of further improvement in the design of super-selective receiving circuits. With the present state of congestion in the ether, the limits of clear-cut reception depend to a very large extent upon what is happening on the transmitting side.

This does not mean to say that selectivity on the receiving side has now reached high-water mark, although it must be admitted that no very startling developments have been made in this direction within the last twelve months or so. It is rather intended to emphasise the necessity and value of the work at present being carried out by the International Broadcasting Bureau in reorganising and standardising the wave-lengths used by the various transmitting centres at home and on the Continent.

In this connection it must be borne in mind that the proposals of the Bureau have only been made feasible by the discovery of ways and means for ensuring that once a station has been allotted a given carrier-wave it shall be definitely stabilised once and for all at that constant frequency. The wave-length scale is now divided up into such narrow zones that even slight fluctuations in frequency are bound to give rise to serious heterodyning with other stations and consequent disturbance over a wide area.



TUNING FORK CONTROL. FIG. 1.

Mechanical Methods.

It is a curious fact that the most efficient methods so far discovered for stabilising the frequency output of a transmitter depend, not upon purely *electrical* methods of tuning an oscillatory circuit by inductance and capacity, but upon some form of *mechanical* vibrator, such as the use of a standardised tuning fork, or the peculiar oscillations of a piezo-electric crystal.

In the case of an ordinary valve oscillator with tuned input and output circuits, it might be expected that so long as the inductancy and capacity values of the external circuits were kept steady, a constant frequency output would be maintained. In practice, however, any variation in the supply of plate or filament voltage, or any alteration of the load on the H.F. generator due, for instance, to modulation at audio-frequency, or to the effect of rain or wind on the aerial, will inevitably cause slight variations in the frequency output unless some automatic form of frequency control is applied to the circuit.

One type of mechanical constant-frequency control still used in high-powered transmission is the tuning-fork system due to Professor Eccles, shown in its simplest form in Fig. 1.

The two legs of the fork actually form a mechanical back-coupling link between the grid and plate-circuits of a valve, with the result that the frequency of the oscillatory current in the plate circuit is maintained in step with the bodily movements of the fork. It will be seen from the Figure that the prongs of the fork are located between two magnets, one in the grid circuit and the other in the plate circuit.

Using the Harmonics.

As the upper prong moves nearer the poles of the grid magnet, the magnetic flux through the pole windings is increased, giving rise to a voltage "kick" on the grid. This causes a corresponding increase of plate current which, as it flows through the plate magnet, causes the latter to attract the lower prong, thereby maintaining the vibration of the fork. The operation of the system as a whole is thus bound up with and controlled by the vibratory movement of the tuning fork.

It is, of course, obvious that no tuning fork could be made to vibrate at anything approaching the enormous frequencies used in wireless transmission. This difficulty is overcome by designing the fork so that it will vibrate at an absolutely constant rate of, say, 250 times per second, and then building-up harmonics of this fundamental vibration until the desired frequency is attained.

For instance, by taking the eighth harmonic of the 250-cycle fork frequency oscillations of 64,000 per second are obtained, corresponding to a wave-length of approximately 5,000 metres. Similarly, if the tenth harmonic is chosen, the wave-

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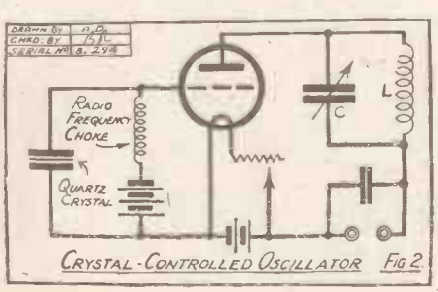
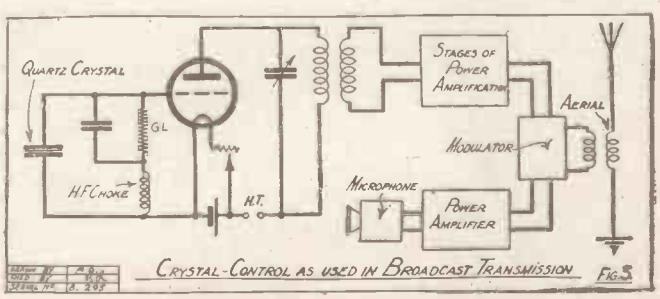


CRYSTAL-CONTROLLED OSCILLATOR FIG. 2



CRYSTAL-CONTROL AS USED IN BROADCAST TRANSMISSION FIG. 3

FREQUENCY CONTROL.

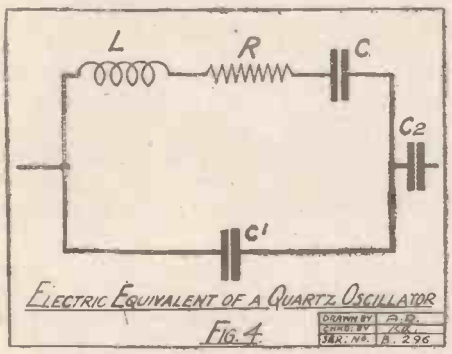
(Continued from previous page.)

length is reduced to a constant value in the neighbourhood of 1,000 metres.

In practice, harmonics are produced by applying the fundamental frequency to a valve, the grid potential of which is adjusted near the lower bend of its characteristic curve. In these circumstances the output current of the valve instead of being a pure sine curve is converted into a wave form extremely rich in harmonics. The required harmonic is separated out by means of a suitable filter circuit and is then amplified by a series of power amplifiers until it reaches the aerial.

The Quartz Crystal.

The elastic vibrations of a quartz crystal, under the influence of an applied oscillating E.M.F., form a still more efficient system of master control, particularly for the shorter wave-lengths used in broadcasting. The natural frequency of such crystals is so enormous that it is possible to cause them to vibrate at the actual radio-frequency



ELECTRIC EQUIVALENT OF A QUARTZ OSCILLATOR

FIG. 4

required, although for very short wave-lengths it is usual to select the first or second harmonic of a more massive crystal.

The crystal period is dependent upon the thickness of the quartz, and varies with different specimens from a wave-length of 100 to 150 metres per millimetre of thickness. When used as a frequency control, the action of the crystal can best be explained by saying that it sets up a vigorous voltage reaction, due to its piezo-electric property, at one particular frequency and at no other.

Fig. 2 shows an arrangement in which the crystal is inserted in the grid circuit in shunt with a biassing battery and a radio-frequency choke. The natural frequency of the choke should be very different from that of the quartz, so that it does not interfere with the selective action of the latter.

Master Control.

When the plate circuit L, C is tuned to the frequency of the crystal, sufficient grid current will flow to maintain the valve in oscillation at that frequency. If the plate tuning is altered, the "piezo" voltage response of the crystal ceases and oscillation immediately stops.

Fig. 3 shows a slightly different arrangement in which the crystal is shunted across a grid condenser and leak in series with a choke. The action is, however, identical with that previously described.

At a broadcast station the output from the master-control valve is passed through a series of graduated power amplifiers to be built up to the required output to the aerial, the audio-frequency from the microphone being applied to the modulating valve after similar amplification as shown.

An Electrical Arrangement.

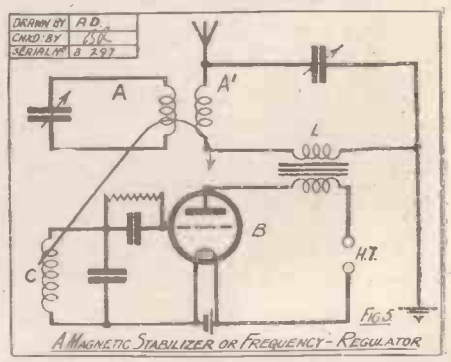
The action of the quartz oscillator has recently been thoroughly investigated at the National Physical Laboratory, where it has been shown to behave as the electrical equivalent of an inductance L, Fig. 4, resistance R, and capacity C, in series, and all in shunt to a capacity C1. The capacity marked C2 represents the capacity of the air gap of the actual crystal mounting.

Attempts have also been made to devise automatic master-control systems which depend for their action upon purely electrical methods for stabilising the frequency output.

In the arrangement shown in Fig. 5 a steady source of oscillations A is coupled with the aerial system A1 and also with the input coil C to a detector valve B. The circuit A is deliberately set to a slightly different frequency from that of the aerial circuit, so that a beat note is created which, in turn, determines the value of the current flowing in the plate circuit of the valve B.

The plate current passes through an iron-cored coil L, coupled to the aerial, and normally saturates it, so that the winding offers practically no impedance to the flow of the H.F. currents in the aerial circuit.

If, however, the frequency of the aerial circuit alters for any cause, such as wind or rain, the beat note with the circuit A changes accordingly, and reduces the value of the current flowing through the windings L,



A MAGNETIC STABILIZER OR FREQUENCY-REGULATOR

FIG. 5

below the point at which the core is magnetically saturated.

This at once tends to throw a larger effective impedance into the aerial circuit, because the H.F. currents flowing on that circuit must now vary the magnetic flux about the windings L. In this way the valve B acts as a brake to prevent frequency-fluctuation, or in other words it acts automatically to stabilise the system.

A DUAL ADJUSTMENT DETECTOR.

By J. F. C.

CRYSTAL enthusiasts who are on the look-out for a ready means of delicately adjusting perikon rectifying combinations of all types will be interested in the dual adjustment detector which is illustrated in the diagram herewith.

A really first-class perikon combination of tellurium-zincite should, for ordinary use, require no dual adjustment. In such cases, it should be sufficient to allow the zincite element of the detector to remain in a fixed position, whilst the tellurium crystal cup only is made adjustable.

Easy to Make.

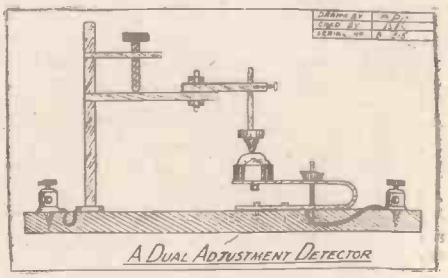
With less efficient combinations, however, for very delicate work, and also for testing out the oscillation generating possibilities of new crystal combinations, it is very convenient to have at hand some apparatus in which both sides of the crystal contact are adjustable.

Such a condition of affairs may readily be achieved by the use of the present detector.

As will be seen from the illustration, the detector is based on the principle of the old heavy brass detectors, which were in common use in pre-broadcasting days. Such detectors comprised a metal pillar from which projected a support for the crystal cup, and also an arm through which an adjusting screw was placed.

Detectors of this type can still be obtained very cheaply from firms supplying second-hand apparatus, and, on the other hand, the amateur with facilities for a little brass working will not find it a difficult matter to construct one for himself.

In the present dual adjustment detector, the bottom crystal cup is not fixed. On the contrary, it is mounted on a piece of



A DUAL ADJUSTMENT DETECTOR

springy brass. An adjusting screw for this latter is provided, as shown in the diagram.

The instrument is a very useful one for serious work, and therefore its employment is recommended for the purpose of the amateur who is carrying out experimental work in the realm of crystal rectifying contacts.

TONE CONTROL UNITS

By O. J. RANKIN.

TONE purity includes finding, by practical tests, the most suitable shunting capacity for the loud speaker, and not, as many beginners imagine, mere tinkering with plate voltages, grid bias, etc. Different loud speakers require different shunting capacities; this does not mean that a definite capacity may always be used with a particular type of loud speaker,

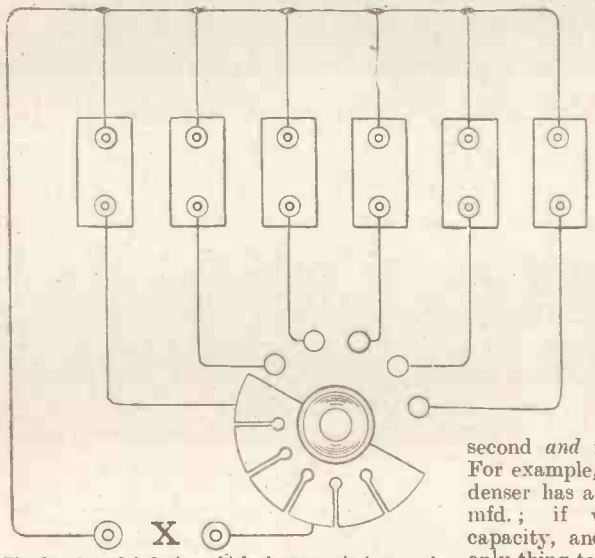


Fig. 1. A useful device which, however, is improved upon in Fig. 2.

for variations in volume often call for slight alterations in the shunting capacity. The best capacity for light speech, music, etc., is not always the best to use when receiving extra loud items such as brass band selections, and it is therefore advantageous to provide a variable capacity.

The most usual method of arranging such a unit is outlined in Fig. 1, where six fixed condensers, ranging progressively from ·001 to ·006 mfd. capacity, are connected as shown, the upper ends being joined to a common lead which is connected to one of the terminals X, and the lower ends to the studs of a sector or fan-switch, the blade of which short-circuits any number of studs, and thus connects a corresponding number of the condensers in parallel. The switch blade is in contact with the spindle and panel bush, and a lead is taken from the bush to the other terminal X. These terminals are connected to the loud-speaker terminals.

An Improvement.

The construction and successful operation of this type of switch presents certain difficulties, as many amateurs have no doubt discovered; moreover, it is not sufficiently selective, since, as we have seen, the only condenser which can be used independently is the first in circuit (on left), the second being added to the first, the third added to the second *and* first, and so on. For example, the second condenser has a capacity of ·002 mfd.; if we require this capacity, and no other, the only thing to do is to connect it up in place of the first condenser. Matters may be improved by using interchangeable condensers of the McMichael or "K" type. But let us consider another and better method of utilising odd condensers of any make which may be already on hand. Glance for a moment at the arrangement shown in Fig. 2. Here the upper ends of the condensers are connected as shown in Fig. 1, but the lower ends are joined each to one side of a special switch consisting of a pair of springy brass clips and a flush type panel socket, the other sides of the switches being joined to a common lead which is connected to the other terminal. The sockets merely act as guides for fairly long brass plugs which, when pushed well into same, short circuit the clips. Thus by using only one plug any one condenser may be selected; by using two plugs any two condensers may be connected in parallel, and so on. By using only four condensers of, say, ·002 to ·006 mfd. capacity, and two plugs, we can select any one of ten different capacities—i.e., with one plug, condensers 1, 2, 3, and 4, and with two plugs condensers 1-2, 2-3, 3-4, 1-3, 1-4, and 2-4, whereas in the foregoing example we use six condensers, and only obtain six different capacities. The advantage of the Fig. 2 arrangement should therefore be obvious.

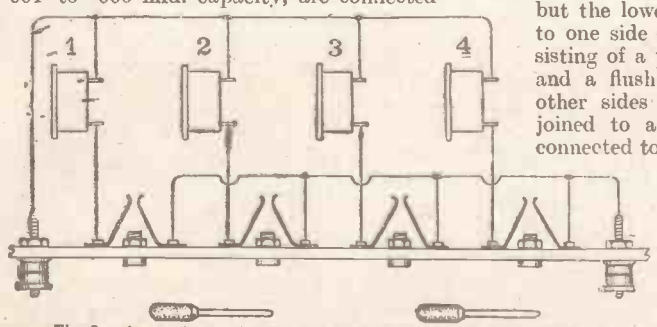


Fig. 2. An easily constructed tone control capable of wide variation.

Further Methods.

Juggling with capacity combinations is an extremely interesting pastime; it is also very confusing, and the reader would be well advised to avoid anything of a very complex nature. There is, of course, practically no limit to the number of condensers which can be used, and the different combinations of capacity obtained, with the Fig. 2 arrangement; four or five condensers will usually be found ample providing they are properly arranged.

Fig. 3 shows a unit of the baseboard type where the panel, on which is mounted a number of "K" condensers, is screwed down to a flat piece of board. The top ends of the condensers are all connected to one of the terminals by means of a sheet-brass strip which is clamped under the nuts of the bolts holding down the condenser clips, on the under side of the panel. The lower ends of the condensers are connected to a row of flush-type sockets. A second row of sockets is fitted as shown, these being all joined to the other terminal by means of another sheet-brass strip. The strips and connections to the upper sockets are shown dotted. The terminals, of course, are connected to the loud speaker; any one condenser may then be brought into use

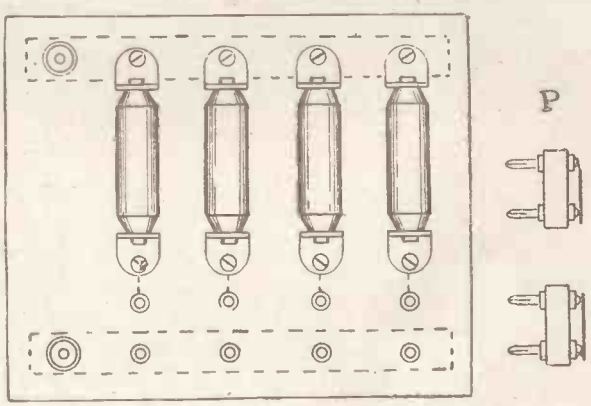


Fig. 3. Another form of unit that gives good results.

by placing a two-pin short-circuiting plug, P, into the corresponding pair of sockets, any two condensers connected in parallel by using two plugs, and so on. The plugs may consist of ordinary valve pins screwed into sheet-brass links, or the pins may be mounted on small pieces of ebonite and joined together with copper wire. A special plug, fitted with two clips and a condenser, may be placed in either pair of sockets so that this condenser is then in *series* with the selected condenser on the panel. Thus apart from its intended purpose this device can be made to serve as a very useful experimental component.

Another very simple and efficient arrangement is shown in Fig. 4. Here one side of

(*Continued on next page.*)

POPULAR BROADCASTING.

From Another Point of View.

By SIR J. KENNETH D. MacKENZIE, Bt.

So far as the technical side of wireless broadcasting is concerned there is really very little with which honest fault can be found. Captious and carping criticism will always be shown by those who expect and demand perfection, but that is not to be found in anything made by the hand of man, and never will be.

Thanks to the wonderful skill and energy of electrical engineers, their resourcefulness and ingenuity in overcoming obstacles which to the lay mind would appear insuperable, results have been achieved which are simply marvellous when one takes the trouble to think them over. But how many of the millions who use receiving sets every day do so, or try to think of anything but what they are hearing, and whether they receive pleasure or not in so doing?

The ingenuity of designers of instruments, professional and amateur, the enterprise and perspicacity of the wireless trade, have all helped incalculably to bring this baby science out of its swaddling clothes into trousers and coat within the marvellously short space of five years!

The fact is, the public is like a spoilt child who no sooner gets a rattle to play with than it demands a grand piano for its entertainment. The programme offered and *achieved*, mark you, by the B.B.C. at its birth was too good for a public who knew nothing whatever about radio except from what it had read, or heard from its friends who did know, and who also knew to what it might eventually lead.

"Spoilt" Public.

It is true that such a wonderfully good start off gave a great impetus to the new entertainment, and helped immeasurably to rake in the licences to enable people to get it, and thus aided the enterprise financially; but the public was not educated proportionately nor concurrently for proper appreciation of the boon, the novelty soon wore off, and the result is what it is.

It is perfectly easy to understand that the B.B.C. wanted to give "the very best they could," and they did it so well that the public got "spoilt" at the beginning, and, like a child, has been "crying for the moon" ever since. In no other scientific or artistic achievement has progress and development been so rapid as wireless broadcasting has been.

All other inventions have taken many years to arrive at their present state towards perfection; while in the musical, painting, theatrical and kindred worlds their art has not become what it is in the course of five or even fifty times five years.

True, certain geniuses in them brought their own expression of their particular art to a very high state of perfection; but the arts as a whole developed slowly, and perhaps none more so than the theatrical. Wireless progress, however, advanced so rapidly that public capability to appreciate its wonders is not much more advanced than it was five years ago. The novelty and wonder soon wore off, and carping criticism has taken its place because everything is not exactly what everybody wants.

The ubiquity of the receiving set, and the greatly increased use of the loud speaker, resulted in many owners of these instruments using them in a way that caused annoyance to neighbours, and consequently regulations for proper control had to be made in some places.

Thoughtlessness rather than malice is probably the cause of such inconsideration for others, which trait is also exemplified in the constant complaints one so frequently sees made regarding items in the programmes. People seem to think they are "the only pebbles on the beach," forgetting that it is not possible for the B.B.C. or anyone to satisfy and please everybody.

As a matter of fact, however, that is just what they do; everyone is pleased at some time or another at what they hear, though not at the same moment. This would be humanly impossible to accomplish, for no two people are exactly similar in their likes or dislikes. I may switch off directly I hear the sound of modern dance "music," or a "sister Ann" trying to hold her top note from wobbling; but those sounds which may annoy me may set another on her feet again eager to dance, or even give her pleasure the more the top note quavers. "One man's meat is another man's poison," and that is what it must always be.

Not Properly Appreciated.

Wireless broadcasting is in itself not merely a priceless boon to humanity which is not properly understood, but a marvellous discovery, underrated because it has become universal too rapidly for true appreciation. Everything becomes "commonplace" after a time, and the true import gets overlooked mainly because we are so apt to make our *personal* feelings the gauge by which a thing should be judged, regarding them as of more importance than the thing itself.

Does not the short history of telephony prove this beyond dispute? It will be the same with television when that also becomes general, and with all other undreamed of marvels yet to come. "Familiarity breeds contempt" in many more ways than one.

TONE-CONTROL UNITS.

(Continued from previous page.)

each condenser is connected to a telephone type terminal, a connection being taken from the centre terminal to one of the main terminals. Normally the centre condenser (No. 2) is in use, this, of course, being interchangeable with the others. By using a simple brass plug, or a length of ordinary copper wire, the two upper, two lower, or all three terminals may be short circuited (see lower sketches); thus any two, or all three condensers are connected in parallel.

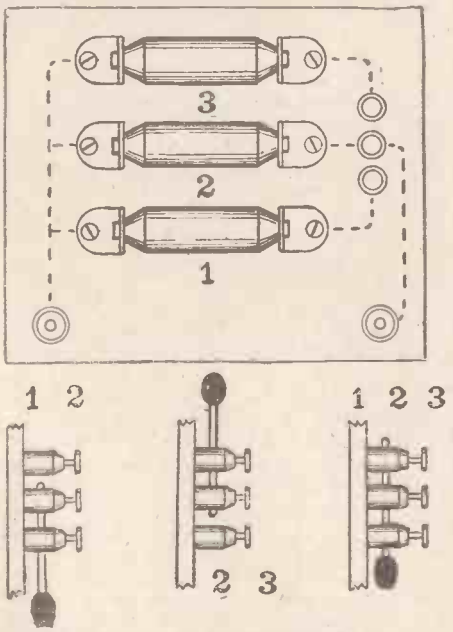


Fig. 4.—A very simple arrangement for three condensers.

Where interchangeable condensers are used, the device should, wherever possible, be arranged on the flat baseboard principle as in Figs. 3 and 4; the board should be well recessed to accommodate terminal nuts, wiring, etc., and should this present a difficulty, owing to lack of tools, the panel might be mounted on two narrow wooden runners, or on a very shallow cabinet. In any case refinements of this description should be arranged as separate components rather than integral parts of receivers.

Pure Output Essential.

Other methods can easily be devised by the constructor, but the foregoing will serve to show the kind of arrangement most suitable. It can be made into a neat unit, housed in a cabinet so that it can be placed either by the receiver or by the loud speaker.

All this, however, will not provide perfect reproduction if the output from the set itself is imperfect. It may, to a large extent, correct certain faults due to the loud speaker, but if the L.F. amplifiers are not working properly it is hopeless to expect the tone control units to clear up the distortion. These units should be used in conjunction with the other methods of obtaining pure results—proper grid bias, correct H.T., suitable valves and coupling devices, and then the constructor may reasonably expect really good reproduction of speech and music if he has a loud speaker worthy of that name.

CURRENT TOPICS.

BY THE EDITOR.

Sir Thomas Beecham and Broadcasting—"Rotten Stuff"—"Millions of Fools"—The Wireless League.

SIR THOMAS BEECHAM has been criticising broadcasting. A few days ago he astonished the world by an angry outburst concerning the state of England and, incidentally, broadcasting. It is his opinion that people who think that what they hear over the wireless is music are fools. Broadcast music to Sir Thomas sounds like the "most horrible gibbering, chortling and shrieking of devils and goblins"—from which it will be seen that Sir Thomas is not enamoured of broadcasting.

Up to a point we have a certain amount of sympathy with Sir Thomas Beecham. He has spent something like half a million pounds in an endeavour to make music more widely appreciated in this country, and he has failed abysmally. Now, any man who has spent half a million pounds in an attempt to foster art in this country must feel rather sore when a new form of entertainment comes along which, in the brief space of four years, can number its devotees in excess of two millions. Sir Thomas has supported opera in this country in a courageous attempt to make it pay, but broadcasting seems to be like the straw which broke the camel's back, and Sir Thomas has now declared his intention of "throwing up the sponge" and going to America.

Lack of Opportunity.

Sir Thomas says he objects to broadcasting of all music, because over the wireless all good music sounds bad and all bad music sounds good. This makes a nice little aphorism, but it is very far from being correct, and Sir Thomas probably knows it as well as we do.

It may be, of course, that he has never had an opportunity of listening in to a good concert received on a first-class wireless set. POPULAR WIRELESS has many times given famous musicians the opportunity of judging the merits of a really good receiving set. We regret that we have not been able to give Sir Thomas an opportunity. We feel confident that if he would accept our invitation he would very quickly revise his criticism because, despite his antagonism to broadcasting, we know Sir Thomas to be a fair-minded man, and also too big a man to stick to a dogmatic assertion in the face of evidence that he is wrong.

The Future of Music.

"The microphone," says Sir Thomas, "makes good music sound worse and the rotten stuff created by putrid minds is refined by this machine in a Mephistophelean way, so that there is no differentiation between the product of the great master and these horrible creations of to-day. The consequence of this will be that in ten years' time there will be only an audience in England for bad music, which is what these infernal degenerates want. Those of us who live for music will be hundreds of thousands of miles away playing for savages hanging by their toes from the branches of trees, who will be the only natural, unsophisticated audience left untainted by the modern appliances for killing the beauty of music."

Our readers will observe that Sir Thomas, in the above passage, reveals an unsuspected vein of humour. That many of his contemporaries do not agree with him is obvious, for, said Sir Frederick Cowen, in a recent interview: "I cannot understand why Sir Thomas should adopt this attitude at all. Surely he has nothing to complain of. He has always met with appreciation all round. There is nobody who has been so petted by the public."

Perhaps the fact of the matter is that Sir Thomas has been petted too much, and his outburst against broadcasting may be due to the fact that he sees a more popular rival in broadcasting.

It is extremely difficult to see on what grounds Sir Thomas bases his strong opinions. When a man like Sir Thomas Beecham

Mr. Victor Brooker, chief wireless operator of the ss. "Jervis Bay."

criticises broadcasting in the way he has, we have to listen to those opinions with attention and give them due consideration, but, however much we consider his recent criticisms, there seems very little sense in them at all. They are in the nature of a rhetorical outburst founded on a prejudice which has no rhyme or reason.

"Millions of Fools."

Whatever Sir Thomas may say, there will be undoubtedly a public for good music in this country; it is a growing public and there can be no gainsaying the fact that broadcasting has done a lot to increase the public's appreciation of good music: nor is there any gainsaying the fact that, famous conductor though Sir Thomas be, the "millions of fools" whom he criticises in this country would probably rather dispense with him than with their wireless receiving sets.

We hope that Sir Thomas, when he goes to the land which gave birth to popular broadcasting—America—will not be constrained to make such another outburst of indignation, otherwise we wonder where he will find a really musical home. Perhaps in the long run he will end up in the desert islands and there conduct a large symphonic orchestra played by coal-black niggers on tom-toms, coconut cymbals, and other instruments which now, in their "refined" state, form the nucleus of the much criticised jazz bands.

Red Hot News.

The Wireless League has taken upon itself the task of issuing a wireless warning. A paragraph of this warning reads as follows: "Nothing could be more fatal to broadcasting and to the interests of the listeners than the existing method of financial limitation. The whole science and art of wireless is at present in its infancy (sic). It is not improbable that in the near future the discovery of simple methods of selection or of beam transmission may render the existing broadcasting set entirely obsolete. It is reasonable to imagine that wireless television may be developed to a point where practical and commercial success is obtainable. If it is the intention of the authorities to budget only for the maintenance of the present stations and programme policy, the service of education and amusement rightly expected by the public will be seriously restricted."

Ingenuously, the League also gives tongue to the fear that the £900,000 paid to the Post Office in fees from wireless licences will not be spent for the benefit of wireless listeners.

That £900,000!

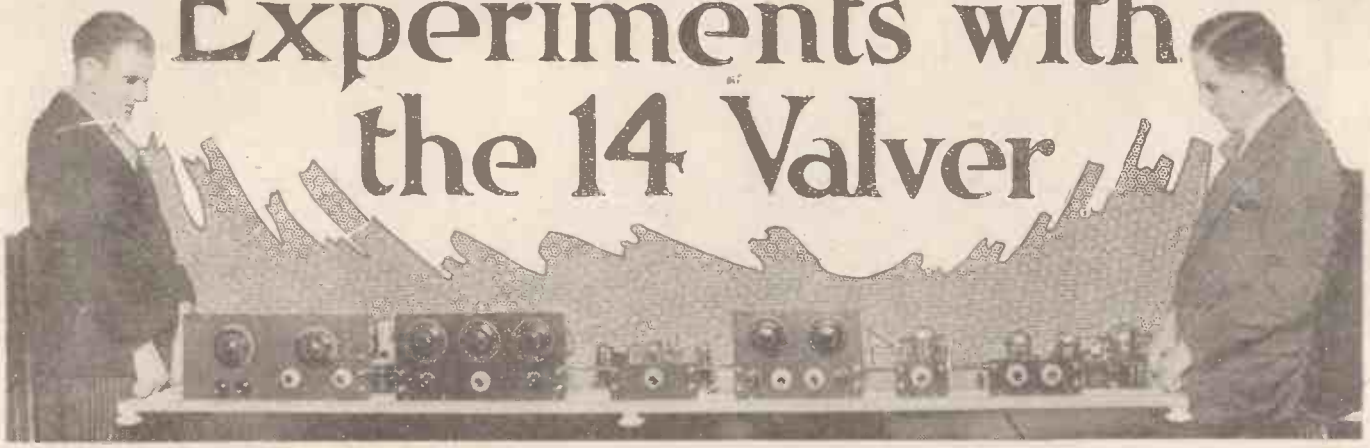
These profound observations have apparently just been discovered by those gentlemen who organise and run the Wireless League. Many, many months ago, POPULAR WIRELESS first drew attention to this scandal of the £900,000. But it is rather amusing to note that a League which claims to represent the listeners in this country should have just awakened to the fact that there is something rotten in the state of broadcasting.

However, we live and learn, and it is interesting, at any rate, to know that the Wireless League are now aware of this scandal. Mr. A. M. Low, who is Honorary Technical Adviser and Secretary to the Wireless League, has also enunciated the profound but by no means original theory that in the near future the "discovery of simple methods of selection or of beam transmission may render the existing broadcasting set entirely obsolete."

The idea that when the new Government Commission takes control they will remain blindly ignorant of technical developments is childish.

It has been clearly pointed out that this Commission will be advised by competent authorities. The Commission, in fact, is merely a figure-head; a well-paid figure-head, it is true, but then, figure-heads in this country are rather popular.

Experiments with the 14 Valver



In this article, Mr. Dowding, Technical Editor of "P.W.," gives some interesting details concerning the problems that had to be solved before "fourteen-valve results" were obtained with "P.W.'s" big set.

OUR fourteen valver is by no means a "freak" and, given the circuit employed, there is no doubt whatever but that many of our readers would be able to build similar sets and get similar satisfactory results. Actually, the circuit is quite straightforward, and it is reproduced here so that readers can examine it and see for themselves that there are no mysterious "wangles" in it.

A Special Coupler.

Taken from the right of the first vertical dotted line it will be seen that it is quite a normal multi-valve long-wave receiver, with seven H.F. stages and three L.F. stages. In the last of the latter two paralleled valves are used.

The super-het unit is laid out on conventional lines with ample spacing and well-separated wiring. A special short-wave coupler, designed by Mr. G. V. Colle, of our Experimental Staff, can be used alternately to one suitable for the normal broadcast band.

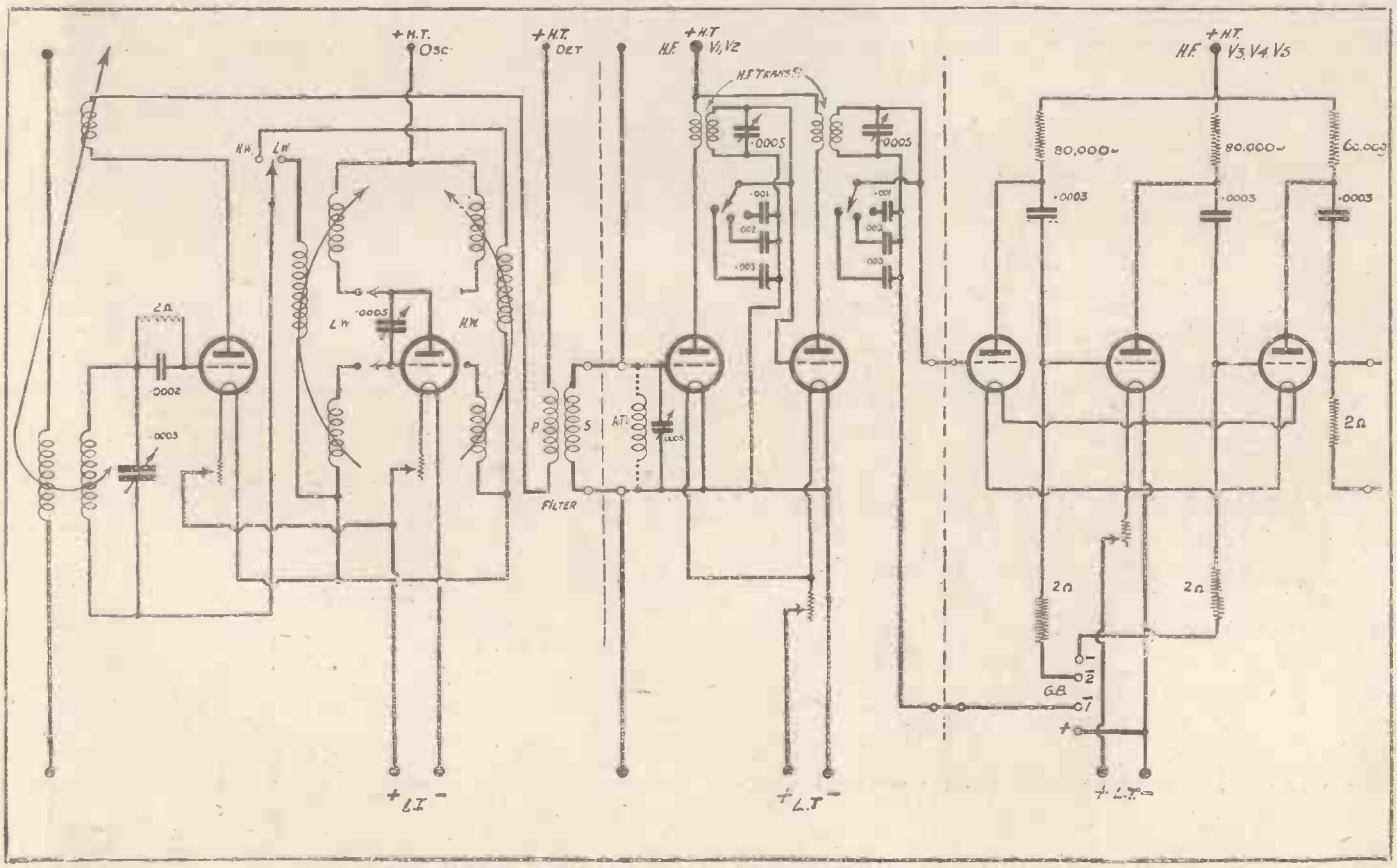
But building this big receiver was not *quite* as simple a matter as the circuit might, to some, suggest. Right at the commencement we could see that our only hope of real success was to assemble the set in self-contained units, each unit consisting of, at most, four valves. Then any fault which existed or which developed, could be tracked down by a process of elimination.

Therefore, each unit was tackled as a separate instrument and got working as such before it was coupled to any other one. Naturally, this did not mean that all the units were certain to operate efficiently together, and many problems had to be solved before the whole assembly would give fourteen-valve results.

An H.F. Hitch.

In order to reduce the lengths of the leads and to minimise the possibilities of interaction being caused by using common batteries, we decided to employ four H.T. batteries and four L.T. batteries. We had very little trouble with the L.F. unit—we hardly expected to in any case—and the detector stage was very docile. This latter functions on the anode bend principle and can, therefore, act as a limiter.

(*Continued on next page.*)



EXPERIMENTS WITH THE 14-VALVER.

(Continued from previous page.)

The three-valve resistance coupled H.F. amplifier caused considerable trouble. In the first place, we wired it up in accordance with the practice of a certain large firm, who claimed that their system was "the last word," but we failed to obtain successful results. The unit would work fairly well by itself—i.e. working direct from an aerial tuner to a detector, but in the big set—well, it was all we could do to hold it down, and certainly results were better without it.

However, we reverted to more standard practice, and after a few experiments with component values the three-valve resistance unit took its place quietly and quite satisfactorily contributed to the long-wave amplification.

Stations Everywhere!

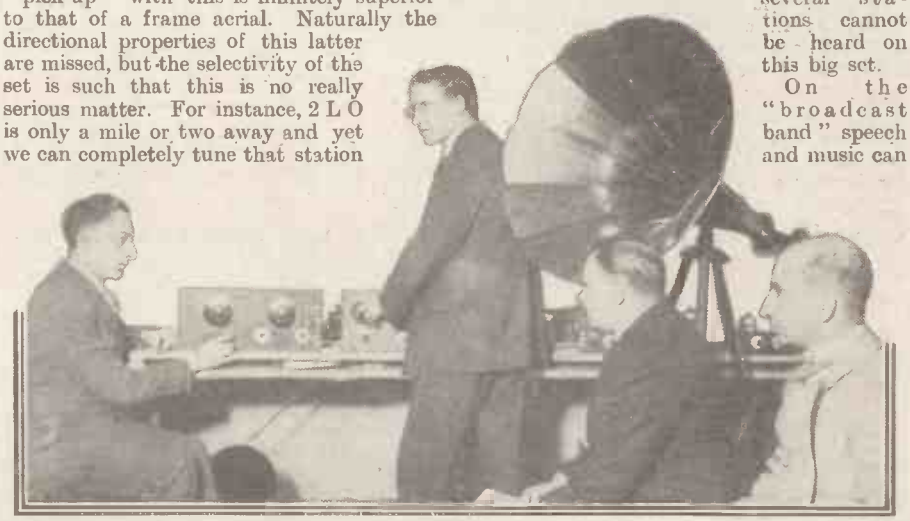
Now it may have been noticed that the long-wave coil transformers used in the tuned H.F. stages are not screened. We did not find it necessary to screen them for, owing to their wide spacing and careful arrangement, no inter-action was observed. In preliminary tests we used screens, but finding we were able to dispense with them we were distinctly relieved, for even the most enthusiastic advocate of screens will admit that they must inevitably cause losses.

We are shielded against direct "pick-up" by the enormous amount of iron surrounding the building in which our laboratories are situated. To a certain extent we are also shielded against "aerial pick-ups," and frame aerial work is distinctly difficult. However, even with the fourteen valver we use one of our outdoor aerials which, situated on the roof of Fleetway House, have very respectable effective heights. Of course, we employ a system of very loose coupling, although the "pick-up" with this is infinitely superior to that of a frame aerial. Naturally the directional properties of this latter are missed, but the selectivity of the set is such that this is no really serious matter. For instance, 2 L O is only a mile or two away and yet we can completely tune that station out in a degree or so, and bring in others on to the loud-speaker.

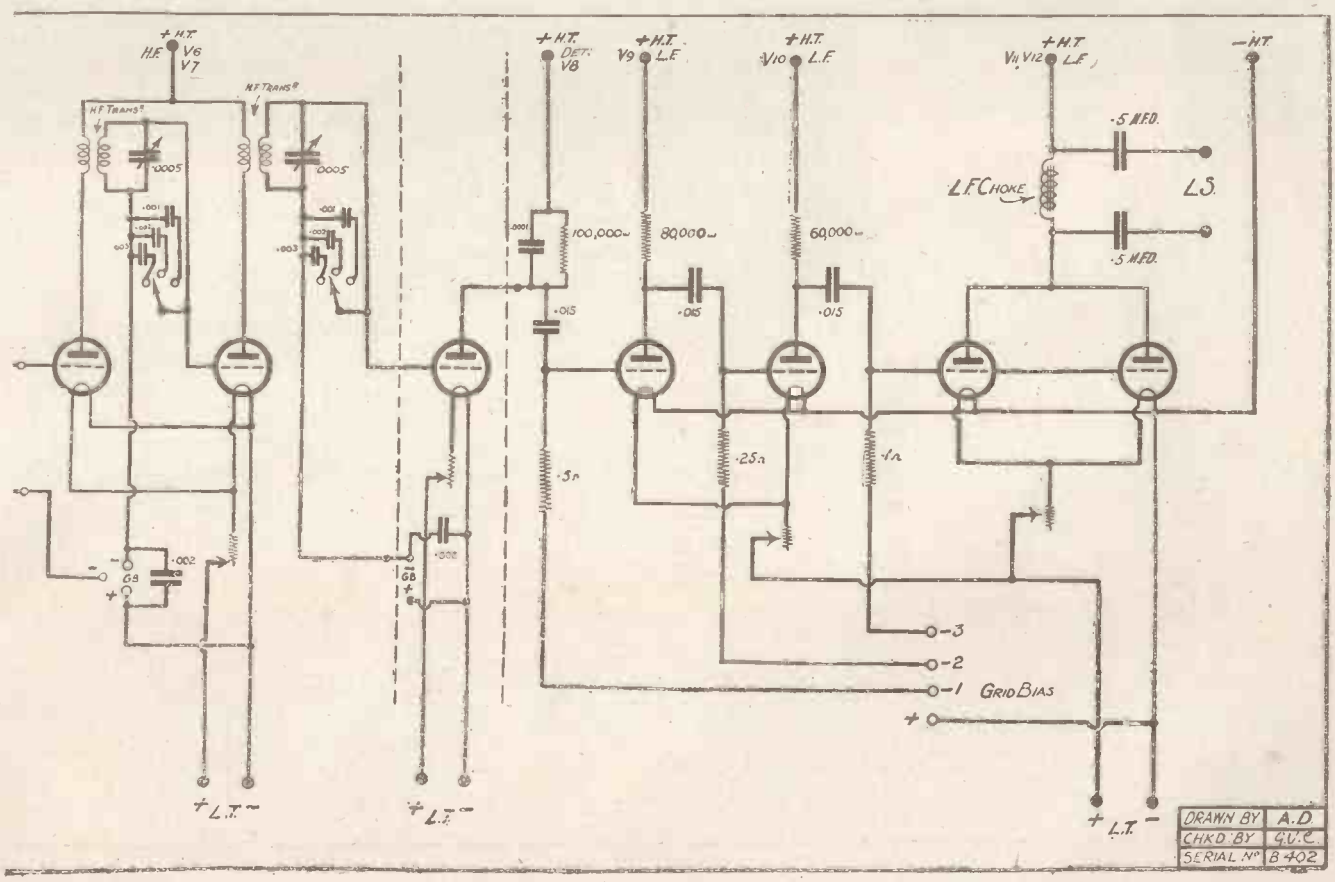
The choice of valves was given very careful consideration, and after many trials we obtained a series of Osram's which answer our purpose admirably. D.E.V.'s occupy the super-het. unit, and D.E.8's and D.E.5a's the remainder of the receiver.

To obtain quiet, efficient reception it is necessary, very closely, to adjust all the H.T. voltages and to tune accurately all the tuned intermediate stages. The process of calibration takes an hour or two, but once completed the set becomes very stable and not at all hard to handle. There is no point between 30 and 30,000 metres where several stations cannot be heard on this big set.

On the "broadcast band" speech and music can be heard at every degree of the oscillator variable, although it takes a few seconds to bring any one station up to full strength. It is quite a thrilling experience tuning this big fellow, and even hardened super-het. "fans" experience that "big gun" feeling when running over its controls.



Mr. Dowding (standing) operating the "P.W." 14-valve set. Mr. Josephs, managing director of Radio Instruments Limited, is seated on the extreme right.



TECHNICAL NOTES.

A Weekly Feature Conducted by

Dr. J. H. T. ROBERTS, F.Inst.P.
(Staff Consultant.)

IN the case of a receiving set in which the filament control of reaction is critical, you may have noticed a curious effect, which is as follows: When you switch on the set and adjust the filament rheostats to the correct position for the volume you require, afterwards adjusting the tuning dial and then, after some time, switch off the set and after a further interval switch on again, you may find that howling results, or in other words, the reaction limit has been exceeded. Considering that nothing whatever has been done to the set except switching off, then, after a certain interval, switching on again, this effect might at first seem rather puzzling. I have one particular set in which the reaction is very critical in relation to filament temperature, with the particular valves which I am using, and with this set the effect mentioned above is sometimes very noticeable.

L.T. Voltage Variations.

A moment's thought will provide the explanation. If the L.T. batteries are fully charged and in good condition, so that when working at the normal load imposed by the set they are able to maintain a practically constant voltage, the effect will not be noticed, for the conditions will not change appreciably either during a period or working or during a period of rest.

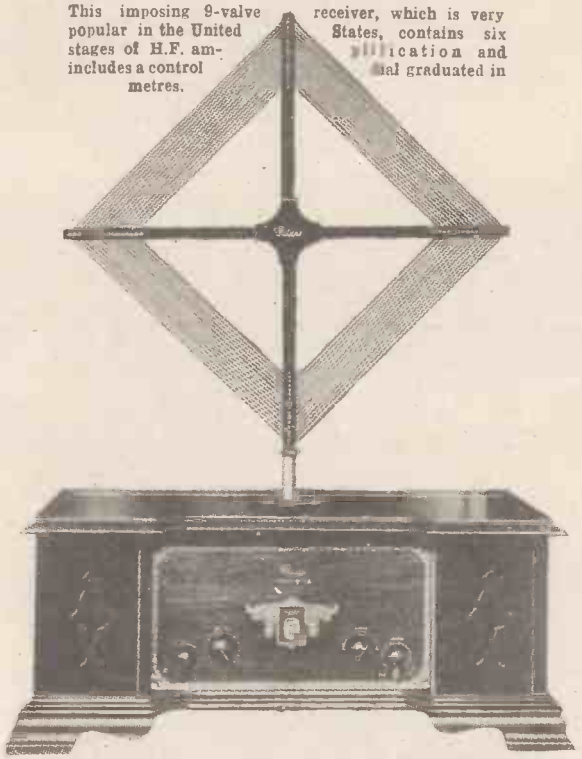
If on the other hand, the batteries are in bad condition or are run down, variations in their terminal voltage will occur. There will, for example, be a fairly rapid drop in the voltage on first switching on the set, but if you are then making the necessary adjustments this will probably not be noticed. On switching off the set, however, after the adjustments have been made, the battery will recuperate and its voltage will rise. If then, after a short rest period, you switch on the set, the result is as though you had reduced the resistance in your rheostats, that is, assuming the filament-temperature reaction-control to be critical, the reaction limit may be temporarily exceeded and the set may howl. If you left it for a minute or two (which, in the interests of your neighbours, I hope you will not) it would right itself and would resume normal working exactly as before you switched off.

Of course, although critical reaction control obtainable in this way has certain advantages, it is sometimes very inconvenient and is better avoided. It may be avoided by adjustment of the reaction coupling or by changing the valves about, as it will be found that valves vary considerably in this respect. If you have a set employing H.F. amplifiers it may be worth while taking one of the H.F. amplifier valves and interchanging it with the detector (assuming that the valves are suitable for interchanging in this way).

Enclosing the Batteries.

The mention which I made recently in these Notes of the possibility of damage to the wiring of a set by enclosing the battery within the cabinet has brought me a communication from Messrs. Siemens, Limited, the well-known battery manufacturers. They mention the experiences of battery users which go to support the view that there is no harm whatever in enclosing a dry battery within the cabinet. I am always pleased to be able to state all sides of any question of this kind where it is a matter of public interest and have no object in advancing the views of one more than another.

My own view (on this, as indeed on several of these technical questions connected with wireless reception) is that a good deal of exaggeration has taken place by way of precautions to the amateur. I have myself used sets for a considerable time in which both the dry H.T. battery and the L.T. accumulators were enclosed within the set and I have for years past used other types of scientific apparatus, in which both dry batteries and accumulators were enclosed, in a manner exactly analogous to that in which they are used in a wireless receiver, and I have never noticed any ill-effects. In this connection it may be interesting to mention that Messrs. Cleartron Radio Limited, who are now manufacturing and marketing the new Lodge "N" receivers, employ a cabinet which is specially designed to accommodate both the H.T. dry battery and the L.T. accumulators within it, and this may be taken to represent the latest and fully approved practice.



This imposing 9-valve receiver, which is very popular in the United States, contains six stages of H.F. amplification and includes a control dial graduated in metres.

A powerful multi-valve set just "out" in the States.

L.F. Transformer Interaction.

The amateur constructor is frequently warned as to the importance of avoiding interaction between L.F. transformers by placing them at right angles to one another. It should be borne in mind that the mere placing of transformers at right angles to one another does not mean that they may with safety be placed in very close proximity. The object, of course, to be aimed at is to prevent the magnetic lines of force from one transformer entering the field of the other, and whilst the placing of the transformers with their axes at right-angles will do a great deal to this end, if the transformers are in close proximity to one another, there will still be, or there *may* still be considerable interaction between them: Many modern transformers are shrouded in a soft iron case which still further reduces the possibility of interference.

It will be seen from the foregoing that it is desirable to space the transformers as far away from one another as may be possible.

The constructor will sometimes find it inconvenient to place two transformers at right angles with their axes both in the same plane: for example, suppose he is using two transformers of the shrouded hedgehog type, provided with feet and intended to be placed with their axes parallel to the panel or baseboard, it might at first seem that there was no other way of mounting these than that indicated by the maker. This difficulty may become more pronounced in the case of three L.F. amplifiers being used, although, of course, the vast majority of constructors do not go beyond one or two. In the case of three transformers it is evidently difficult to place them all with their axes at right angles to one another unless a three-dimensional arrangement be used. Thus, the first two may have their axes parallel to the plane of the baseboard, whilst the third may be placed "end on" so to speak, that is, with its axis at right-angles to the plane of the baseboard. By this simple arrangement the three transformers have their axes mutually at right-angles.

A Question of "Lay-out."

The same arrangement may be used in the case of two transformers where it is inconvenient to mount them at right-angles to one another, and parallel to the plane of the baseboard. In the case of a "barrel" type of transformer, provided with feet and designed to be mounted parallel to the baseboard, the upright or "end on" mounting may be accomplished by the use of two brass-strip brackets or angle-pieces. These should be drilled with two holes in each of the two limbs; in the longer limbs the two holes register with the holes in the feet of the transformer. When these two brass strips are bolted to the transformer feet they provide a right-angle mounting which may be secured to the baseboard in the usual way. Alternatively, a brass "strap" may be used to go over

(Continued on page 720.)

Build your own loud speaker

GONE ARE the days of troublesome 'phones. The LISSENOLA brings loud speaker convenience to every home at a record in low price. For 13/6—less than the cost of headphones—you can buy this wonderful loud speaking unit, needing only the addition of a horn to make it a powerful, full-sized instrument yielding results equal to an expensive speaker. And you can build a horn yourself—with each LISSENOLA we give you full size exact patterns and clear instructions how, for a few pence, you can build a big horn of proved efficiency. In addition, the LISSENOLA will fit the tone arm of any gramophone. The secret of this efficiency rests in the remarkably effective manner in which the electro-magnetic sound-reproducing system is concentrated.

Compare the price last

—before you buy go to your dealer and make this test: Ask him to put on the best loud speaker he has in stock—then use the same horn on the LISSENOLA, *and see if you can notice any difference.*

THE

LISSENOLA

Now no home need lack a loud speaker.

PRICE

13/6

EACH

The illustration shows the effective horn you will build yourself—it can be covered with fancy paper, or wallpaper, and painted so as to resemble a factory article. Get a LISSENOLA for your home.

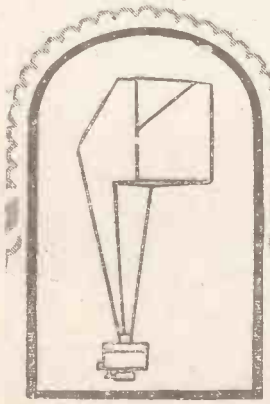
By using the Lissen Reed (sold separately for 1/-) the Lissenola will carry a cone or any other diaphragm working on the reed principle. Your dealer will gladly demonstrate and supply, or the "Lissenola" can be obtained post free by return from the makers.

LISSEN LIMITED,
8-16, Friars Lane, Richmond, Surrey.

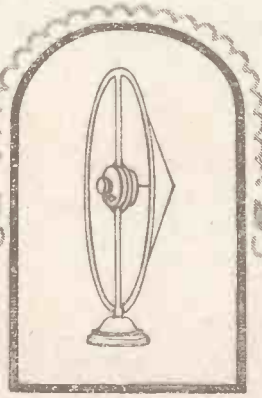
'Phone: Richmond 2285 (4 lines). *'Grams: "Lissenium, 'Phone, London."*

Managing Director: T. N. COLE.

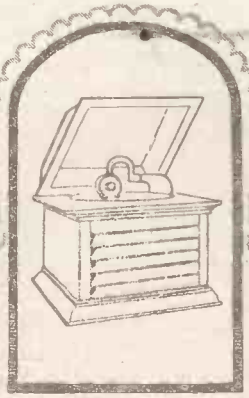
Full directions for making this horn are given with every "Lissenola."



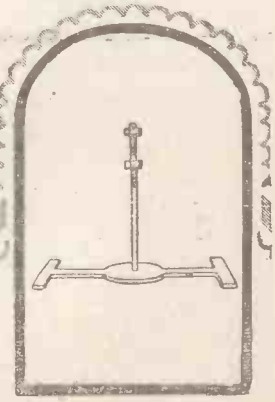
A cone diaphragm loud speaker can easily be constructed. The illustration shows one method of mounting.



The "Lissenola" instantly converts any gramophone into a loud speaker.



The "Lissenola" Reed Attachment (pat. pending) for use with cone diaphragm loud speaker. Price 1/-.



L.7.

Some Reliable Circuits

A Critical Examination of a few of the hundreds of circuits the amateur has to choose from.

By C. E. Field, B.Sc.

WIRELESS receiving circuits may be reckoned by hundreds, and the amateur whose facilities, or finances, do not permit of extensive experimenting is frequently in a quandary as to which of the many recommended circuits he should employ.

Working on Averages.

The following notes are intended as a rough guide to those desirous of owning a set which can be relied upon to give good results within its own limitations, only straightforward circuits of proved merit being included.

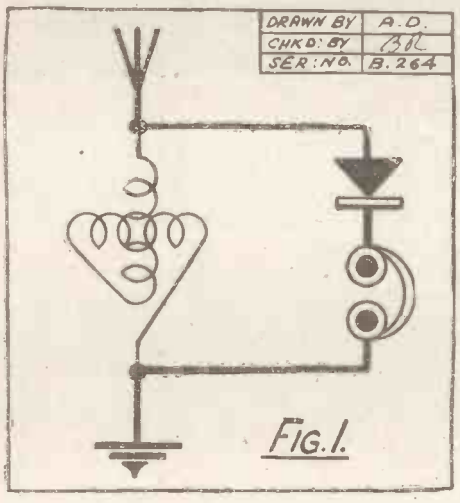


FIG. 1.

In order to furnish an idea of the outlay involved, the price of the components shown in the diagram is given in each case, the figures covering valves and batteries, but not aerial equipment, headphones, or cabinet work.

In each case two prices are quoted—one assuming the use of bright valves, and the other the use of dull emitters of the ·06 amp. type. The employment of dull-emitting valves of the 2-volt, 0·3 amp. type will usually incur an intermediate figure.

It will be realised that the prices given are very approximate, on account of the enormous variations that exist in the amount which may be paid for any one component. For example, a three-coil holder, complete with three home-wound coils, may be constructed for a cost of about five shillings, whilst nearly ten times that amount might be paid for a high-class manufactured article.

The following prices have therefore been assumed in all cases: Bright valves, 8s.; dull emitters, 16s. 6d.; power valves, 22s. 6d.; variable condensers (·0003 and ·0005 mfd.), 6s. and 8s.; fixed condensers up to ·002 mfd., 2s. 6d.; coils and coil holders, 7s. per coil; crystal detectors, 2s. 6d.; grid leaks, 2s. 6d.; rheostats, 2s. 9d.; valve holders, 1s.; variometers, 7s. 6d.; L.F. transformers, £1; H.T. batteries, 10s.; accumulators, 3d. per volt per amp.-hour continuous rating; ebonite panel, terminals, etc., 4s. per valve.

Using One Valve.

The results to be expected in each case refer only to reception from a main B.B.C. station, using an efficient P.M.G. aerial.

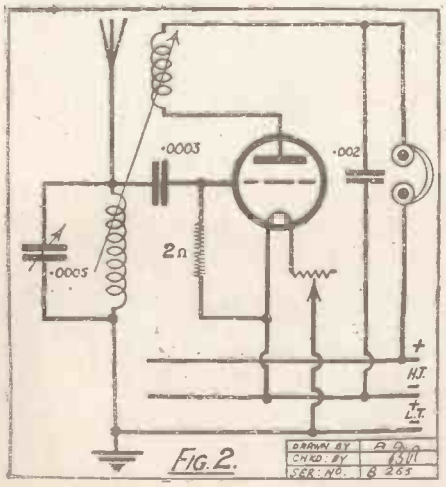


FIG. 2.

No. 1.—Variometer crystal receiver.

This is the simplest and cheapest form of wireless receiver, and depends for its success largely upon careful attention to detail in the aerial-earth system and in the wiring of the set.

Satisfactory headphone strength should be obtained at distances of from fifteen to twenty-five miles from a station, according to local conditions.

Approximate cost, 12s.

No. 2.—Single valve receiver, with reaction.

A very useful receiver, giving good headphone results up to a range of about forty miles. Under favourable conditions most B.B.C. and many Continental stations may be received, but these results cannot be relied upon. Great care should be taken in the use of reaction.

Approximate cost, using bright valve, £3 5s.; ·06 amp. valve, £3 14s.

No. 3.—H.F. amplifier and crystal detector, with reaction between anode and aerial coils.

This circuit will provide slightly louder signals than No. 2, and is particularly suitable for those living just too far from a B.B.C. station to obtain satisfactory results with a simple crystal set, and for those who are unable to obtain an efficient aerial system.

Approximate cost, using bright valve, £3 11s.; ·06 amp. valve, £3 19s.

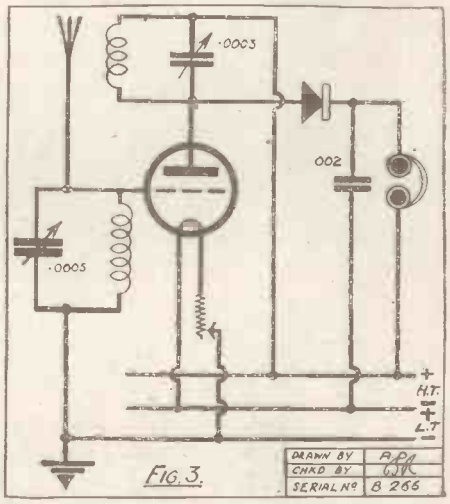


FIG. 3.

No. 4.—Crystal detector and note-magnifier.

A circuit which can be recommended for use within twenty miles of a B.B.C. station. If signals are audible with an unaided crystal, good results may be expected, and loud-speaker reception may be obtained within eight or ten miles of a station. The circuit is not selective, and is suitable only for reception from the local station.

Approximate cost, using bright valve, £3 18s.; ·06 amp. valve, £4 6s.

Dual Amplification.

No. 5.—Crystal detector and dual valve, with reaction between anode and aerial coils.

This is a very efficient method of utilising one valve, and, in view of the small outlay involved, is a circuit to be thoroughly

(*Continued on next page*).

SOME RELIABLE CIRCUITS.

(Continued from previous page.)

recommended. Care must be taken in the use of reaction, as the circuit is apt to be unstable.

Most B.B.C. stations should be received at headphone strength, and loud-speaker results obtained at a range of twenty-five miles.

Approximate cost, using bright valve, £4 13s.; ·06 amp. valve, £5 2s.

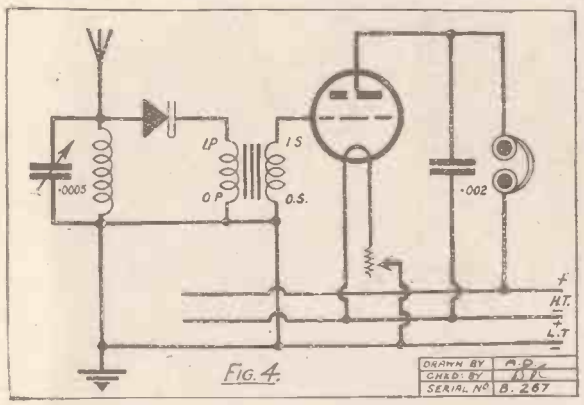


FIG. 4.

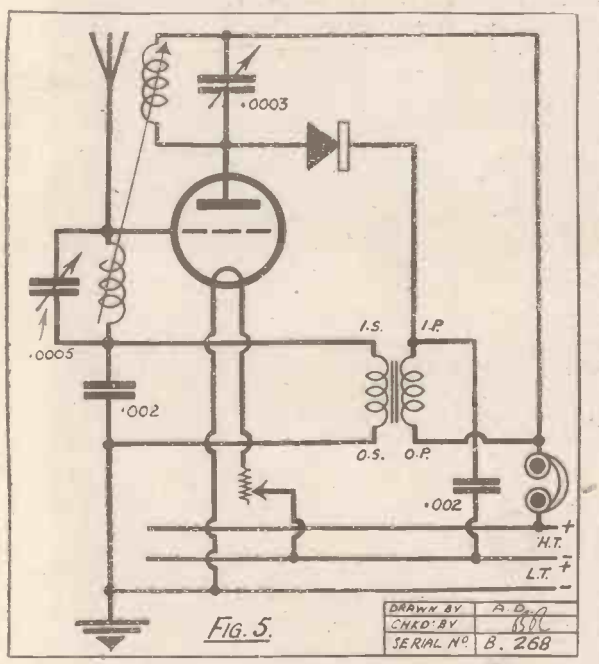


FIG. 5.

No. 6.—H.F. amplifier and valve detector, with reaction on aerial and anode coils.

This is perhaps the best 2-valve circuit for general use, as it is very selective, and under favourable conditions all B.B.C. and many Continental stations can be received. Great volume is not to be expected, and loud-speaker results will be limited to within a very close distance of a station. The circuit is apt to be unstable if not carefully handled, but the tendency to oscillation may be checked by the use of a small reaction coil, and small anode coil with correspondingly large condenser setting.

Approximate cost, using bright valves £5 4s.; ·06 amp. valves, £5 11s.

No. 7.—Valve detector, with reaction, and note-magnifier.

Within a range of about thirty miles this circuit will yield louder signals than No. 6, and the loud-speaker range may be extended to fifteen or twenty miles.

Although with slight modifications this is a favourite circuit for long-distance, short-wave work, generally speaking, the preceding arrangement should be employed if it is required to receive many different B.B.C. stations.

This circuit, however, is moderately selective, and very simple to operate.

Approximate cost, using bright valves, £5 13s.; ·0 6amp. valves, £6.

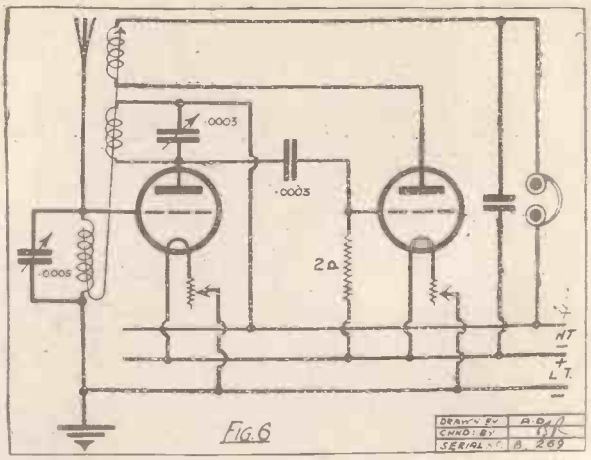


FIG. 6.

No. 8.—Crystal detector and two-note magnifiers.

For good loud-speaker results within a range of fifteen to twenty miles from a station, this circuit has much to recommend it. It is extremely simple to operate, and if care is taken not to over-run the second valve, and good transformers are employed, the quality obtained should be excellent. The circuit is not selective, and should only be employed if it is not desired to receive from beyond the local station.

Approximate cost, using bright valves, £4 14s.; ·06 amp. valves, £5 1s.

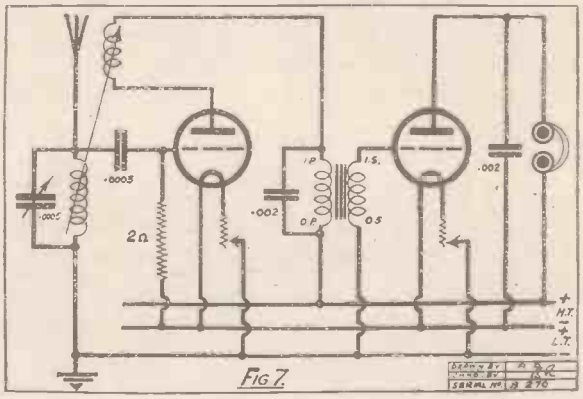


FIG. 7.

No. 9.—H.F. amplifier, valve detector, and note-magnifier, with reaction on the aerial and anode coils.

This is deservedly perhaps the most popular valve circuit for all purposes. It is selective, far reaching, and capable of providing considerable volume.

Loud-speaker Sets.

Most B.B.C. and many Continental stations may be expected at good 'phone strength, strong loud-speaker signals being obtainable in many cases.

It will be noticed that, from considerations of first cost, dull-emitter valves are now the most economical. This is because when more than two bright valves are employed it is desirable to use a 6-volt accumulator of ample capacity, and it is here that the extra cost is incurred.

Results may be very considerably improved by the use of a power valve, with extra H.T. voltage and correct grid bias. The cost will be from 15s. to £1 in excess of the figures given below, but the additional expense will be fully justified.

Approximate cost, using bright valves, £8 8s.; ·06 amp. valves, £7 18s.

No. 10.—Valve detector and two note-magnifiers, with reaction.

In cases where strong loud-speaker results are required from stations beyond the reach of circuit No. 8, this arrangement provides considerable volume and is simple to operate. Care should be taken in the choice of transformers, the second of which should be of the low-ratio type. The prices given assume the use of a power valve, with extra H.T. voltage.

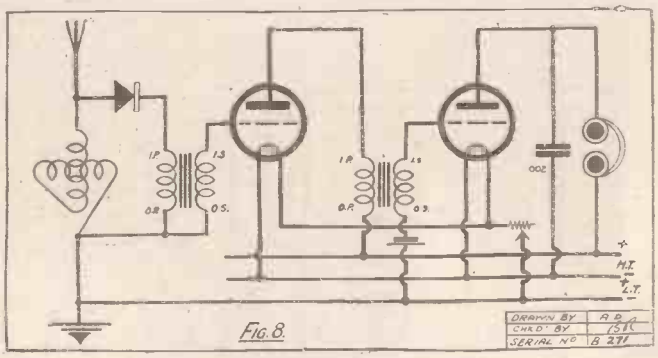
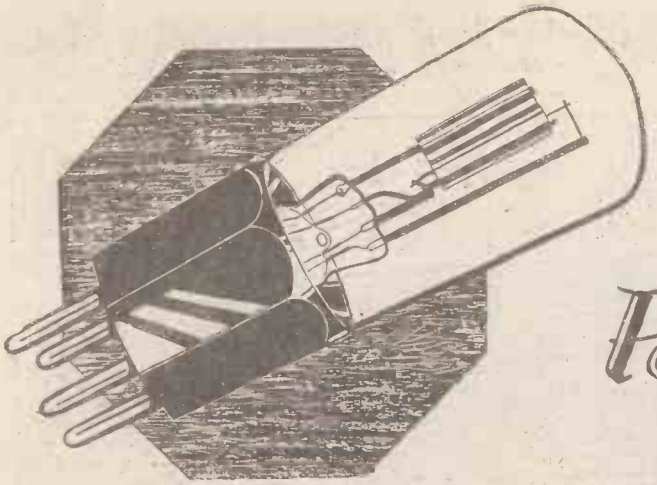


FIG. 8.

(Continued on page 681.)



Features of the OCTRON Radio Valve

No. 2
The Base

In the base of the Octron Valve—instantly recognised by its Octagonal shape—are embodied several features of importance. A hole is drilled through the bakelite cap which by air di-electric reduces self-capacity to a minimum. The leads from the plate, filament and grid—instead of being soldered at the top of the valve pins as in many valves—go right through a hole in the pin and are soldered at the point. Thus a perfect contact is assured without fear of damaging or disconnecting the leads. Finally, the Octagonal Base prevents the Octron Valve from rolling off when placed on table or bench—saving breakages.

Watch for other points—or send for full description of all types of Octron Valves at

Prices from **12/6**

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Electrical Engineers

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Telephone: Central 7460 *Telegrams: Hosaval, Birmingham*

SOME RELIABLE CIRCUITS

(Continued from page 678.)

Approximate cost, using bright valves, £10 3s.; ·06 amp. valves, £9 5s.

No. 11.—H.F. amplifier, valve detector, and two note-magnifiers.

This is circuit No. 9, with the addition of a power valve, and makes a reliable receiver for long-range loud-speaker work. All B.B.C. and many Continental stations should be received on the loud speaker under good conditions.

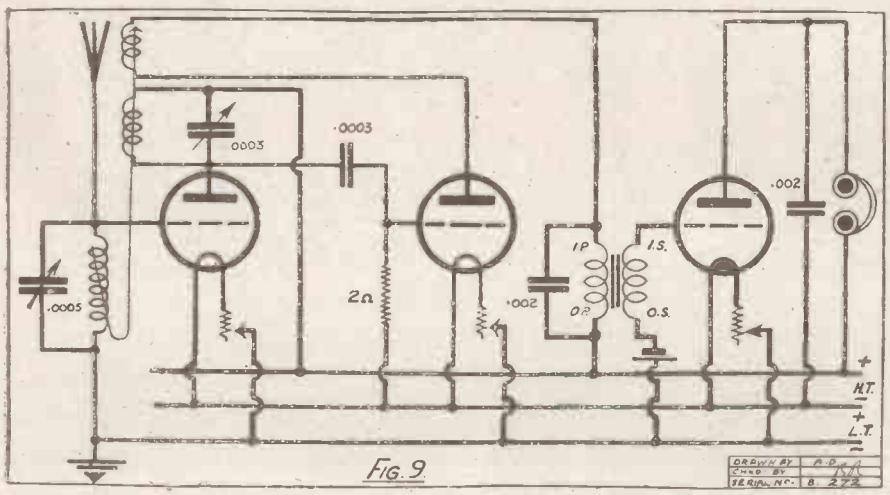


FIG. 9.

As in the preceding circuit, the second transformer should have a low ratio. The quality of reception may sometimes be improved by joining a resistance of about half a megohm across the secondary winding of the second transformer.

Approximate cost, using bright valves, £11 13s.; ·06 amp. valves, £11 3s.

A Resistance-Coupled Amplifier.

There are, of course, many excellent circuits which have of necessity been omitted from the foregoing.

It is not the purpose of this article, however, to provide a comprehensive list of circuits, many of which might differ from one another only in detail, or which might, on the other hand, be highly specialised and suitable only for one particular purpose, but rather to assist the amateur who is undecided as to what type of receiver will give him the best results for the smallest initial outlay.

However, in view of the attention which is now being given to the design of receiving sets and loud speakers which are capable of very faithful reproduction, mention should perhaps be made of a type of circuit which is eminently suited for distortionless reception over comparatively short ranges.

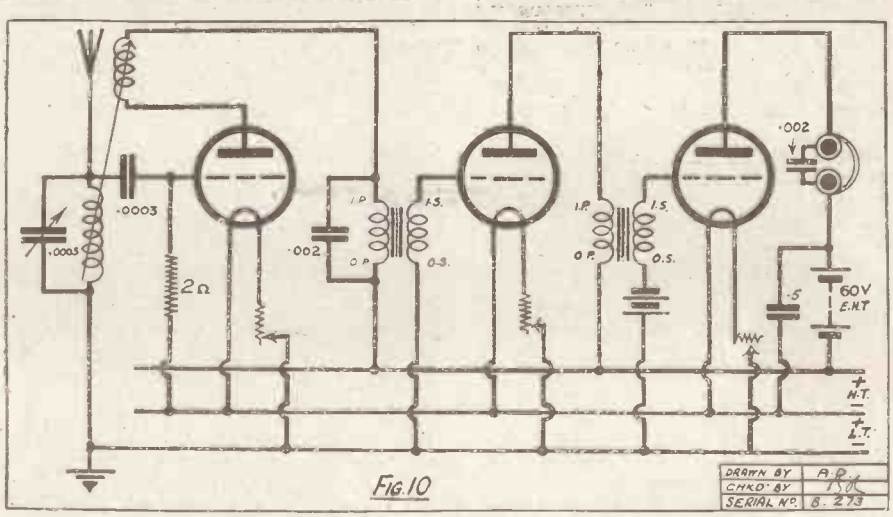


FIG. 10.

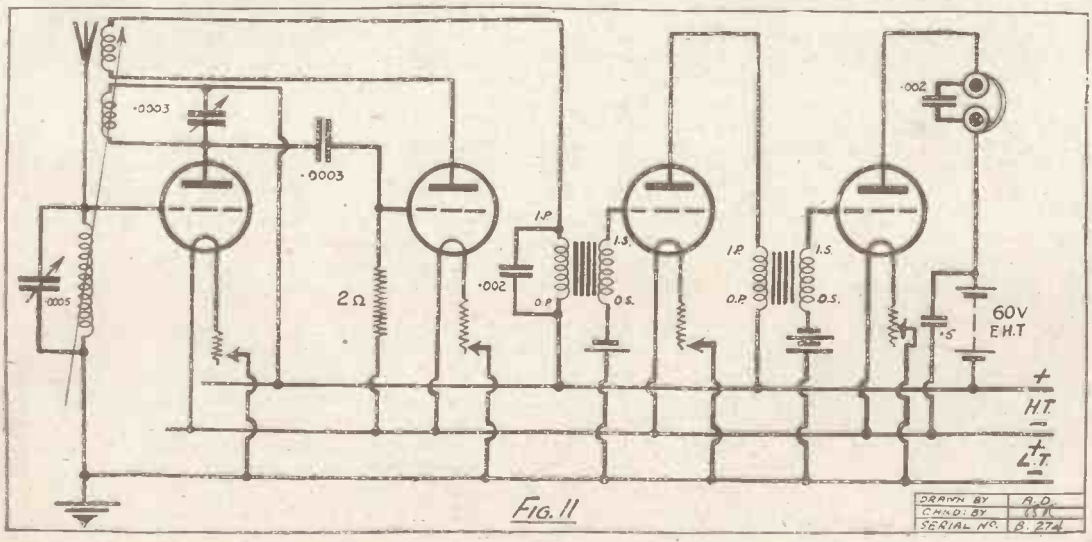


FIG. 11.

This is the resistance-coupled amplifier, following a valve detector, no reaction or selective H.F. amplification being employed.

If, for example, the circuit shown in Fig. 10 were modified by replacing each intervalve transformer with a resistance-capacity coupling unit, and eliminating reaction, an almost distortionless receiver would be obtained.

Difference in First Cost.

The use of specially designed high-amplification valves as detector and first L.F. amplifier would result in a signal strength little less than that obtained in the transformer-coupled circuit, and any loss in this direction would be more than compensated for by the increased purity of tone.

Such a receiver is only suitable for reception from the local station, any attempt to increase the range or selectivity of the circuit introducing distortion.

The difference in first cost of the two amplifiers is negligible, for, although in the resistance-coupled set the somewhat expensive intervalve transformers are avoided, it is essential for good results that the components should be of the highest possible quality, especially when, as is usually the case, high anode voltages are employed.

The question of valves is a far more important one than it would seem that many amateurs and listeners realise. Most no doubt know that there are different types of valves for different purposes available, but how many realise that the types extend to further than a mere H.F., detector, L.F. classification?

This has a very distinct bearing on the capabilities of receivers, for an L.F. valve which is suitable for transformer-coupled stages may give very poor results if used in a position preceding a resistance-coupled stage. And in conclusion, it is worth while to emphasise the fact that the last valve in *any* loud-speaker set should be a low-impedance power valve.

BROADCAST NOTES.

FROM OUR BROADCASTING CORRESPONDENTS.

St. Cecilia's Day—Sir Thomas Beecham—De Groot, Next Year—Trafalgar Day Trouble—More Gilbert and Sullivan—"Shock-Headed Peter"—Brahms' Requiem—"Love Adrift"—Florence Mills, a B.B.C. Blunder—Licences: The Danger Signal—Parliament: The Forthcoming Storm—A Broadcasting Genius.

St. Cecilia's Day.

NOVEMBER 22nd is St. Cecilia's Day, and a special programme is being introduced by Captain Ian Fraser, M.P.'s The artistes will all be blind and will be drawn from St. Dunstan's and from the National Institute for the Blind.

Sir Thomas Beecham.

The violence of Sir Thomas Beecham's attack on Broadcasting considerably discounted its effect. Curiously enough, it is a fact that he once dallied with the suggestion of becoming conductor-in-chief of all twelve of the B.B.C. National Concerts at the Albert Hall. He was offered a very attractive figure, and nearly yielded—but not quite.

De Groot—Next Year.

The De Groot affair was unfortunate; but in point of fact, the B.B.C. were not particular whether or not he continued to broadcast. It is understood also that the management of the Piccadilly Hotel are not sorry that there is at least to be an interruption of broadcasting from there. What will happen will be a re-engagement next year.

Trafalgar Day Trouble.

The B.B.C. organised a special programme from the decks of the "Victory"—Nelson's flagship—to mark the anniversary of Trafalgar Day. Apparently this was listened to on the Continent. The result is that there was a certain amount of heart-burning among a section of patriotic Frenchmen. A demand has been expressed in influential quarters for propagandist reprisals against "Perfidious Albion." One newspaper expresses French resentment in very decisive terms. It will be regrettable if broadcasting begins to take on a consciously nationalist tendency. The organisation at Geneva has so far prevented this, at least among the bigger countries. There is, of course, a certain amount of hostility as a normal affair between the broadcasters of some of the smaller Balkan and Central European States.

More Gilbert and Sullivan.

There are bright prospects of more Gilbert and Sullivan in December. Negotiations are now under way which should enable the B.B.C. to broadcast excerpts from "The Yeoman of the Guard" and "Iolanthe."

"Shock-Headed Peter."

Mr. Nigel Playfair will probably produce "Shock-headed Peter" as a Children's Hour feature during the special Christmas programmes. This should be an exceptional treat to old and young alike.

Brahms' Requiem.

Brahms' Requiem is to be relayed from Canterbury Cathedral at 5.30 p.m. on December 16th.

"Love Adrift."

A studio selection of this musical comedy will be given shortly. The play was not successful at the Gaiety, but it is regarded as successful musically, and therefore suitable for broadcasting.

The Grebe "Princess," an American completely self-contained cabinet receiver.

Florence Mills—A B.B.C. Blunder.

The contretemps about Florence Mills had little real justification. When the B.B.C. stipulated a fifteen minutes' performance for the fee mentioned, they did not mean a continuous performance. Fifteen minutes was to cover the introduction, the announcements and reasonable intervals between items. The artist would probably not be required to render more than a maximum of three pieces. Thus there was a lot of fuss and exasperation about one piece. Mr. Cochran had said he would let Miss Mills do only two pieces. In such circumstances, there is a measure of blame on both sides, but most people "in the know" place the chief blame on the shoulders of the B.B.C. negotiators. Whoever represented the Savoy Hill authorities in this matter was guilty of curious inflexibility. It is to be hoped that the approach of the new régime is not being reflected in a new attitude of arrogance on the part of a section of the people at B.B.C. headquarters.

Licences: The Danger Signal.

The rate of increase of broadcast receiving licences has become practically stationary. A decline set in in early October and the curve has been getting more and more like a straight line ever since. The process is likely to continue until the public is definitely sure that the new régime is not going to ruin the service. Of course this decline in licence increase is of no practical interest to the B.B.C., because they do not benefit from extra licences, in any event.

Parliament: The Forthcoming Storm.

It is certain that Parliament will be much more critical of broadcasting plans than the officials of the Treasury and the Post Office had expected. There is increasing evidence of restiveness, both with regard to the constitution and with regard to financial arrangements. There will have to be a Consolidated Fund Bill before the end of November to sanction payment for the new Governors and Chairman. Just before this is taken, the P.M.G. will lay papers, including the Charter and the Licence. He will have to outline the financial proposals, and will have to explain on what ground he is departing materially from the recommendations of Lord Crawford's Committee on Broadcasting. The Wireless League has stirred up a lot of interest throughout the country, and Members of Parliament are in no doubt as to the attitude of their constituents. There is keen general anxiety that the B.B.C. should carry on untrammelled and that there should be no withholding of funds for at least three or four years. With this attitude prevalent it is a pity the B.B.C. does not give more information about the details of its finances. This is a point on which B.B.C. policy has always been unsatisfactory, particularly from the point of view of its best friends. The Savoy Hill people are too apt to declare parrot-like: "There is no practicable limit to the money that can be spent usefully on broadcasting, but we cannot give you figures; you must trust us." This attitude is not helpful. Programme expenditure should be analysed and published under various headings, and all such accounts published with the authority of auditors. It is profoundly to be hoped the B.B.C. changes its policy in this matter in time for the parliamentary discussion.

A Broadcasting Genius.

The appointment of David Cleghorn Thomson to be Director of all broadcasting work in Scotland and Northern Ireland marks another step in the romantic career of this brilliant young man. He is still only 25 years old. He is a distinguished product of Balliol. He has stood several times as a parliamentary candidate, and has been looked upon in Liberal circles as a potential Gladstone. He is temporarily out of politics, and he may indeed stay with broadcasting permanently. He is regarded by his friends as the natural successor to Mr. Reith in about five years' time.

Who earns your money? Who spends it? Who chooses your parts for you?

No set published by any periodical could use only one make of parts or could use the same make of transformer, for instance—it would not be fair to advertisers if they did not all have a share in this kind of mention. BUT YOU ARE FREE TO CHOOSE YOUR OWN PARTS.

Your transformer, for instance. Never again pay a high price for your transformer no matter what may be specified—the new LISSEN has revolutionised all previous ideas of transformer price and performance.

So good is it, that all our own high priced models, which have been on the market and largely sold for several years past, have been unhesitatingly withdrawn in favour of this new LISSEN.

The fine tone and great power of this new LISSEN Transformer have been proved by the trade—they are largely using it for their own built-up sets.

It Fully Amplifies Every Note—Every Harmonic—Every Overtone.

Choose the New LISSEN. First for its Performance. Secondly for its Price.

ACTUALLY TEST IT FOR 7 DAYS—IF NOT SATISFIED THEN TAKE IT BACK TO YOUR DEALERS OR SEND IT BACK TO US.

Our new direct to dealer policy of distribution (which cuts out all wholesale profits), aided by our huge production programme and the special plant installed to turn it out have enabled us to sell this new LISSEN Transformer at an unheard-of low price.

8/6

AND GUARANTEED FOR 12 MONTHS.

TEST IT FOR 7 DAYS

Turns ratio 3 to 1
Resistance ratio 4 to 1

Use it for 1, 2 or 3 stages L.F.

It will suit every circuit and every valve you will want to use.

USE LISSEN FIXED CONDENSERS, TOO, Mica & Mansbridge Type

LISSEN Mica Type CONDENSERS

Small energy-conserving condensers—note the new case which enables the condenser to be used upright or flat. At present the new case is available only in the most used capacities, but will quickly become a LISSEN standard.

Capacities—
·0001 to ·001 **1/-** each (much reduced).
·002 to ·006 **1/6** each (much reduced).

Accurate to 5%—they never leak—they never vary.

LISSEN Mansbridge Type CONDENSERS.

To a fine LISSEN quality condenser is added the specially moulded case—the condenser cannot short circuit on to its case. The new LISSEN case protects you if the condenser is used in any circuit connected straight on to the electric light mains. And due to our new policy of direct to dealer distribution this LISSEN Condenser costs no more than the ordinary type.

·01 to ·09	2/4
·1	2/6
·2	2/8
·25	3/-
·5	3/4
1·0	3/10
2·0	4/8

LISSEN FIXED GRID LEAKS

A case of these was left on our factory roof during the summer of 1925, soaked in rain, baked by sun and the resistance value of these leaks never altered.

All capacities, previously 1/8, **Now 1/-** each.

Improve every circuit by using LISSEN parts wherever you can—save money too—for now you get keen prices as well as fine quality.

LISSEN LTD., 8-16, FRIARS LANE, RICHMOND, SURREY.

Managing Director: Thomas N. Cole.

Many are using LISSEN Transformers in "N" Circuits.

L. 199

The RADIO CONSTRUCTOR

Edited by PERCY W. HARRIS, M.I.R.E.

This valuable eight page supplement, devoted to the interests of amateur wireless constructors, appears every week in **POPULAR WIRELESS.** Tell your friends about it, for it is only in "P.W." that they will find the radio articles by the leading constructor expert, Mr. Percy W. Harris.

IT is really surprising that in an art as new as radio there should be so many conventions and so much difficulty in persuading both manufacturers and home constructors to depart from them, even when it can be shown that the original ideas on which the conventions were founded are fallacious.

In some cases, of course, when the convention is connected with a standard, it is wise to adhere to the particular arrangement so as to simplify construction and to maintain interchangeability. For example, there are still many experimenters who believe that the object of the pin and socket in the base of a plug-in coil is to avoid the possibility of plugging in a coil "the wrong way round."

The Coil Socket Fallacy

It seems to them that if the coil base had two pins and the coil holder two sockets, the user would not know which way round to plug in the coil so as to get the correct reaction effect. In point of fact, assuming that a coil has two pins on its base, and the holder two sockets, and that with a particular circuit the reaction coil is applied the correct way round, reaction will *not* be reversed by pulling out the coil and reversing it in the holder. The explanation is that, while we reverse the direction of winding by making such a change, at the same time we reverse the *connections* to this winding, so that we have a double reversal and the field direction remains precisely the same.

It will thus be seen that no advantage is gained by this pin-and-socket arrangement, so far as irreversibility is concerned; but as the plug and socket has been adopted by so many makers of plug-in coils, and as all coil holders of the conventional type are made to take such fittings, any change to a different form would be attended by far more disadvantages than advantages, particularly as efficient inductances not of the multi-layer type are evolving on separate and distinct lines.

Another convention which has many disadvantages and no advantages that I can see, is that of marking the primary and secondary windings of L.F. transformers I.P., O.P., I.S. and O.S. respectively. I.P. means "inner primary," O.P. means "outer primary," while I.S. and O.S. are "inner" and "outer secondary" respectively. Assuming we wind the primary next to the core, the I.P. will be the start of the winding and the O.P. the end of the winding which comes immediately next to the insulation separating the primary and secondary windings.

Assuming also that we wind the secondary immediately over the primary, the I.S. connection will be relatively close to the O.P., while the O.S. will be the end of the winding on the outer layer. If a transformer is wound in this way—i.e. by ordinary layer winding with primary next to the core and secondary immediately over it—it is distinctly better that the O.S. terminal should be connected to the grid, but transformers are now wound in so many different ways that it by no means follows that the O.S. is always the best grid connection.

Some Transformer Problems

Some transformers, for example, are wound in section form so that primary and secondary sections are sandwiched between one another. Others are wound with the secondary next to the core and the primary outside, while sometimes the primary is in one section and the secondary in two.

In any case, the user can only be very mildly interested in which is actually the beginning and end of the primary and secondary windings. What he aims at is the best result, and unless he has a good knowledge of transformer design and, in particular, knows the method by which the particular transformer is wound, he has no means of telling which is the best connection by looking at the lettering.

A few transformer manufacturers are now marking their transformers: plate (or anode) H.T. positive, grid and L.T. negative, a far more sensible way and one which gives information of value and not merely of slight scientific interest. Obviously the transformer manufacturer knows which are the best connections for his particular instrument, and as these connections do not alter with different valves, they can be standardised.

But here again there is a danger of falling into another error in marking. Of those manufacturers who mark their transformers in a way showing how to connect them, quite a number mark the secondary ends "grid" and "L.T. negative" respectively. A far more sensible marking would be "grid bias negative" instead of "L.T. negative," for in practically every case grid bias will be used, and the terminal needed for this should be properly marked.

Have you ever thought of the absurdity of calling your accumulator your "L.T. battery," and your anode battery your "H.T. battery"? Nobody ever thinks of referring to house lighting voltages as "H.T." even when they are in the neighbourhood of 250 volts, yet a 60 or even 30 volt dry battery is referred to as "*high* tension." It is quite easy to fit up efficient circuits for reception with a 6 volts L.T. and 6 volts H.T., whereupon the absurdity becomes even more apparent.

As the L.T. accumulator is used simply for the purpose of supplying current to heat the filament, it would appear that "filament battery" is sufficiently explanatory and accurate for all purposes.

Percy W. Harris

The success of the year! This Hale receiver in the form using Reinartz reaction. Have you built yours yet?

Building a Resistance Amplifier

A Further Article of the "Modernising" Series by the Editor of the Radio Constructor.

This unit will fit into many existing sets without change of panels.

WHILE I do not agree with the people who say that pure reproduction is *only* possible with resistance-coupled L.F. amplification, it is true that in more than one stage of amplification high quality is easier to obtain with the resistance amplifier than with the transformer-coupled type.

So many readers have asked me to tell them how to modify their receivers in order to introduce resistance coupling, that the present article has been written as an answer to their request.

Transformer Pros and Cons.

Many long articles could be written on the relative advantages of resistance- and transformer-coupled amplifiers, but however interesting the subject may be, we have not space here for such a discussion. Suffice it to say that on the transformer side of the argument greater amplification per stage is possible, and it is not necessary to use such high plate voltages as with resistance amplifiers. On the resistance side of the argument the important fact that stands out is that it is much easier to get satisfactory reproduction with two resistance-coupled note magnifiers than with two transformer-coupled magnifiers, and against the increased plate voltage required can be set off the considerably reduced plate *current*.

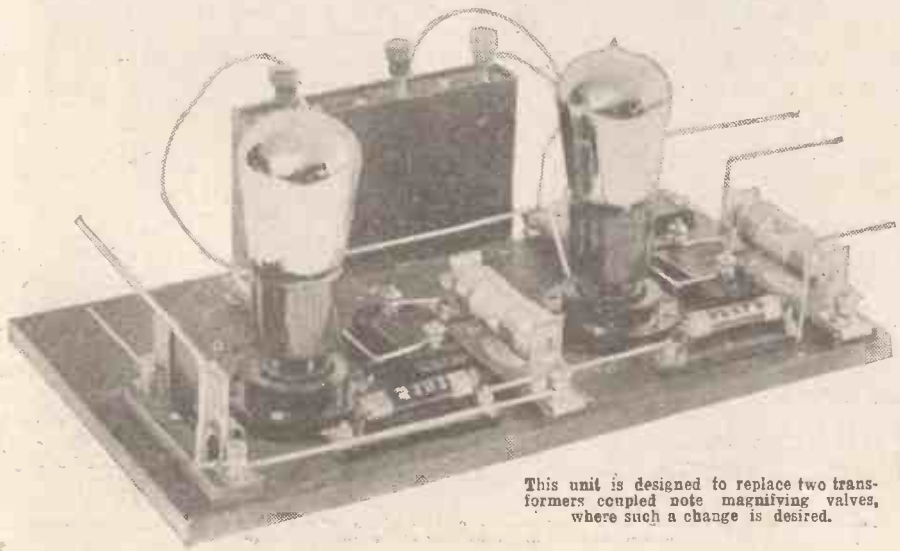
In view of the article in last week's issue entitled "The Assault on your Battery," readers may realise that the reduction in plate current is no inconsiderable advantage.

I have listened to sets with two transformer-coupled amplifiers, the quality of reproduction from which was indistinguishable from that of the best resistance amplifiers, but in obtaining these results the greatest care had been taken in choosing the transformers, the valves, the lay-out of the set, and a dozen other points. I have also had some little experience in examining home constructors' sets, and have frequently found the builders thoroughly dissatisfied with the quality obtainable with two transformers. It is safe to say that such people, who seek good quality and do not object to the sacrifice of a little volume, will get all they desire by reconstructing the amplifier portion of their receivers in the resistance-capacity coupled type.

How the Unit is Made.

The unit described in this article has been designed to occupy approximately the same space in a receiver as that taken by the usual transformer-coupled arrangement, and can be considered as the amplifier end of any receiver. For this reason, readers should find it very simple, if they so desire, to remove the present L.F. portion of their receivers, fit the unit shown, and make all necessary modifications without disturbing the panel lay-out or the H.F. and detector portions of the sets.

An examination of the photographs will show that no part of the amplifier is carried on the panel, and that the existing terminal strip, valve holders, and baseboard can be used.



This unit is designed to replace two transformers coupled note magnifying valves, where such a change is desired.

If you examine the theoretical diagram of Fig. 1 you will see that it depicts the conventional transformer-coupled arrangements. In Fig 2 I have drawn the equivalent resistance-capacity coupling method so that you may see the exact difference between the two. In the transformer method the plate current in the valve, being modulated by the incoming signals, passes through the primary of a transformer and induces into the secondary windings similar variations, but with a "stepping-up" effect, giving higher voltage variations than would otherwise be possible. This is, of course, an advantage. The variations of potential so set up between grid and filament similarly modulate the plate current of the next valve, and we repeat the process through the second transformer.

The Resistance Arrangement.

Now compare this with the resistance amplifier. The current from the H.T. battery, on its way to the plate of the detector valve, passes through a high resistance, usually of the order of 100,000 ohms. Ohm's law tells us that for a given current to flow through a given resistance a certain voltage is required. If the resistance remains the same and the current varies, obviously the voltage required to force the current through the resistance is altered. As variations of current are set up in the valve by the action of the grid, corresponding variations of voltage occur across the terminals of the high resistance.

You will notice that one end (the plate end) of the resistance is connected through a fixed condenser to the grid of the next valve. The other end of the resistance is connected to the H.T. battery and, through this, to the filament. If you consider for a moment, you will realise that, to all intents and purposes, one side of the resistance can be considered as connected to the grid of the next valve and the

(*Continued on next page*)

A RESISTANCE AMPLIFIER.

(*Continued from previous page.*)

other to the filament. In this way any variations of voltage across the ends of this resistance are applied to the next grid. Thus our signals are passed from one stage to the next, just as we were able to pass them through the transformers.

The object of the fixed condenser between one end of the resistance and the subsequent grid is to prevent the positive H.T. voltage reaching the grid of this valve and spoiling its action. The value of this condenser, being fairly large, allows the passage through it of the varying audio-frequency voltages, but effectively stops any direct current flow. In this way we keep our H.T. D.C. voltage away from the grid.

Constructional Details.

Unless we were to provide some means, the charges on the grid of the valve following the resistance would have no opportunity of leaking away. We therefore connect a grid leak between the grid and the filament, introducing in this path a grid bias battery to keep the grid sufficiently negative to yield good results.

An excellent article explaining grid bias has very recently appeared in POPULAR WIRELESS, so that it will not be necessary to give any further explanation on this point here.

You will now see that to substitute a resistance-capacity coupling for transformer coupling we must provide, in place of each transformer, a high resistance, a coupling condenser and a leak. Fortunately for us, these are not expensive, and the cost of building a resistance amplifier using the very best components is no higher than that of building a transformer amplifier. To build the unit described, we need:

Two anode resistances (wire-wound type). Those shown in the set are Varley. Excellent wire-wound resistances are also made by Mullard and Dubilier, while the Radio Communication Co. supply complete units with a resistance, grid leak, and coupling condenser built into one.

Two high-grade fixed condensers of a value ·015 mfd. Do not use the Mansbridge type here. Mica-insulated condensers only should be used. Those shown in the set are Dubilier, but there are many other good makes that can be substituted.

Two baseboard mounting grid leak holders. The Dubilier Dumetohm is shown. If you care, you can, of course, make your own clips quite inexpensively from small pieces of sheet brass and odd scraps of ebonite.

Two grid leaks, ¼ or ½ megohm each.

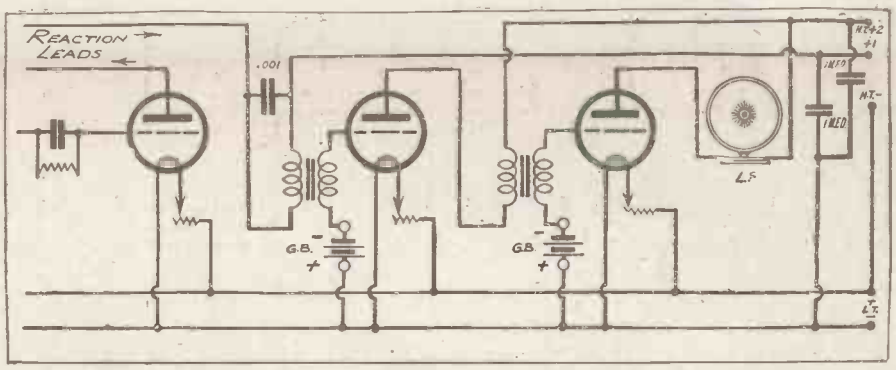
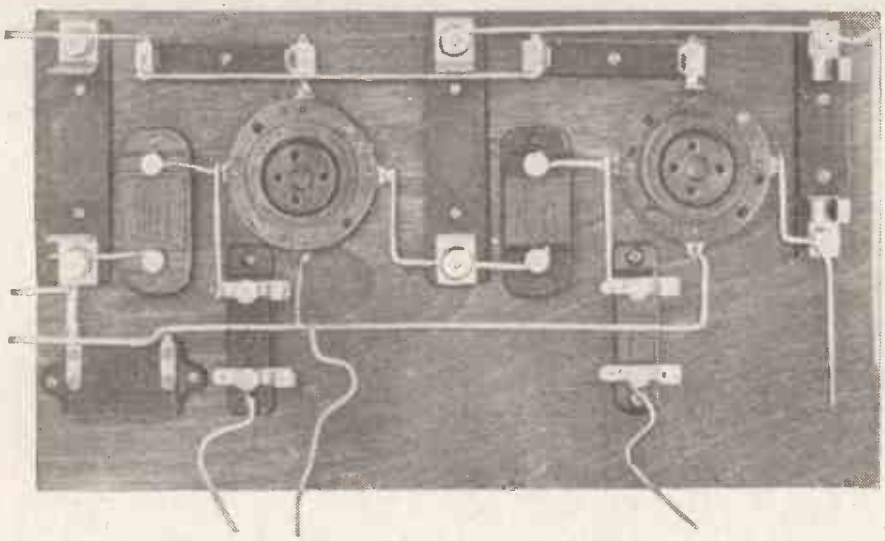


Fig. 1. A conventional transformer coupled arrangement. Compare this with the diagram below.



A plan view of the resistance amplifier unit.

One fixed condenser, ·001 mfd. Any good make will do.

Two fixed resisters, suitable for valves to be used. I have used Amperites in the unit being described. If you already have filament resistances of the variable type, there is no reason why these should not be used; or, if both valves are of the same type, they can be run from the same filament resistance.

Two suitable valve sockets of the anti-vibration type of any of the well-known makes, such as Benjamin, Burndept, Etherplus, Lotus, etc., etc.

Suitable grid bias battery.

Three plugs for same.

Base for clip-in condenser.

Clip-in condenser to suit your particular loud speaker. A value of ·001 or ·002 mfd. suits many instruments, while some loud speakers work best of all without any shunting condenser. The McMichael base and clip-in condensers are suitable here.

I suggest that you follow the lay-out of parts shown, as this makes the wiring particularly simple. It may be, however, that the space in your cabinet is not quite suitable for this arrangement, and in such circumstances you may have to modify the lay-out slightly. If you can, adhere to the arrangement shown, as, even in a low-frequency amplifier, short wiring is a distinct advantage, and helps to avoid undesirable low-frequency effects which often give rise to distortion, even in a resistance amplifier.

On examining the wiring diagram of the unit, you will find a fixed condenser connected between one input terminal and the low-tension negative. This is to provide the necessary by-pass for high-

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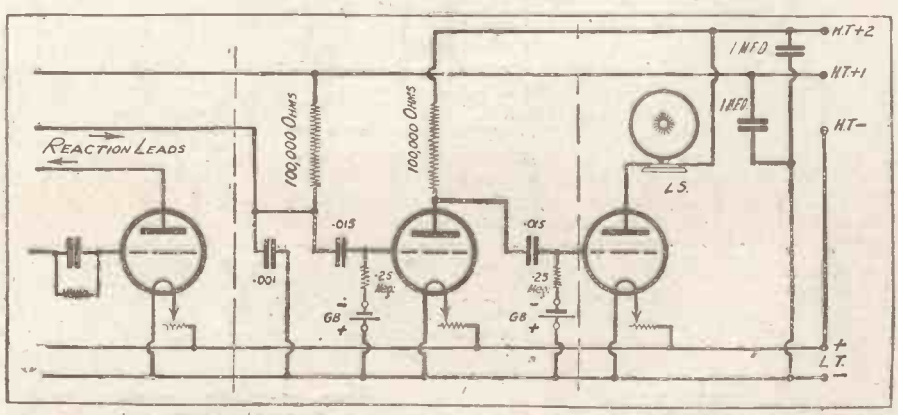

Fig. 2. A resistance amplifier unit. Note that the portions to the left and right of the dotted lines are the same as in the transformer coupled arrangement above.

A RESISTANCE AMPLIFIER.

(*Continued from previous page.*)

frequency currents in the detector circuit, such as you obtain when using reaction amplification. If, as is probably the case, you have already used such a condenser across the primary of your first low-frequency transformer, this condenser will take its place; and, indeed, you can use the same condenser re-wired in this position.

I prefer the connection between the plate of the detector valve and negative low tension to the position across the resistance alone, for reasons explained in the first number of "The Radio Constructor" (on the "Correspondence" page).

Valves.

The choice of valves for a resistance amplifier is a very important matter, for the ordinary types of valves, which give good results with transformers, are not the best for resistance amplifiers. To get the best results, you need what are called "high impedance valves." Practically all valve makers now make special valves designed for resistance amplification. These are obtainable in two, four, and six volt types, so that if you are accustomed to using, say, two-volt valves, you can obtain suitable resistance-coupling valves to go with this filament voltage.

The first special valves for resistance capacity coupling were of the six volt type, known in one make as the D.E.5B., in another as the D.F.A.4, and another as the C.T.25B. As these were the first they are probably some of the best known, but as suitable valves have now been made by most makers in the four and two-volt varieties, we are not, as has occasionally been suggested, limited to six-volt valves.

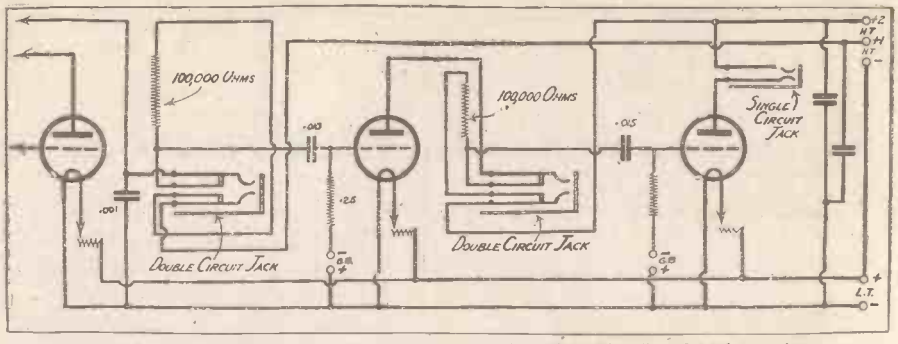

Fig. 3.—If jack switching is desired in a resistance amplifier, it can be effected as shown above.

THIS SET IN A NUTSHELL.

Circuit: Resistance unit to replace present two-valve transformer-coupled amplifier.

Purpose: To obtain pure reproduction when present arrangement is unsatisfactory.

Cost of replacement parts (excluding valves): Approximately 25s.

The Last Valve.

It is important to point out that the last valve, having no resistance in its plate circuit, does not require to be of the special type, and, indeed, is preferably *not* of that type. For the last valve, then, use the same type of valve as you have previously used in the last stage of your transformer amplifier.

This will save buying one special valve. While the ordinary valves *can* be used in a resistance amplifier, the amplification so obtained will be far less than is possible with the proper type. Resistance capacity types of valves are, therefore, needed for the detector (which you will see has a resistance in its plate circuit) and the first low-frequency stage.

How you connect up your high-tension leads will depend on your present arrangement. If you have been using a rather

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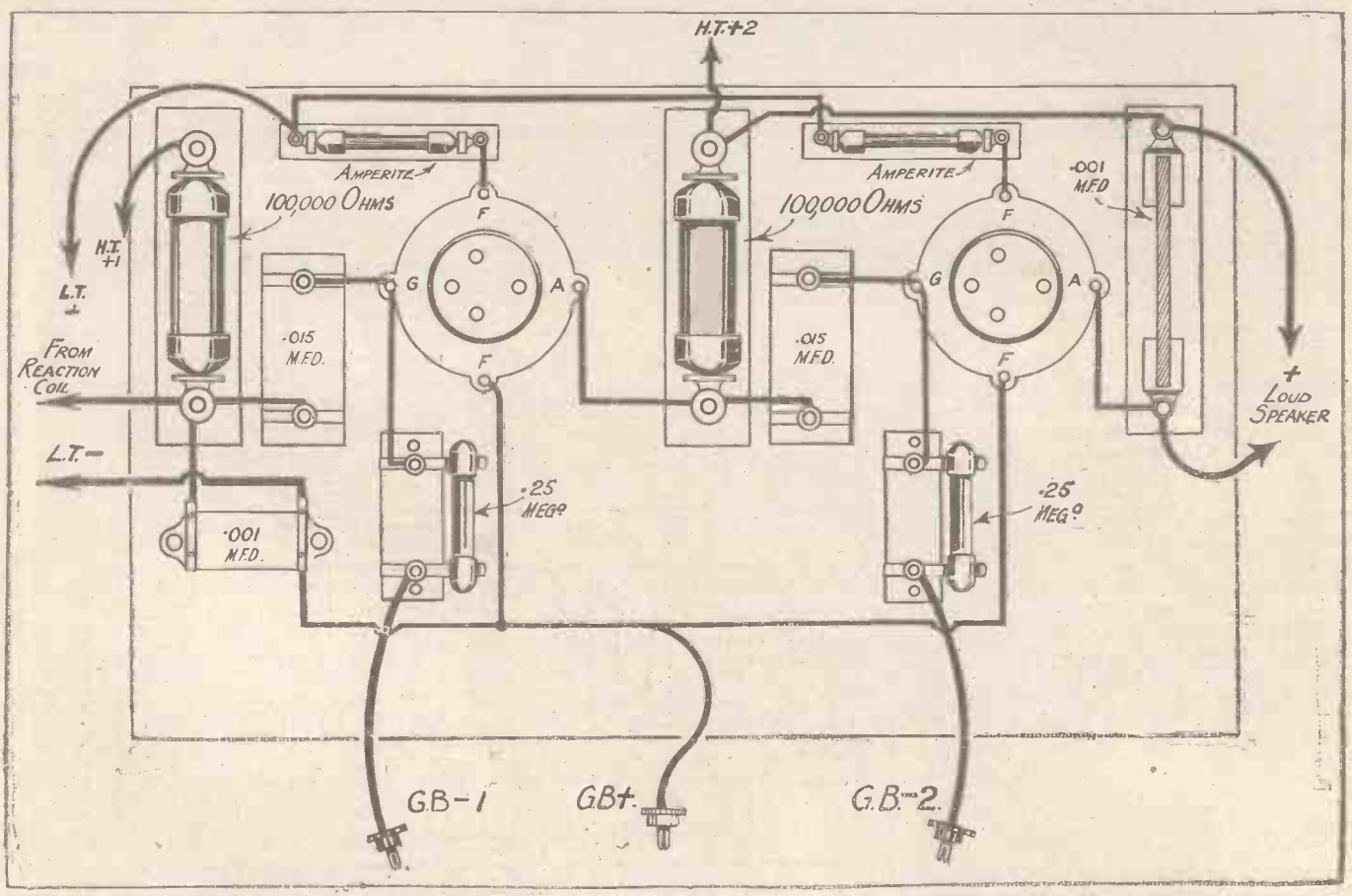


Fig. 4.—This diagram shows both the wiring and the connections to the other parts of the apparatus. Lausbridge condensers should be mounted across the H.T. terminals, if not already fitted.

FACTS ABOUT L.T. ELIMINATORS.

By P. W. H.

The Editor deals with points raised by correspondents who are building Battery Eliminators for Home use.

A CORRESPONDENT wants to know why, if we can get our high-tension supply from the mains, we are not provided by the manufacturers with low-tension eliminators, for surely, he says, supplying the filament current is a far simpler problem.

I wish it were so, for, although the accumulator manufacturers are now giving us excellent products and the valve manufacturers on their part are doing their utmost to reduce the current demands, many people find the use of accumulators highly inconvenient owing to their distance from a suitable charging station.

It must not be forgotten that accumulators need recharging even when no current has been taken from them, as they gradually lose their charge when standing idle. Indeed, accumulator manufacturers tell me that a regular charge and discharge of our accumulator is much better for its health than keeping it fully charged without use.

How it feels when you don't charge your own accumulators.

The so-called "direct current" supply to so many houses is not perfectly continuous, but has superimposed on it a ripple which can give a very irritating hum. It is necessary to smooth this out before it is used for wireless purposes. However, there are means of running filaments in series and using an arrangement quite different from the ordinary smoothing unit as used for high-tension battery elimination, so as to give currents of a small order, such as are taken by the ·06 ampere type of valve, but there are a large number of practical difficulties in the way.

So far as direct current is concerned, even assuming that the supply was perfectly smooth and free from ripple, the many disturbances caused by switching lights on and off, starting and stopping lifts, trams, trains and all kinds of devices, set up many surges which inevitably find their way into the wireless set as noises. Filtering a small current of a few milliamps, such as is required to operate the high-tension side of the set, is a relatively simple matter, but to handle currents comparable with those generally used for filament lighting is not yet really practical.

You will see that if there are difficulties in relation to the so-called direct current, they are greatly magnified in regard to alternating current. The rectification of a current of, say, quarter of an ampere is quite beyond the capabilities of the ordinary small rectifying valves. These are generally designed for a maximum output of about a quarter of this figure.

In America, where the standard voltage of 110 and a standard frequency of 60 makes the design of battery eliminators a much simpler matter, the best solution that has been found is the use of a very small accumulator with what is known as a "trickle-charger," so that when one leaves the set it goes on charging automatically until the next time it is needed.

MODERNISING THE "FOUR-VALVE FAMILY" RECEIVER.

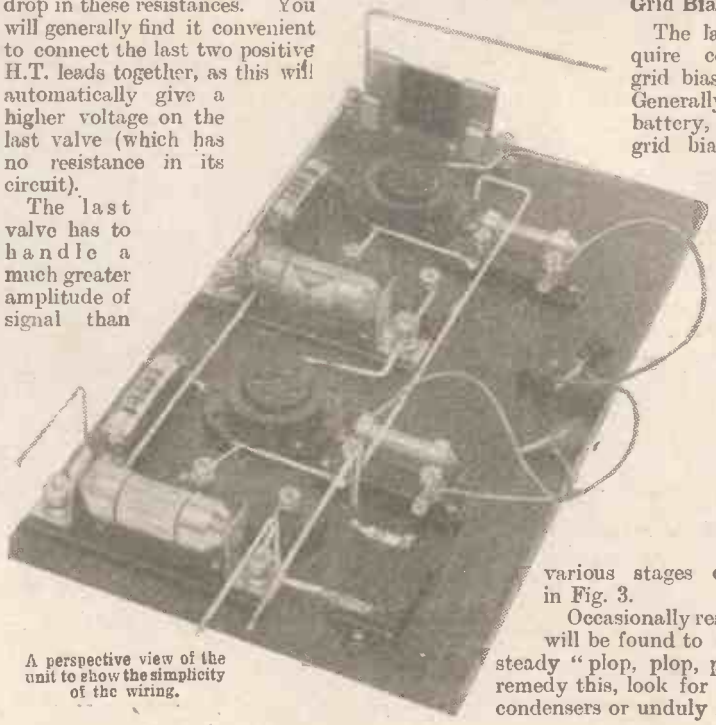
SEE NEXT WEEK'S ISSUE OF "THE RADIO CONSTRUCTOR"

A RESISTANCE AMPLIFIER.

(Continued from previous page.)

low voltage on your detector, remember that it must be increased by at least 50 per cent when using a resistance amplifier, as there is a considerable voltage drop in these resistances. You will generally find it convenient to connect the last two positive H.T. leads together, as this will automatically give a higher voltage on the last valve (which has no resistance in its circuit).

The last valve has to handle a much greater amplitude of signal than the previous valve, and the higher voltage is thus desirable to avoid distortion. Usually a 120-volt battery gives adequate results with a resistance amplifier, although if very loud signals are *received* (this is somewhat different from very loud signals being *required*) you may find it advisable to use 150 volts. Normally, however, the additional cost of a further 30 volts for high tension would not be justified by results.



A perspective view of the unit to show the simplicity of the wiring.

Grid Bias.

The last valve will require considerably more grid bias than the other. Generally, with a 120-volt battery, about 1½ or 3 volts grid bias is adequate for the first low-frequency valve, as you will see on examining the leaflet supplied with the valve by the maker. For the last stage you will probably require six or eight volts, using the average small power valve.

If jack switching is used, the connections for plugging in various stages can be as shown in Fig. 3.

Occasionally resistance amplifiers will be found to howl, or to give a steady "plop, plop, plop," sound. To remedy this, look for faulty grid-leaks, condensers or unduly lengthy wiring.

"MEET the METER"

The Why and Wherefore of Wireless Measurements.

By PERCY W. HARRIS, M.I.R.E.

THE wireless hobby becomes much more interesting when we can ferret out facts for ourselves, and have not to take the "other man's word" in matters scientific. In this article I want to introduce to you a few great friends of mine, in the hope that they may prove as useful to you as they have to me. Mr. Experimenter: allow me to introduce to you the Meters! In particular this strapping daughter of the family, Milly. Milly and I have known one another for years and have made many interesting voyages of discovery together.

Then there is Micro. Micro-ammeter is a quite expensive sort of person, with a

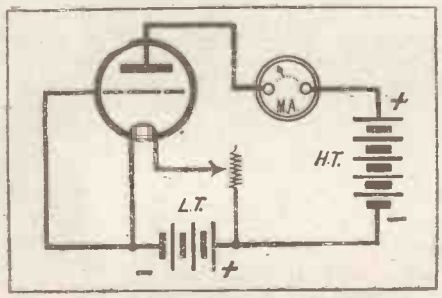


Fig. 1. Measuring plate current with a milliammeter.

vision far more acute than that of his sister Milly; and here we have Galvano. Galvanometer is a rather flippant member of the family, and usually considers he has done a good day's work if he gives a kick when he sees anything interesting.

A good, solid, reliable and very useful member of the family is Volt-meter. In my laboratory he has several servants, and I will tell you something about them and of their limitations a little later.

Seriously, I should like every reader of the "Radio Constructor" to realise how very useful one or two meters can be. Like all scientific instruments, the prices vary according to the capabilities of the particular specimens, and the high grade meters may prove very expensive indeed. However, those which are most useful are not by any means the most costly and even if we purchase only one—the milliammeter—it will provide us with an immense amount of useful information.

The Milliammeter.

A milliampere, as you know, is one thousandth part of an ampere, and any meter which will show us accurately the amount of current flowing in the plate circuit of the valve will afford a great deal of help. A milliammeter of quite good quality can be obtained from such firms as the Economic Electric Co., Ltd., Fitzroy Square; Electradix Radio of Upper Thames Street, Ward & Goldstone, Ltd., of Pendleton, Manchester (to mention but three), for about thirty shillings, and may be chosen to give a maximum reading of not more than fifteen milliamperes.

If a scale of about this size is used, it is possible to take quite small readings without confusion. Better still, one can obtain a multi-range instrument with plugs or switches so that the variety of ranges can be obtained, but, naturally, such instruments are more expensive.

I could write several articles on the use of the milliammeter alone, but here are a few examples of its practical value. Take, first of all, the case of a valve which does not seem "up to scratch." The valve lights, but somehow or other signals seem weaker than usual or perhaps badly distorted. Such effects may be due to several causes, such as a faulty grid bias battery, H.T. battery running down, L.T. failing, transformer faults, and so.

But it may also be due to the valve having lost some of its emission power. Without a milliammeter it is very difficult to find out whether this is the case, but with the instrument it is but the work of a few moments to make a test.

If you look at Fig. 1 you will see a simple diagram of a valve, an accumulator, a filament resistance, milliammeter, and an H.T. battery. It shows you the way to connect up a valve if you want to see if its emission has fallen off considerably. You can quickly rig up on a board a filament resistance, valve socket and flexible leads for the batteries, and for this test you should join the grid connection to the negative filament, keeping the filament resistance in the positive lead.

Testing Valves.

When the batteries are connected up, a current will flow through the valve and, passing through the milliammeter, will give a reading. Now if you know the actual voltage of your H.T. battery, and add to it the voltage of your accumulator, you can then look on the makers' chart (which usually gives a curve) and see what the emission should be given at "zero grid volts." If the figure given on your milliammeter differs substantially from this something is wrong.

Perhaps you will say: I have not a good voltmeter which will show me the correct voltage.

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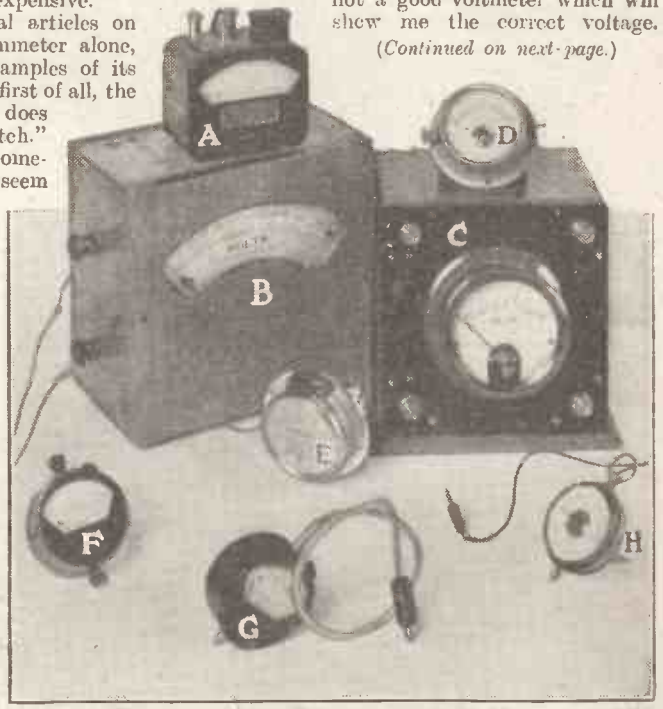


Some of the meters in my laboratory. A.—A "Universal" meter, measuring milliamperes, amperes and volts. B.—A high resistance voltmeter for measuring H.T. voltages. C.—An A.C. voltmeter. D.—A D.C. ammeter (low reading). E.—Hot wire ammeter for transmission experiments. F, G, and H. Portable voltmeters and milliammeters.

"MEET THE METER."

(*Continued from previous page.*)

This is not a matter of very great importance for a rough test on your set will have told you whether the H.T. battery is in fair condition and, in any case, if the valve is giving an emission reasonably near the figure it is supposed to give, there will not be much wrong with your signals.

If, as is frequently the case, you have another valve of the same type which you *know* to be working satisfactorily, you can see whether the reading with the satisfactory valve is the same as that for the one about which you have doubts. This, then, removes the necessity of knowing the exact voltage of the H.T. battery.

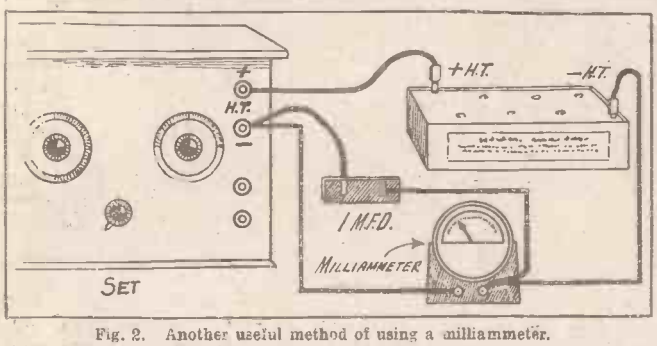


Fig. 2. Another useful method of using a milliammeter.

A second very useful way of utilising a milliammeter is to place it in series with the negative H.T. lead from your battery to your set, taking the precaution of shunting the milliammeter with a one mfd. Mansbridge condenser (otherwise the inductive effect of the windings may upset the functioning of the receiver). Do this first of all when you know your set to be working well and note the figure given.

Checking your Set.

If at any time your set should seem to be working badly, reinsert the milliammeter as shown and see if the reading is normal. Quite likely you will find that the reading has dropped several milliamperes, which may indicate that one or more valves have lost their emission. Remember that any alteration of grid bias will alter the milliammeter reading and if your grid-bias battery has failed you, you may get an indication in this way.

Many experimenters use the milliammeter as a check to see whether their audio-frequency valves are distorting. When correct grid bias has been applied to a valve the voltage swing, set up by the signals, will all be within the negative side of the curve, provided the valve is not overloaded. As a practical example, let us imagine that we are using 120 volts on the plate of a power valve of a type which requires for this plate voltage four and a half volts grid-bias. With such a grid-bias voltage, a "grid swing" of, say, 3 volts on either side of the working point will still keep the grid negative.

If the curve is approximately straight, the rise and fall of current on each side of the working point will be equal, and the *average* current through the valve will be maintained constant. A milliammeter in the plate circuit of the particular valve will thus keep its needle steady. Now let us imagine that our grid bias has been incorrectly set to, say, two volts.

Why the Needle Flicks,

A grid swing of three volts will therefore carry us over on to the positive side, and directly the grid becomes positive, grid current flows and a three-volt swing on either side of the working point will make the rise and fall of the current unequal. The effect will be that so long as a three-volt swing is being maintained the average plate current will be different from its normal value. Thus, every time the grid becomes positive the needle of the milliammeter will flick.

You will now see why some experimenters use a milliammeter in the circuit as a check on distortion.

There are many other uses for a milliammeter, to which space does not permit reference here. For the experimenter the milliammeter is by far the most useful of all the meters, and if he is beginning to do serious work it will soon prove indispensable.

The voltmeter is also very valuable, but, unless of the correct kind, it can be very misleading. All the cheap voltmeters have a low resistance, and when connected across a battery, take a considerable current.

For example, the current taken by the cheap watch-case type of voltmeter, while not sufficient to upset the reading of an L.T. accumulator, is far too low for use in H.T. battery testing.

An H.T. battery which will show, say, 60 volts with a current of three or four milliamps. may show only half that figure when giving the large current required by a cheap voltmeter. For H.T. battery testing you should always specify a high resistance voltmeter.

Many experimenters have wondered why they cannot get a correct or even *any* reading with their voltmeter testing the actual voltage applied to the plate of a valve in a resistance-coupled amplifier. The reason is not immediately obvious. Let us imagine we are using a 120-volt battery and a 100,000 ohm resistance in series with it. We know there is a considerable drop of voltage in this resistance, and at the first glance we might think that connecting the voltmeter between the plate and filament would give us the voltage applied to the valve.

A few moments consideration will show us why this is not the case. For simplicity, let us consider the plate to filament resistance of the valve as 100,000—the same as that of the anode resistance. As the voltage of the battery is absorbed across the two resistances in series, half the voltage will be dropped across the anode resistance, and half across the valve. Thus, roughly speaking, 120 volts applied to the set will give 60 volts across the valve.

Now let us apply our voltmeter. We will assume it is a good voltmeter, having a resistance of, say, 10,000. This will now be in series with the anode resistance, and in parallel with the valve resistance. Again, to simplify matters, we will ignore the slight reduction of the resistance due to the paralleling of the 100,000 ohms with the valve. We will consider we have now 100,000 ohms in series with 10,000 ohms.

As the whole voltage will be dropped across the 110,000 ohms, ten-elevenths of the voltage drop will be in the resistance, and only one-eleventh across the voltmeter. The voltage across the voltmeter terminals will thus be roughly eleven, which has no relation to the voltage across the valve when the voltmeter is disconnected.

In an early issue we will consider some more facts and problems relating to meters.

For those who wish to charge their H.T. accumulators at home, there are several commercial forms of chargers, two of which are shown above.

Note.—In this section Mr. Harris will discuss each week interesting points from the large correspondence he regularly receives. Readers are invited to write to him on matters of interest, and extracts from their letters, together with Mr. Harris' comments, will be published from time to time. It must be pointed out, however, that general and technical queries cannot be answered in this section, but should be addressed to the Technical Query Department, complying with the conditions laid down under the heading, "Technical Queries" in each week's issue of POPULAR WIRELESS.

I HAVE recently received a number of enquiries on matters relating to apparatus and "eliminators" for running sets from the mains, particularly from readers who are ardent readers of American advertising and wireless literature. Here is a typical letter:

"Dear Sir,—I am rather puzzled at the results I am obtaining with my high-tension battery eliminator which, I must say at once, gives generally satisfactory results. Previously to purchasing this eliminator, I was using dry batteries with tappings at about 50 and at 120 volts for the low-frequency stages. On connecting up my set to the eliminator I adjusted the plugs as recommended by the makers and was soon obtaining splendid results without any trace of hum from the A.C. mains.

Voltmeter Readings.

"I am, however, very puzzled with the readings of my voltmeter. Although signals are coming through excellently it gives a reading far below what must really be the high-tension voltage I am getting. Again, I understand that one of the greatest advantages of the battery eliminator is that it cannot 'run down' as do high-tension batteries or accumulators.

"Can you account for the fact that the other evening after I had put some new valves in the set I had to increase the voltage on the tappings very considerably before I could get the same signal strength? This is just what I had to do with my high-tension batteries owing to their steady loss of voltage."

My correspondent has asked two questions seemingly on different aspects of the subject, but which are really related to the same point. It is not generally realised that the actual voltage given by these high-tension battery eliminators is largely dependent upon the load taken from them. By this I mean that if you are getting, say, 100 volts from your eliminator when your set is taking, say, 8 milliamps, the increase of load to, say, 16 milliamps (by the use of other valves, or a change in grid bias) will bring the applied voltage down. How much the voltage drop will be depends upon the make of eliminator and its general excellence. In some the voltage drop may be so considerable as to make it necessary to reset your tappings to entirely different values.

This is not due to the set "running down," but simply, as stated, to the fact that the voltage is closely related to the load on the eliminator. Presumably the new valves which my correspondent used took considerably more plate current than the older type. If he restores the old valves he will find the voltage on the new tappings will go right up. Usually, however, the battery eliminators have plenty of margin to allow for changes of this kind, although with some of the power valves when one is anxious to get the highest possible voltage, the maximum may not be quite as high as one desires.

NEXT WEEK:

"The Stationmaster."

A Five-Valve Set for Frame Aerial Reception and Modernising the "Four-Valve Family."

The point relating to the voltmeter is very interesting. Here again it is not generally appreciated that most voltmeters require an appreciable current to operate them. For example, I have a good (and expensive) voltmeter which I use for testing high-tension batteries. On a 72-volt battery it takes seven milliamps, which, incidentally, is rather a useful figure because it shows me the practical working voltage of the battery under a reasonable load.

Doubling the Load.

Now, if I place this voltmeter across the tappings of an H.T. battery eliminator, which is already delivering seven milliamps to a set, the current required by the voltmeter added to that consumed by the set, makes in all fourteen milliamps or exactly double the normal load. This will make a very important variation of voltage. While the voltmeter thus reads accurately the voltage given by that particular battery eliminator with a load of fourteen milliamps, its reading bears little relation to the voltage given by the same eliminator at seven milliamps.

Of course, it is possible to measure the voltage with suitable instruments, but these are not generally available to the average experimenter.

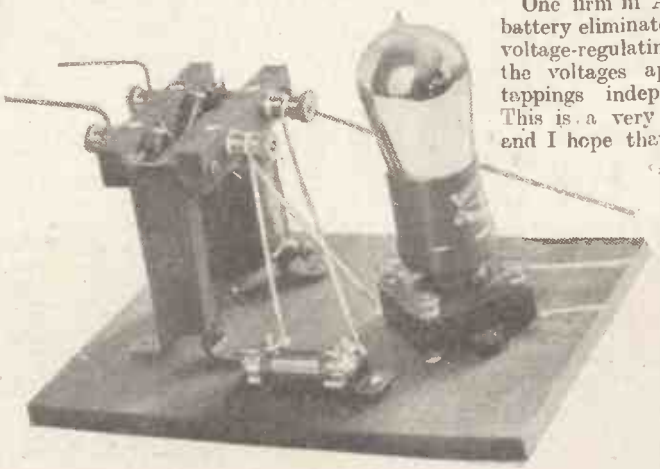
Speaking of battery eliminators reminds that it cannot be too strongly impressed upon all listeners that great care must be taken in using them. Let us assume you are using dry batteries giving 120 volts, and for these you substitute a battery eliminator giving the same voltage.

The shock you can obtain from the H.T. eliminator may be *far greater* than that from the dry battery, although the voltage is the same. For this reason be careful when altering the various tappings.

Tapping Troubles.

Here again we come against the difficulty of load varying voltage. If you have tappings for, say, 40 volts for the detector, 60 volts for the high frequency, and 150 for the low frequency, remember that removing the plug from any one tapping will appreciably decrease the load on the eliminator and automatically increase the voltage on the others, possibly upsetting your reaction arrangements.

One firm in America is marketing a battery eliminator which has a special voltage-regulating valve to maintain the voltages applied to the various tappings independently of the load. This is a very valuable improvement and I hope that, before very long, it will be introduced into all the battery eliminators.



Showing the ¼ megohm grid across the L.F. transformer.

A Useful Pictorial Hint.

If your amplifier howls, try connecting a ¼ megohm grid across the IS and OS terminals as shown. This will probably stop the howl and improve the quality of the reception from both your local and distant stations.

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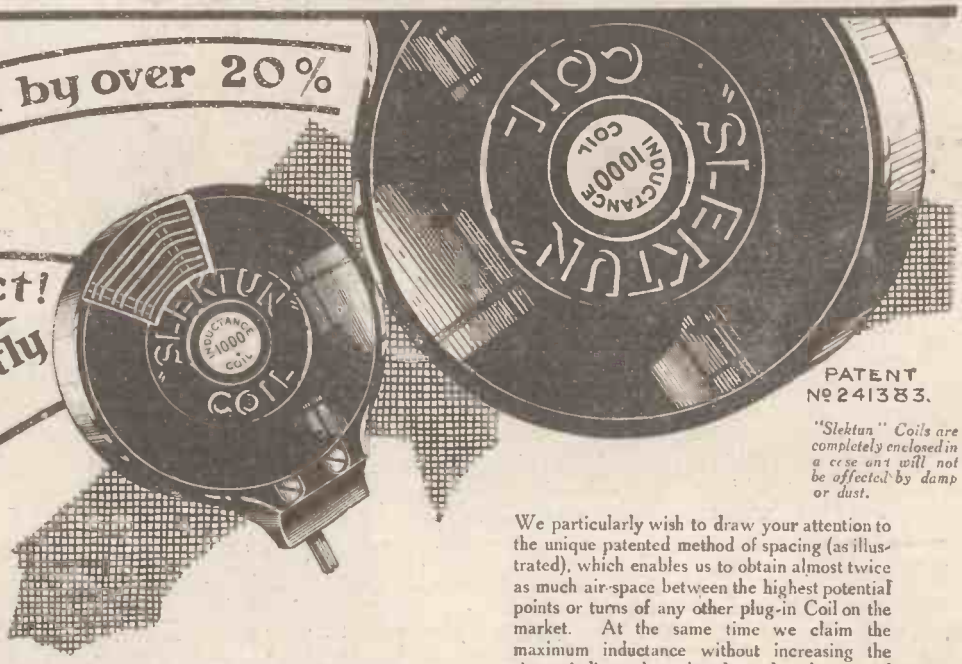

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The World's finest Coil

We are confident of our claim that "Slektun" Coils are the finest that have ever been produced, and to support our contention give below details of a test made by the National Physical Laboratory. Compare these figures with those of any other Coil:

"Slektun" Coil	Inductance:	Self Capacity:
of 200 turns	1770 Micro-Henries	3 Micro-Micro Farads

These figures constitute a record in the manufacture of Inductance Coils.

So confident are we that you will obtain unprecedented results that we are prepared to forward "Slektun" Coils direct to you, carriage paid, at the reduced prices and on the condition that if you are not entirely satisfied with them, they can be returned within 7 days and money refunded. Read the details alongside and forward your order at once. This offer is only open for a limited period!

We particularly wish to draw your attention to the unique patented method of spacing (as illustrated), which enables us to obtain almost twice as much air-space between the highest potential points or turns of any other plug-in Coil on the market. At the same time we claim the maximum inductance without increasing the size windings, brought about by the use of wedge-shaped Ebonite Separators.

We can only supply Coils in sets, for any other Coil in circuit with "Slektuns" will naturally not produce the same perfection owing to the difference in the direction of the winding.
The following sets are available at once:

DAVENTRY.

A set of 2, viz.:	200 and 250	... Price 15/-
,, 3 ,,	200, 250 & 300	... Price 20/-
,, 4 ,,	150, 200, 250 & 300	Price 25/-

BROADCASTING.

A set of 2, viz.:	35 and 60	... Price 9/-
,, 3 ,,	35, 60 & 75	... Price 14/-
,, 4 ,,	35, 50, 60 & 75	Price 17/6

Remember this: The "Slektun" Coil gives the lowest distributed Capacity and Resistance with the highest inductance. (All cases are the same size.) And now forward your order at once to avoid disappointment—Orders taken strictly in rotation.

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SULPHURIC BLEMISHES IN ACCUMULATORS

A MICROSCOPIC INVESTIGATION.

By JAMES SCOTT, M.S.C.I., M.A.C.S., and M.E.H.A.

TOO little attention is given by the majority of users of wireless sets to the various *chemical* aspects of their recreative hobby. They may be well advanced in respect to the knowledge gained in an electrical, magnetic and etheric direction, but they neglect to learn, or practise, much about the changes which are liable to occur through the mutual operations of the acids and metals which necessarily form part of their equipment. Yet considerable loss of or, in minor cases, interference with current is thereby involved, with consequent and corresponding detriment.

The Power of Sulphuric Acid.

Most readers will, I daresay, be aware that their accumulators are charged with sulphuric acid, which is known also as white vitriol, and oleum or oil of vitriol. Now this

Greatly magnified bluish crust formed on accumulator terminals.

acid, like all others, possesses the very active property of readily and easily dissolving most kinds of metal. It is true that there are specialised productions which are guaranteed to resist such corrosive tendencies, and they undoubtedly do so to a certain extent.

But since these metals are, in a way, unique, and are only used in circumstances where sulphuric acid is manufactured or stored, their consideration must be ruled out from our present consideration of the subject. Our subject is a very important one, more so than might be thought by the reader unless he is conversant with the science of chemistry.

If you will pour some warm dilute sulphuric acid into a glass or earthenware jar, or any other suitable receptacle, you will find that upon dropping a piece of any ordinary metal therein action almost immediately commences, and lasts for a very long time—unless the amount of solid substance is very trivial—continuing to consume, eat, or dissolve the metal until it entirely vanishes—that is to say, it vanishes as far as discernment by vision is concerned, although really it is still present in another condition, without form as such.

Simultaneously with these changes the evolution of a distinct colour becomes evident, this being quite different from that of the metal which has, in conjunction with the sulphuric acid, given origin to it.

The colour is dispersed throughout the acid, and differs according to the kind of metal which has been thus treated. In the case of copper it is *blue;* in that of zinc it is *white;* in iron *green;* in some other metals equally distinctive and clear.

Bear in mind that theoretically the metal, whatever element it may be, can be recovered *as* metal, in exactly the same nature and amount as it was before it was dissolved, provided that it is subjected to suitable treatment.

Corroded Terminals.

If the acid solution is boiled so as to expel all the water, or as much of it as is possible, there should finally remain behind *a coloured metallic salt*, representing the combination of sulphuric acid and metal. By serving this salt in the same manner as an ore is dealt with metal may be smelted out from the compound and used as required.

On the present occasion I have in view the formation of the "*sugary*"—*it has nothing whatever to do with sugar, however*—crust which is frequently noticed upon the upper portions of accumulators, and so on. It is bluish in colour, unless the latter has been further modified by the presence and action, or incorporation, of a newly produced salt of one or other of the adjacent metals, such as iron or steel, when the colour may have a greenish tinge.

But I must confine my remarks to the contemplation of copper and sulphuric acid, when the salt yielded by their interactions is blue. The familiar "bluestone," so widely used in horticultural insecticide sprays, etc., is a compound, or salt, of copper and sulphuric acid, purposely prepared from those two items.

Copper sulphate (or sulphate of copper) is the true chemical name.

If you have an accumulator with brass or bronze fittings these will often be found surrounded by scraps, nodules, or flakes of this substance. They can be scratched or pulled away by the merest touch, and are due to the action of the sulphuric acid on the metal, especially the bared end, or terminal, of the connecting wire, which is, of course, generally copper.

Copper Sulphate Magnified.

Brass is an alloy or mixture, of the two metals copper and zinc, and the acid dissolves the copper into "bluestone," and the zinc into zinc sulphate, a white salt, the presence of which lightens the blueness of

The same crust spread out in a drop of water.

the copper sulphate, which otherwise would be, *if pure*, a deep rich blue.

Bronze is a compound of copper and tin. There are, however, several varieties of bronze, named according to the ingredients which are incorporated with the alloy, and thereby confer definite, oft-times striking appearances and attributes upon it. For instance, aluminium-bronze—this is the fictitious aluminium *gold*—contains, besides the necessary copper and tin, a small proportion of aluminium, which is responsible for its beautiful brilliance. The acid forms aluminium sulphate with it.

Phosphor-bronze carries a little phosphorus in it, in addition to the other two elements named. Hence it will yield, if acted on by sulphuric acid, quite a different salt. It is too technical a matter, however, to go deeper into on the present occasion, as the presence of traces of phosphorus

(*Continued on next page.*)

SULPHURIC BLEMISHES IN ACCUMULATORS.

(Continued from previous page.)

acid would have to be taken into consideration, and it is really not incumbent on me to do so.

I will now deal with the microscopical structure of this salt, copper sulphate, round the screw heads, etc., of an accumulator. When this remarkable apparatus is charged it is almost impossible to prevent some of the sulphuric acid from attacking the metals in the vicinity. Thus it gives a crusty

After a few hours' soaking, and then evaporation, crystals typical of their metal bases begin to form.

residue of copper sulphate from the copper, brass, or bronze with which it comes into direct contact.

Upon properly magnifying a scrap of this bluish, or greenish-blue, substance, in its wholly undisturbed position and condition, we find that it appears as shown in Fig. 1. It is then seen to be a mere small heap of granules, among which are embedded some minute, highly glistening crystals of various shapes, which the chemist can, if he wishes to do so, thoroughly analyse.

Interesting Changes.

Next detach a small piece of the grit from the accumulator and lay it on a glass slide—i.e. a strip of thin glass a few inches long and about an inch wide. When this is run beneath the microscope, after a drop or two of water has been placed upon it to separate its particles, it is disclosed as a layer of crystals and specks, of the character depicted in Fig. 2. These resemble tiny gems and sparkle prettily as the light is caused to play upon them at different angles.

They signify a mixture of objects, consisting of copper sulphate, zinc sulphate, tin sulphate, and so on, and within a few hours, if enough water is present for the purpose, they completely dissolve and give a solution of the mixed salts just named. Upon prolonged exposure to the air they are replaced by formless filigree, left by evaporation of the water.

During the first few hours after being watered the irregular granules are merely surrounded by fluid medium, because certain of the components are deliquescent—that is to say, speaking in a technical sense, they not only retain but absorb from the air available moisture.

But as time proceeds changes develop in the respective constitutions of the particles, and they become devoid of all apparent solution, and stand up dry but crude, as delineated in Fig. 3. If they are warmed the final result is the production of shapeless ridges wherein these objects are fused together.

Preventing Deterioration.

Note the comparatively long, needle-like crystals. They are known as raphides, and are typical of sulphatic combinations; or in other words, compounds of sulphuric acid with a metal, or other solid material.

The points that I have so minutely demonstrated have a very practical significance. One will commonly find in houses and shops where such should not exist faulty and dirty, or worn, accumulators. The metallic lids, coverings and fittings are spotted or disfigured by the presence of bluish, greenish, brownish and dusty wafers, specks, pimples, or other products of reactions resulting from the sulphuric acid and accompanying metals. *There need not be any such rubbish if only people would take the trouble to learn about these things;* and surely, in this age of wonderful experiment and practice, it should not be argued as an excuse for neglect that the owners did not know of such possibilities.

Maintenance Hints.

One cannot altogether avoid the appearance of some sort of signs of wear and tear, so to speak, but ordinary wear, traceable to straightforward performances, is very much different from those faults to which I am referring, since they are evidently based on necessary chemical action. We cannot expect *anything* that we handle to last for ever.

That is no reason, however, why users should hasten the decomposition of their respective sets. And it is *so* easy to hinder the rapid onset of these injurious traits—just keep all excess, spilt sulphuric acid from *continuous* intimacy with the parts hitherto mentioned. Wipe it off after recharging, or when an accumulator has been moved. Keep the metals clean and bright. In this case ignorance is *not* bliss—but means loss of current and of money!

CONCERNING TERMINALS.

By J. F. C.

A TERMINAL which ultimately comes loose in a neatly laid out and arranged radio panel is an article the wayward propensities of which would indeed sorely try the proverbial patience and self-restraint of a Job.

Yet, indeed, this sort of thing does happen, even in some of the best constructed sets.

The first cause of a terminal coming loose may be seen in the habit some amateurs have of drilling the hole in the panel much larger in diameter than the shaft of the terminal which has to fit through it. Such terminals are merely secured by the frictional pressure of the washers and nuts below the terminal. Consider what happens in such cases. The ebonite in contact with the washer or securing nut of the terminal is subjected to a considerable degree of compression. When the panel is new, the ebonite is soft and elastic, and its elasticity enables it to bear against the compression of the terminal securing nut. After a time, however, the ebonite loses a good deal of its elasticity, especially if it be poor quality ebonite. Consequently it ceases to bear against the compression of the nut, and thus the terminal comes loose.

Some Remedies.

The remedy, of course, is to drill the holes in the panel of such a size that the terminal only just passes through them. Always use a washer under the securing nut. This gives a greater area in which the pressure of the nut may be distributed.

Another cause of loose terminals is to be looked for in the undue heating of the terminal shaft during the soldering operation. Beginners in radio construction often experience a difficulty in making soldered connections to terminals, and it takes them some considerable time to effect a good joint. During this time, of course, the terminal shaft naturally becomes very hot. The heat softens the ebonite, and thus the hole in the panel becomes enlarged. The remedy is obvious. The soldering of any connection to a terminal should be done as rapidly as possible in order to prevent these unwanted effects of too greatly prolonged heating.

Apart from making the hole in the panel only sufficiently wide to just take the terminal shaft, another good method of ensuring that panel terminals will not come loose is to tap the ebonite with a thread of the same gauge as the terminal thread, and then to screw the terminal home. This makes an extremely effective and permanently secure terminal mounting, but the method is rather difficult for the beginner, and its use calls for the employment of special taps.

[A terminal with a side prong.

The easiest way of permanently securing terminals to the panel is to employ only terminals which are provided with side prongs, as indicated in the illustration. Such terminals are, unfortunately, not always readily obtainable, but they can generally be procured from firms specialising in the sale of W.D. disposal apparatus.

In using these side prong terminals the main hole in the panel is drilled with just sufficient clearance to take the terminal shaft neatly. A very small hole is drilled about an eighth of an inch at the side of the main hole. This accommodates the side prong.

Opesti~ Nipitia~Secomba

These strange words were broadcast into space the other week when Mars came within the chatting distance of 42 million miles. The chat, however, was all on our side, and several theories exist as to why our advances met with no response. One enthusiast writes :

"Assuming that Mars enjoys the blessing of Radio, we take too much for granted that their instruments are as efficient as our own. In the transmitting set used down here by us, ORMOND Condensers were employed, and the fact that ORMOND Condensers are not, up to the present, available in Mars would amply account for their failure to establish contact."

We agree. In fact, we are convinced that the ORMOND Condenser, with its slow-motion friction drive, ball bearings, and easy mounting has a ready market in that distant sphere.

Illustrated above is our artist's idea of Mars and the Martians. Others, doubtless, have different conceptions. But however much at variance opinions on this point may be, no two opinions exist as far as Ormond Condensers are concerned. In this all are unanimous in acclaiming Ormond as consistently the best.

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RETRANSMISSION OF BRITISH BROADCASTING IN GERMANY AND SCANDINAVIA.

FROM A FOREIGN CORRESPONDENT.

RELAYING of foreign broadcasting is now a regular part of the weekly programmes of the German and Scandinavian main stations, and these retransmissions are indeed very popular among the listeners. The foreign stations which are most frequently relayed are Daventry, Königswusterhausen, Radio-Paris and Hilversum, but it is beyond doubt that Daventry gives the best results of them all. When the reception of any of the other stations fails, Daventry is always certain to come in at good strength.

Of course, the reception is best in the winter-time, but even in the summer months it may be wonderfully clear and, as far as Daventry is concerned, "fading" is not very much experienced in the northern part of Europe. Also several of the other B.B.C. stations have been relayed, for instance, Bournemouth, Aberdeen, Glasgow and Newcastle, whereas London is very difficult to pick up.

A Popular Station.

In Germany the retransmissions are most often carried out by the Königswusterhausen station. Last winter Daventry was often relayed by Königswusterhausen three or four times a week from 12 to 1 o'clock at night (German time). Königswusterhausen—the German 5 X X—is transmitting with a power of 10 to 12 kw., thus having a very large crystal range, and as the retransmissions, furthermore, usually are relayed by land-line to several of the other German stations—i.e. Berlin, Cassel and Elberfeld, thousands of German listeners have enjoyed the B.B.C. programmes during the past winter season.

Königswusterhausen is a very popular station in Northern Europe, and its transmissions may be heard very well on one-valve sets in Denmark and in the south of Sweden. For many of these listeners using one-valve sets it is difficult to pick up Daventry direct, and it has therefore been of great interest to them to hear the B.B.C. programmes via Königswusterhausen.

A Weekly Feature.

In Denmark the retransmissions are broadcasted by the Copenhagen station and also relayed to the other Danish stations. The foreign broadcasting is picked up by a receiving station ("Amager Radio") situated on a small island called Amager, a few miles south of Copenhagen. British broadcasting has always been very popular with Danish listeners. It is only quite recently that the first Danish relay stations were taken into use; about one year ago there were only broadcasting stations in Copenhagen, and it therefore stands to reason that a large percentage of Danish listeners had to be valve set owners. Fifty per cent. of all Danish listeners are still using valve sets, and are thus also able to tune in direct to the foreign stations; as the British stations are heard better than any of the other foreign broadcasting stations, thousands of Danish amateurs are, of course, listening-in direct to the British programmes. However, as relay stations have now been taken into use the number of crystal listeners is rapidly increasing, and the weekly retransmissions of the Daventry programmes

A Danish relay post for picking up and re-broadcasting programmes from the British stations.

are very much appreciated by these listeners.

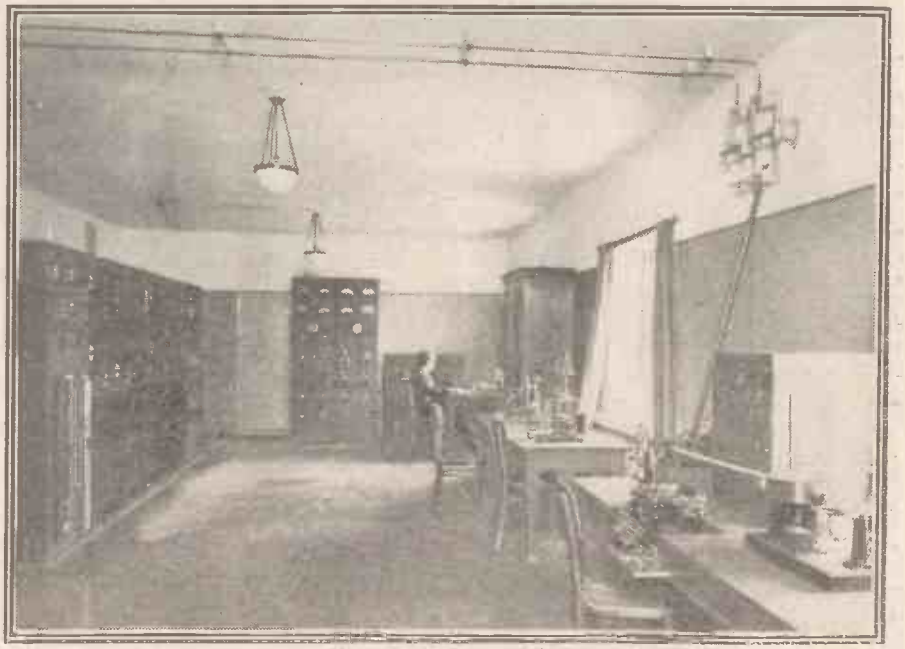
During the recent general strike the ordinary Copenhagen programmes were, on several evenings, broken off and the official strike bulletins which were broadcasted from Daventry were picked up and re-broadcasted to the Danish listeners. The Danish nation, being so closely connected with Great Britain in commercial matters, was, of course, very much interested in the development of the situation.

A Double Relay.

The Kungsbacka Station, near Gothenburg, is the Swedish "Keston." It is a very powerful station, which is also used for the direct wireless communication between Sweden and U.S.A. Last winter Kungsbacka relayed Daventry once a week, and these retransmissions are known all over Scandinavia, and are generally recognised as being some of the best of this sort. Heard on a crystal set these relays of the Daventry programmes are often almost as good and clear as the transmissions of the local station.

Swedish listeners have even heard American broadcasting via one of the British stations. The Swedish "Keston" was on a certain evening re-broadcasting the Newcastle transmissions, and as the Newcastle station on that evening also retransmitted K D K A, Pittsburg, U.S.A., it was made possible for thousands of Swedish amateurs to hear American broadcasting, which it, so far, has proved impossible to relay direct to the Scandinavian listeners.

The reason why the retransmission of British broadcasting is so popular in these countries is, no doubt, also due to the fact that English is understood better than any other foreign language, and is taught in most schools. The B.B.C. programmes are published in full in many of the daily newspapers, and several of the leading British wireless periodicals may be obtained at many bookstalls in the larger towns.



Part of the Swedish Keston—at Kungsbacka—where British broadcasting is picked up and relayed to the Swedish stations.

WHY A FAMOUS SINGER LIKES BRITISH BROADCASTING.

By "ARIEL."

"THERE are some people who sit beside the fire for hours reading novels. I, too, can sit for hours at my fireside, but I know of no more agreeable companion than my wireless set."

Madame Maria Olczewska, the famous singer, told me this when I saw her a few minutes after her great 'ovation at the Royal Albert Hall, on the occasion of the First National Concert organised by the British Broadcasting Company.

There was never a voice more suited to broadcasting than the one we heard that evening, but it is a pity that the items chosen were rather of a sombre nature. One can imagine Madame Olczewska in lighter and better vehicles for such a fine voice. Notwithstanding the somewhat doubtful songs and the great drawback of the German language (for those who understand German are in the minority), she scored a great personal triumph both with her seen as well as her unseen audience.

Madame Maria Olczewska is a radio enthusiast. I had not spoken to her for one minute before I discovered the fact. Not only has she a beautiful set in her home abroad, but she also takes a deep interest in the scientific possibilities of wireless.

Madame Olczewska and I spoke in French, as she is not a fluent linguist when it comes to the British language.

A "one-knob" four-valve set, complete with loud speaker, which can also be used as a table lamp.

"Broadcasting in England seems to be run on a much smoother line than is the case on the Continent," she said. "In my opinion, and I am one of many who think the same, broadcasting programmes at the London station are far superior to those relayed by any of the Continental or even American stations.

"Is England Really Musical?"

"I think that the items are chosen with more care, and there seems to be something to satisfy every taste. This is not the case in other parts of Europe, and I am often bored by what I hear through a loud speaker."

Madame Olczewska went on to say that the success of a broadcasting programme relied mainly on its originality.

"The London station seems to be able to furnish its programmes with this most necessary evil. The little revues and impromptu shows I like very much, and what I have heard or know of them have afforded me great pleasure and infinite amusement.

"But just now, of course, the great thing is to be able to answer that most important question, 'Is England really musical?' and as you, too, ask me that question I can reply to you without a moment's hesitation, 'Yes.'

"I Love Jazz."

"Of course," went on Madame Olczewska, "what is wrong about good music in England is that there is not enough of it done. It has remained to the B.B.C. to show how popular good music can become; and I really believe that the B.B.C. National Concerts will prove a very effective weapon in driving the fact home."

"Many great musicians in England today believe that the B.B.C. is missing great opportunities. Their criticism is that the kind of music that is broadcast is not good enough," I told Madame Olczewska.

"I am one of those who realise how very difficult it must be to compose a really perfect radio programme," she replied. "When it comes to including good music in these programmes it is more difficult than ever, as in this particular case, more so than in any other, there is no limit to the variety of taste.

"Personally, I love some kinds of Chamber music that my best friends could not listen to at any price. I love jazz. Sir Hamilton Harty, to whose accompaniment I have just sung, hates the very word.

"I like any kind of music, and I think that any kind of music should be broadcast. Certainly as much as possible only the best should be given, and I think that the first National Concert has shown that the tendency is definitely in that direction."

Madame Maria Olczewska told me, furthermore, that she did not think that serious music should be taken purely as an entertainment rendering all listeners speechless with delight, but rather in the form of an education.

"Good music is one of the finest forms of education in existence to-day. It is better than all the medicine in the world. I will even go farther and say that syncopated music, in other and simpler words, jazz, is one of the finest means of relaxation after stressful periods of fatigue and brain work.

"I may be a little biased," she said, with a smile, "for I love dancing. After my singing, I love my dancing more than anything else. That is why I cannot suppose for one second that the broadcasting of dance music is overdone.

"Jazz is an incentive to dancing; beautiful symphony an invitation to dream. Why, therefore, if one wants to dance, why shouldn't one prefer syncopation to symphony at certain times of the day.

"Certainly there are times when all kinds of music seems out of place. It must be terribly annoying to get jazz when one's mood asks for symphony, that is why I should like to see the scheme of alternate—or is it alternative?—programmes come into being. Then at leisure one could get just what one happened to be wanting at that moment, *n'est ce pas, monsieur?*"

"Your Talks Annoy Me——"

I asked Madame Maria Olczewska if she had any criticism against broadcasting.

"Yes," she said to me most emphatically, "your talks annoy me tremendously. I cannot understand them. Why are they not broadcast in any of the languages I understand. And some of your jokes. I cannot see the point. *C'est vraiment très ennuyant!*

"But there is one thing I would like to say in conclusion. I wish to say how impressed I have been by the marvellous way my singing has been received both in the Albert Hall and over the wireless. I have received nothing but congratulations. I confess that before the concert I was a trifle frightened, and I feel so happy that my vast English audience has been so good to me.

"Will you tell them through POPULAR WIRELESS that I send them my sincere thanks for the kind letters they have sent me, and that whenever I have another invitation to broadcast I shall always do my very best to fulfil it."

And Madame Olczewska, with her charming smile, said au revoir!

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IT'S THE CURVE THAT COUNTS!

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

FAR too little attention is given these days to the characteristic curves of valves, although no one can question the fact that all the operating merits or faults of a valve show up in its characteristic curves. The size, shape, etc., of the electrodes of a valve all contribute to the curves, so does the emission from the filament. There is, in fact, no essential feature which does not affect the mutual conductance, the impedance, or amplification factor of a valve. The experienced experimenter can learn all he wants to know from the curves and that is why I am publishing this week the curves of the S.T. valves which disclose their great superiority over ordinary valves. The curves given are of the static variety to enable readers to make comparisons with other makes. The valves have, however, been designed on the basis of *Dynamic* curves, which represent operating conditions, *i.e.* with an impedance in the anode circuit. This impedance is, in actual practice, a transformer, loud speaker, or other apparatus, and causes the anode voltage to vary during reception, while in the case of static curves the anode voltage is maintained fixed at, say, 80 or 100 volts.

The excellent operation of S.T. valves is borne out in practice, and, in fact, every valve is tested not only electrically, but on actual broadcasting. It was, however, essential to ensure that these good results would be maintained. For this reason, the filament is made of torodium, which operates at an extremely low temperature. The vacuum is also vital and the Barguet process of exhaustion ensures the highest vacuum known to science.

To return to the curves, you will no doubt wish to keep them for reference. Meanwhile, they will convey to you far more regarding the merits of the valve than pages of claims.

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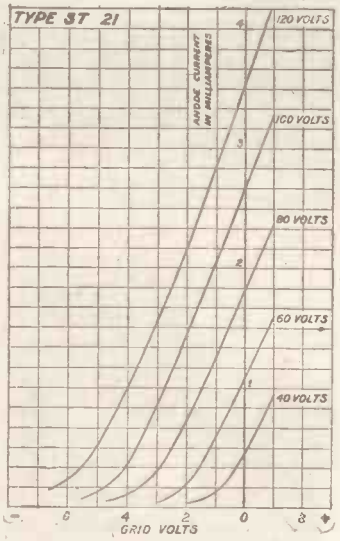
VALVES FOR 2 VOLT BATTERIES.

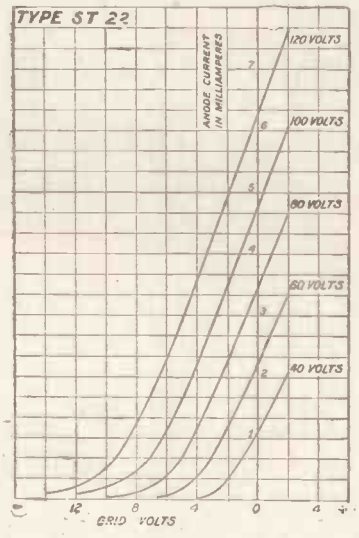


S.T. 21
H.F.

Filament 1·8 volts.
,, 0·1 amp.
Anode 40–120 volts.
Impedance 26,000 ohms.
Amplification 16.

An excellent valve for H.F. amplification and resistance capacity coupling. It is also to be recommended as a detector valve.

Price 14/-

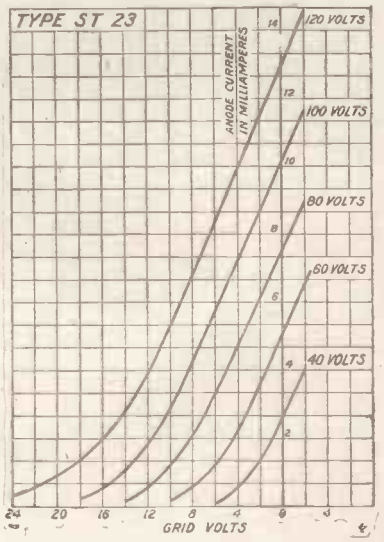


S.T. 22
L.F.

Filament 1·8 volts.
,, 0·1 amp.
Anode 40–120 volts.
Impedance 16,000 ohms.
Amplification 10.

This valve is for the first stage of a low frequency amplifier and will give undistorted reproduction. It may also be used for H.F. amplification, especially in neutrodyne circuits, and for detection.

Price 14/-



S.T. 23
POWER

Filament 1·8 volts.
,, 0·15 amp.
Anode 80–120 volts.
Impedance 6,000 ohms.
Amplification 6.

A magnificent 2-volt power valve giving superb reproduction when used as the last valve of a set, when a loud speaker is employed. Note its low impedance and the high amplification factor for such a valve.

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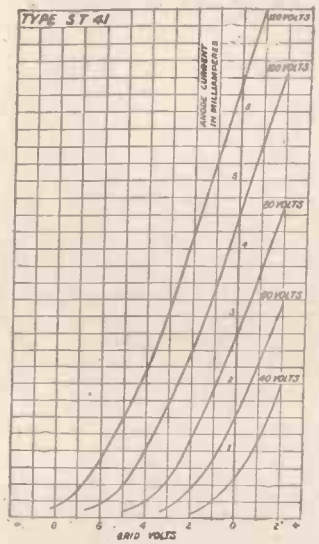
VALVES FOR 4 VOLT BATTERIES.

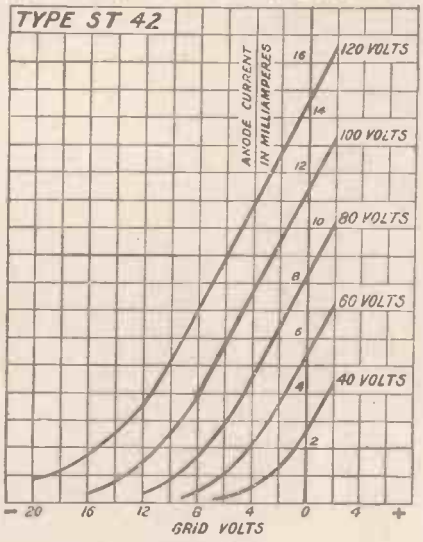


S.T. 41
H.F.

Filament 3·7 volts.
,, 0·1 amp.
Anode 40–120 volts.
Impedance 16,000 ohms.
Amplification 13.

This is an efficient H.F. valve, more particularly designed for neutrodyne circuits. It brings in the distant stations with ease. This valve may be used as the first L.F. and as the detector valve. It is the valve for resistance capacity coupling.

Price 14/-



S.T. 42
POWER

Filament 3·8 volts.
,, 0·1 amp.
Anode 40–120 volts.
Impedance 6,000 ohms.
Amplification 6.

An excellent power amplifier recommended for first and also the second stage of L.F. although the S.T. 43 is the ideal loud speaker valve in the 4-volt class.

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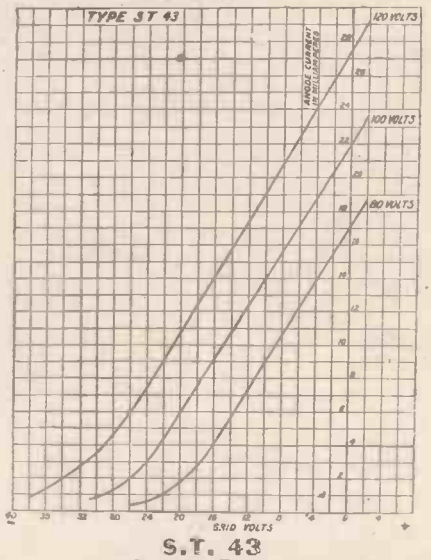

S.T. 43
Super Power

Filament 3·8 volts.
,, 0·25 amp.
Anode 120 volts.
Impedance 4,000 ohms.
Amplification 3·33.

This valve is the only standard 4-volt valve in the super-power class, hitherto confined to 6-volt valves. It is "the valve with the golden voice" and is capable of great volume and exceptional purity of tone.

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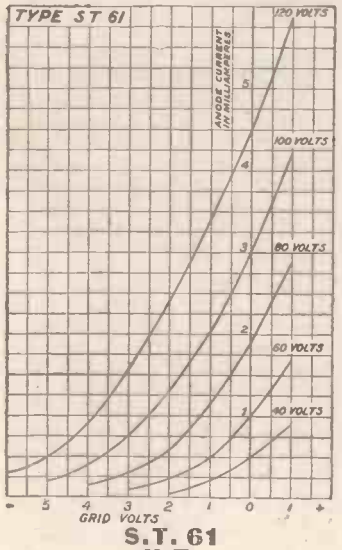
VALVES FOR 6 VOLT BATTERIES.

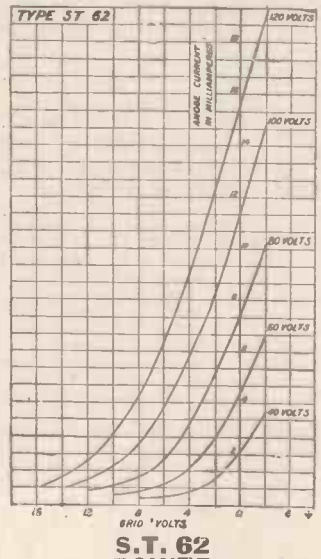


S.T. 61
H.F.

Filament 5·6 volts.
,, 0·1 amp.
Anode 50–120 volts.
Impedance 20,000 ohms.
Amplification 20.

This efficient H.F. valve is particularly to be recommended for all neutrodyne types of circuit, while it may also be used for resistance-capacity coupling. It makes an excellent detector.

Price 18/6

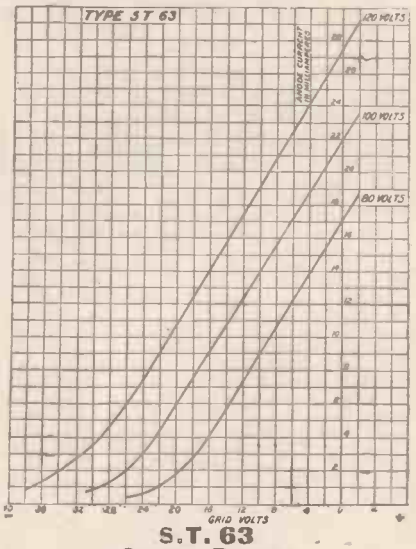


S.T. 62
POWER

Filament 5·6 volts.
,, 0·1 amp.
Anode 80–120 volts.
Impedance 6,000 ohms.
Amplification 8·3.

This power valve is the best of its class and makes a good 1st and 2nd L.F. valve. It is intended especially as a good all-round power valve.

Price 18/6



S.T. 63
Super Power

Filament 5·6 volts.
,, 0·25 amp.
Anode 120 volts.
Impedance 4,000 ohms.
Amplification 3·33.

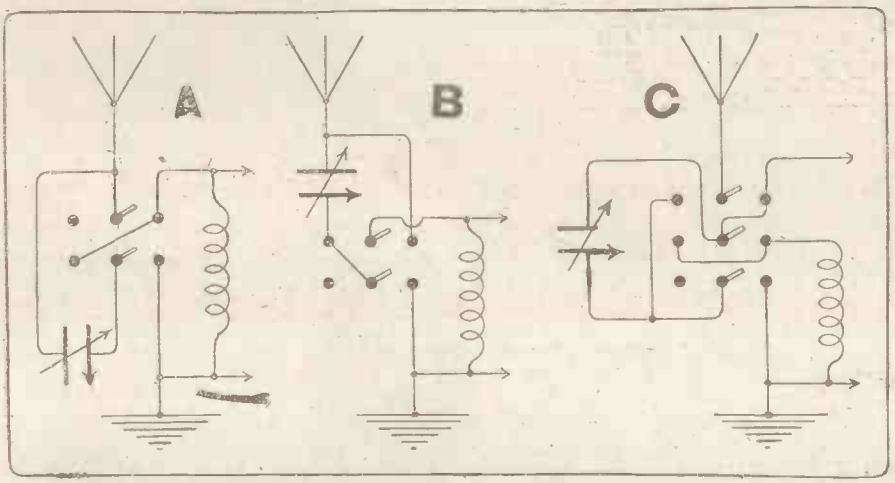
This is "the valve with the golden voice." It is an entirely new class of valve, having very long, dead-straight, dynamic curve, giving exquisitely pure loud speaker reproduction.

Price 22/6

AN INTERESTING COMPARISON.

By O. J. RANKIN.

HAND-CAPACITY effects are most pronounced when the moving vanes of a tuning condenser are connected to that part of a circuit where the presence of the operator's hand has an unbalancing effect upon the tuning. It should be remembered that the moving vanes are connected to the spindle, which, of course, carries the manipulating knob, and that every time the knob is adjusted, one's hand is thus placed in close proximity to the spindle, or otherwise moving, vanes. For this reason they should always be connected to the "earthed end" of a circuit. In other words, the fixed vanes should be connected to the "aerial" or "grid end" of a circuit, not only in the case of direct or inductively coupled aerial circuits, but also in tuned anode and H.F. transformer couplings, the anode of the valve being considered as the "grid end" in the latter examples.

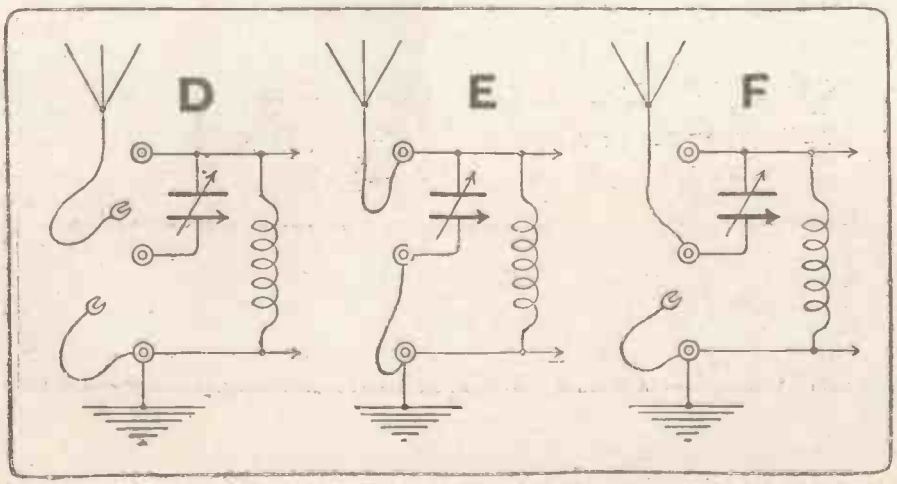


A Three-Pole Switch Method.

This rule applies in all cases where the condenser is connected in parallel; in the case of a series aerial tuning condenser it is, of course, not possible to connect the moving vanes to earth, but it is possible to connect the fixed plates to grid (assuming a direct coupled circuit) and this should always be done. But with many series-parallel switching devices even this becomes impossible, as will be seen from the examples given at A and B in Fig. 1.

Here we have the two most common series-parallel arrangements; in each instance a D.P.D.T. switch is employed, the condenser being in parallel at the right-hand setting, and in series at the left-hand setting. The moving plates of the condenser are indicated by the heavy arrow-head, as in further examples.

It will be seen that when the condenser is in parallel with the coil the fixed vanes go to grid, as they should do, but in the series position the *moving* vanes go to grid. One obvious method of overcoming this difficulty is to use triple-pole two-way switch in the manner shown at C; here the fixed vanes go to grid at either position. But such a device is complicated and expensive, and when we consider the merits of the simple and inexpensive three-terminal method of series-parallel switching, one cannot help wondering why elaborate switching devices are allowed to flourish in aerial circuits.



The Three-Terminal System.

Diagram D, Fig. 2, shows the correct method of wiring up the terminals, condenser, and coil. It will be seen that the moving vanes of the condenser are connected to the centre terminal, which is usually marked "A2-Series." The top terminal, which is connected to the fixed vanes, is marked "A1-Parallel." The lower terminal is the common earth terminal, this being provided with a length of flex long enough to reach the centre terminal. This and the aerial lead-in are fitted with spade terminals. The condenser is in parallel when connections are made as indicated at E, and in series as at F.

It should be noted that the fixed vanes go to grid at either position; thus one obtains the same effect given by the arrangement at D, Fig. 2. But on account of the complex nature of the latter one loses a good deal of efficiency at the cost of a little convenience, whereas with the three-terminal system it is possible to obtain the highest possible degree of efficiency, and I have never yet heard anyone complain of the inconvenience of hooking up terminals.

By the way, I believe the present popularity of this ideal arrangement is due to the efforts of the "P.W." technical staff; it is invariably included in their circuit diagrams, and maybe that is one reason why they "get away" with so many successful hook-ups.

WHAT TO DO WITH AN INEFFICIENT TRANSFORMER.

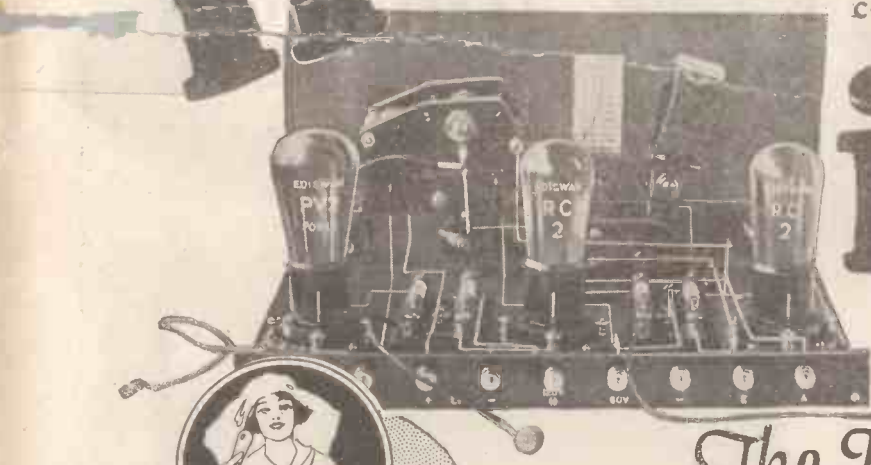
IF one possesses two L.F. transformers, one of them a first-class instrument with a primary winding of high inductance and a moderately low ratio (not more than 4 : 1), and the other a 5 : 1 component with comparatively little wire in the windings, the difference in the results when tested under similar conditions may be so marked that there will be a temptation to throw the cheap transformer into the dustbin forthwith.

But even if the results with the cheap transformer are relatively very bad, it is probably not altogether worthless. Much depends on the type of valve used immediately before a transformer of this kind. If only one stage of L.F. amplification is being used and if the detector valve is of the H.F. type, it will be found that the results from the cheap transformer will be very much improved by substituting a small power valve in the detector position. If two L.F. stages are employed, the cheap transformer will probably be better in the second stage than in the first, provided both the L.F. valves are power valves. The first L.F. stage may contain the better transformer, or a resistance or a choke.

If only one transformer coupled stage is desired, the cheap transformer may often be used successfully as a choke, either for L.F. amplification, or in a shunt circuit across the loud speaker terminals. When the transformer is used as a choke, the windings may be connected in series, O.P. being joined to I.S., or the secondary winding only may be used.

Here it is!

R.C. THREESOME
3-valve resistance capacity voltage coupled receiver.



The R.C. Threesome

A wonderful 3 valve set you can build yourself in three hours for £3.0.0. or less

Again, Ediswan leads!—this time with resistance-coupling amplification.

Beautiful, mellow, natural reproduction with an abundance of volume has been made possible by the employment of two New Ediswan Valves—R.C. 2 and P.V. 2—in the new quarter-watt POINT ONE ECONOMY Range.

For the betterment of wireless reproduction, with economy, Ediswan offers FREE, the new R.C. THREESOME Book of simple-to-follow instructions, with a full size blue-print of the wiring diagram. A theoretical diagram is included for experienced experimenters.

If you can use a screwdriver *you* can make this set in one evening—it's so simple. The necessary components are inexpensive—in fact, the set can be made for £3, or less.

Reception is truly remarkable. Both local and high-power stations come through at full volume—tone is pure and rich without a trace of the throatiness so evident in transformer-coupled sets.

With the R.C. THREESOME you are several steps ahead in radio.

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Applications for the FREE blue-print and FREE book of instructions will be dealt with in rotation.

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P.W., 20/11/26.

Name .....

Address .....

PLEASE USE BLOCK LETTERS .....

Please send, post free, presentation copies of the "R.C. Threesome" Instruction Book and Blue-print.

Traders and manufacturers are invited to submit wireless sets and components to the "P.W." Technical Dept. for test. All tests are carried out with strict impartiality in the "P.W." Test room under the supervision of the Technical Editor, and the general reader is asked to note that this weekly article is also intended to provide a reliable and unbiased guide as to what to buy and what to avoid.—EDITOR.

EUREKA LOW-LOSS H.F. TRANSFORMER.

SOME long time ago we gave it as our opinion in these pages that insufficient attention was paid to the design of H.F. transformers. These were for years treated more as L.F. than as H.F. components. Both windings were generally wound cotton-reel style in a tight little bunch in a groove turned in solid dielectric. Moreover, most of the wire used was of an extremely fine nature. In these circumstances is it to be wondered at that many amateurs asked the question "Is H.F. amplification worth while?"

We recalled these facts to mind when we received a Eureka low-loss H.F. transformer for test—as good a specimen of modern practice as we have seen. Being critical, we cavil at the use of the words low loss, holding the opinion that all radio components should, as a matter of course, be "low loss" these enlightened days, more especially H.F. components. However, as there are probably still a number of very "high loss" H.F. transformers still flooding forth from the factories of unconscientious exploiters of radio, there is no doubt that the Eureka people must put those two words in as a measure of self-protection.

The Eureka low loss H.F. transformer is by no means cheap; with a standard valve holder base it costs 15s., and 17s. 6d. with a special wide spaced base. But the component really is beautifully made and its design as "modern" as could be. It is wound with a healthy gauge of silk-covered wire, and the windings are carried on high-class ebonite formers of the true "skeletonised" order. Replacing an old-fashioned H.F. transformer for one of these modern Eurekas, the difference can be noted at once. Tuning is much sharper, and the increase of sensitivity obtaining is most noticeable. This realisation of what is almost an ideal in a key H.F. component will make the DX "fan" really happy, even if it is rather expensive. Five models covering ranges of 150—300 and 2,400—3,500 metres are available.

R.I. H.F. CHOKE.

As was stated in one of our recent articles, one of the chief requirements of an efficient H.F. choke is that it shall have a very, very low self-capacity. The self-capacity of the new R.I. H.F. choke—a sample of which was recently to hand—is so low that for practical purposes it is quite negligible. The former upon which the wire is wound is less a former than a mere collection of light, but strong, little girders. The wire is wound in eight small bunches, each bunch being widely separated from the others. A reduction of turns (and this means to some extent a reduction of losses) has been obtained by employing a rather larger diameter than usual—nearly two inches. But the component is not unwieldy and is less than 3 in. high. It is designed for baseboard mounting. Very wisely, we think, Messrs. R.I. have given it a transparent casing so that all its "innards" are in plain view and ready for the critical inspection of the modern amateur. We have already used this R.I. H.F. choke in one or two important experimental receivers, and in each case it gave perfectly satisfactory results. We can describe it as a "safe" component—i.e. designed to choke H.F. currents it can be incorporated in a hook-up without fear that it will fail to do its duty under the most adverse of conditions.

(*Continued on page* 708.)

APPARATUS TESTED.

(Continued from page 706.)

RIPAULT'S LATERAL ACTION CONDENSER.

A very novel movement is incorporated in this component, a sample of which was recently sent in for test by Messrs. Ripaults, Ltd., King's Road, London, N.W.1. Two sets of plates, measuring approx. 2½ by 1¼ in. are provided, one set being made to travel along two guides and intermesh neatly with the other by means of a cam device. Thus the area covered by the condenser is no greater than that of the 4-in. dial in whatever position are the moving plates. The action is as mechanically perfect as could be, and there is not the slightest "backlash" harshness or looseness or any other such fault at any point during the 360° revolution of the dial between maximum and minimum.

A direct and permanent connection is made through two soldered springs between the metal frame and the moving plates. One bar of ebonite is all the solid dialectric which figures in the solid construction of this Ripault product. Electrically the device is essentially a "low-loss" component and obeys a "square law" in accordance with modern practice. A low minimum is provided, and the maximum capacity is substantially as stated. One hole fixing is possible.

This variable is very well made, being strong and clean in design and nicely finished. Model S.Q.1, which is rated at ·0005 mfd., is priced at 18/6, but it is a precision instrument and not an inartistic assembly of black composition and aluminium.

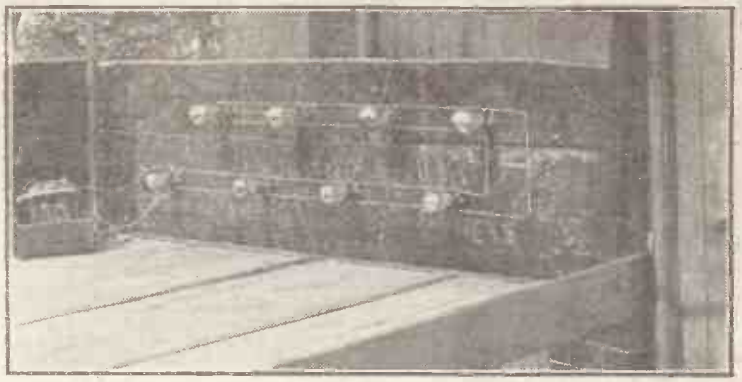
THE CLEARTRON "N" RECEIVER.

We recently received a complete "N" receiver outfit from Messrs. Cleartron Radio, Ltd. It included a two-valve Lodge "N" set, a Cleartron loud speaker, valves and batteries, and was exactly similar to those advertised at £15 15s. inclusive of all royalties. All our readers will know what an "N" two-valver is, and should not need to be told that it is a Det.-L.F. embodying a circuit due to our eminent scientific adviser. Nor should it be necessary for us to enter into details concerning the remarkable properties of this circuit, as these have been described in articles written by the inventor, Sir Oliver Lodge, F.R.S. But doubtless many readers will appreciate our unbiassed comments on the Cleartron assembly.

The receiver is contained in a handsome polished case, which is provided with an apartment for batteries. The panel is mounted at a very convenient angle and allows comfortable access to the single tuning dial. First-class materials appear to have been used throughout and the lay-out and wiring closely follow the original specifications. The Cleartron dial allows the fine adjustment the set requires and the filament rheostat gives a smooth control of volume.

Quite apart from the fact that this receiver embodies a special "N" circuit we consider that it would be good value for £15 15s. with the complete set of accessories were it only a standard Det.-L.F. On test the Cleartron "N" gave excellent results well up, in our opinion, to those given by the original model upon which we have reported at length. The Cleartron loud speaker capably handles the respectable volume the "N" delivers.

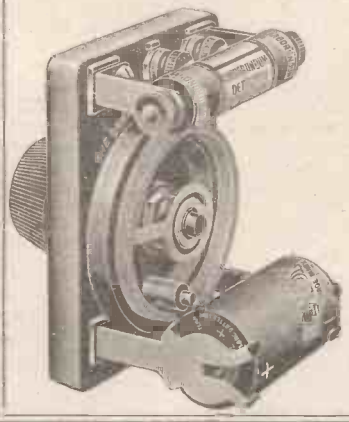
A VERY PRACTICAL TEST.



Eight "Lotus" valve holders, complete with valves, were fitted to the tailboard of a Ford lorry, which was then driven over 30 miles of rough roads. Despite this rough treatment, no damage was done.

WHY USE VALVE RECTIFICATION

The special feature of the CARBORUNDUM STABILISING DETECTOR UNIT is the electrical control, which enables the resistance to be varied to match the circuit impedance. The CARBORUNDUM STABILISING DETECTOR UNIT can therefore be substituted for any detector in any set with the following advantages :— OSCILLATIONS OF H.F. VALVE UNDER PERFECT CONTROL. INCREASED SELECTIVITY. CRYSTAL CLEAR TONES.



The UNIT is also of inestimable value to the two-valve set user, as it enables the detector valve to be used for H.F. amplification, thus giving increased range and volume, and sharper tuning.

PRICES
(including postage) :

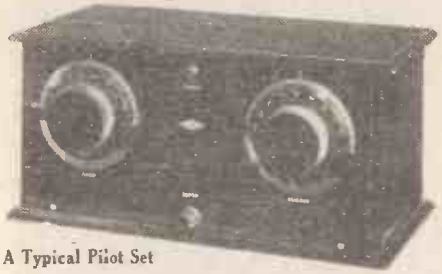
No. 32, price each - 12/6
Ever Ready Dry Cell U.W.5, 5d.
No. 30 (Detector only) 5/-

Send for Descriptive Folder W3 and Hook-up Booklet to :

The CARBORUNDUM COMPANY, LIMITED
Trafford Park, Manchester

ALL THE LATEST "P.W." SETS

Supplied as finished instruments or in parts for home construction



A Typical Pilot Set

¶ *Every finished set we sell is tested under the supervision of Capt. R. W. TINGEY, A.M.I.R.E. (Late of Radio Press Laboratories).*

If you want an efficient and handsome receiver ready built, you cannot do better than purchase one of these "Pilot" sets. They are designed by experts, made by skilled workmen, and thoroughly tested on a large number of stations at full loud-speaker strength. These sets are installed free within 50 miles of any one of our branches.

Should you prefer to assemble your own set—and there is no finer hobby for the long evenings—you can do so under our famous "Pilot" Service, with every assurance that your efforts will be successful. Write for details of this service and mention the type of set you want.

IN EITHER CASE WE GUARANTEE GOOD RESULTS!

There is a set to suit YOUR needs in the famous "PILOT" range.

Let us know exactly what results you wish to obtain, and we will advise you as to the set most suitable for your requirements.

The PILOT MANUAL contains illustrated details of a number of up-to-date sets which we thoroughly recommend. Much useful information on soldering, assembling, testing, etc., is also included.
Post free .. 3d.

THE PILOT MANUAL

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A longer life to meet the long and frequent periods of use which you demand to-day without sacrificing in the slightest the smooth uniform supply which has made Hellesen Dry Batteries known as the *BEST IN THE WORLD.*

60 volt "WIRIN" 12/6
99 volt "WIRUP" 21/-
(Postage Extra)

All types, voltages, etc., in Double and Treble capacities for H.T. and L.T. Supply. Ask your dealer for the type to suit your set and get the maximum service, or write us for full particulars.

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RADIOTORIAL.

The Editor will be pleased to consider articles and photographs dealing with all subjects appertaining to wireless work. The Editor cannot accept responsibility for manuscripts and photos. Every care will be taken to return MSS. not accepted for publication. A stamped and addressed envelope must be sent with every article. All inquiries concerning advertising rates, etc., to be addressed to the Sole Agents, Messrs. John H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4.

As much of the information given in the columns of this paper concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and the trader would be well advised to obtain permission of the patentees to use the patents before doing so.

Readers' letters dealing with patent questions, if sent to the Editor, will be forwarded to our own patent advisers, where every facility and help will be afforded to readers. The envelope should be clearly marked "Patent Advice."

TECHNICAL QUERIES.

Letters should be addressed to: Technical Query Dept., "Popular Wireless," The Fleetway House, Farringdon Street, London, E.C.4.

They should be written on one side of the paper only, and MUST be accompanied by a stamped addressed envelope.

Queries should be asked in the form of the numbered questions: (1), (2), (3), etc., but may be accompanied by a short letter giving any necessary additional particulars as briefly as possible.

For every question asked a fee of 6d. should be enclosed. A copy of the numbered questions should be kept, so that the replies may be given under the numbers. (It is not possible to reproduce the question in the answer.)

BLUE PRINTS. A series of 20 Blue Prints can be obtained from the Query Dept., price 6d. per Blue Print. Only a limited number of circuits are covered in this series, and full details of the circuit arrangements available in Blue-Print form are published fortnightly in the advertisement columns of this journal.

No set in this series has more than three valves. All are of the flat-panel type.

All other back-of-panel diagrams have to be specially drawn up to suit the requirements of individual readers at the following rates: Crystal Sets, 6d.; One-Valve Sets, 6d.; One-Valve and Crystal (Reflex), 1s.; Two-Valve and Crystal (Reflex), 1s.; Two-Valve Sets, 1s.; Three-Valve Sets, 1s.; Three-Valve and Crystal (Reflex), 1s. 6d.; Four-Valve Sets, 1s. 6d.; Multi-Valve Sets (straight circuit), 1s. 6d. Except SUPER-HETERODYNE DIAGRAMS, all of which, irrespective of number of Valves used, are 2s. 6d. If a panel lay-out or list of point-to-point connections is required an additional fee of 1s. must be enclosed.

Wiring diagrams of commercial apparatus, such as sets of any particular manufacture, etc., cannot be supplied. (Such particulars can only be obtained from the makers.)

Readers may submit their own diagrams, etc., for correction or for criticism. The fee is 1s. per diagram, and these should be large, and as clear as possible.

No questions can be answered by 'phone.

Remittances should be in the form of Postal Orders.

MORSE INTERFERENCE.

H. J. W. (Whitley Bay, Northumberland).—I have a crystal set with which I get fair results (with an indoor aerial) from Newcastle B.B.C. station, distant 8 to 10 miles.

Unfortunately I am near to the Cullercoats Signal Station (about 1½ miles). When this station is working "listening-in" is impossible. I shall be glad if you could advise me what to do "to cut Cullercoats out" by recommending a selective (1) crystal set, or (2) a dull-emitter one-valve set.

If the latter I should prefer one with which distant stations, particularly London, could be obtained on the 'phones. Would either of the

(*Continued on page* 712.)

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from page* 710.)

one-valve sets described in the "P.W." "Constructors' Guide" in "P.W." for week ending October 23rd be suitable? If not, perhaps you could refer me to a design in one of your back numbers.

A powerful land-station working Morse constitutes one of the most difficult forms of interference that has to be contended with. Apart from specially designed circuits made experimentally on the spot, the most effective form of wave-trap or selector is one that can be used for loose-coupling, "series-drain," or other trap circuits, the various methods being tried on the spot until the best one for that particular locality is found.

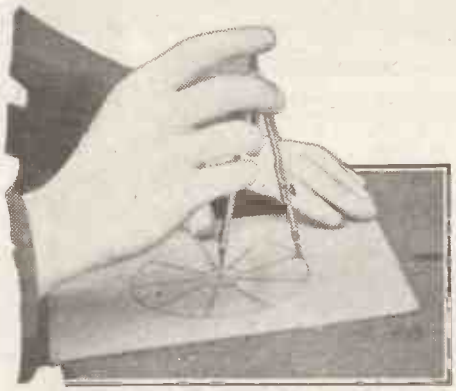
Such a wave-trap is the "Complete Eliminator," that was described in "P.W." No. 193 (Feb. 6th issue). It is suitable for use with any ordinary valve or crystal set, though the latter type is generally not suitable for reception in an area where interference is very bad.

The "Complete Eliminator" would, however, be quite suitable for use with the straight 1-valve set described in "P.W. No. 229 (Oct. 23rd issue).

SPIDER WEB COILS.

"COUNTRYMAN" (Perthshire).—What is the best method of marking out spider-web formers for making flat tuning coils?

A compass or dividers may be used as shown in the accompanying photograph. Alternatively the segments may be marked out from a template,



Marking the slots for a Spider-Web Coil-Former.

showing the respective angles. A template of this kind, with all necessary details for 9 or for 11 slots, was given in the "Radiotorial" columns of "P.W." No. 228 (October 16th issue).

ECONOMICAL 2-VALVE CRYSTAL SET.

S. B. J. (Gloucester).—I have the following parts on hand, and should like to build them into a good long-distance set: One 2-coil holder, two valve holders, one L.F. transformer, one crystal detector, one ·0005 variable condenser, coils, 'phones, rheostats, etc. What would be a good circuit to employ, using two valves and a crystal? (I should prefer a straight circuit to a reflex.) The set will generally be required to work three pairs of 'phones at good strength, but sometimes for reaching out for foreign stations on one pair of 'phones only.

You should get good results from a straight H.F., crystal, and L.F. circuit, for which you have on hand most of the essential parts.

We recommend you to include a switch so that when trying for long distance only the H.F. valve and crystal can be used, the last valve being switched into circuit only when necessary.

Such a circuit appears in the "P.W." Blue Print series (No. 16). It can be obtained from the Query Department for 6d. if a stamped, addressed envelope is enclosed. (See announcements under the heading "Radiotorial.")

H.T. UNIT FOR A.C. MAINS.

"NEW READER" (Islington, London, N.19).—I wish to make an H.T. unit to do away with H.T. batteries for my set, which is a 3-valver. Where can details of a suitable unit (for A.C. Mains) be obtained?

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

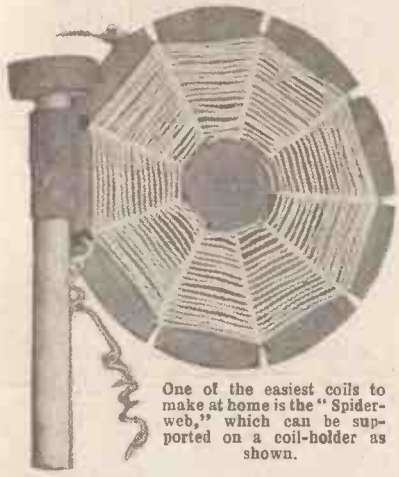
(Continued from previous page.)

An H.T. unit for A.C. mains was fully described in "P.W." No. 227 (Oct. 9th issue). Back numbers of "P.W" can be obtained direct from: The Back Number Dept., Amalgamated Press (1922), Ltd., Bear Alley, Farringdon Street, E.C.4. Price 4d. each, post free.

HOME-MADE COILS.

"COIL-MAKER" (Bury St. Edmunds).—Are cheap coils made at home really efficient? If so, which is the least expensive kind to make to tune a one-valve set?

It is possible to make extremely efficient coils at home, and some of the types which are easy to make,



One of the easiest coils to make at home is the "Spider-web," which can be supported on a coil-holder as shown.

e.g., basket-coils, spider-web coils, have a very high efficiency when properly constructed.

One of the simplest forms of tuning coil is the "spider-web," shown in the accompanying photograph. It is wound in and out of slots upon a cardboard former, the "number of turns" being the number of times the wire passes round the former. No. 22, 24, or 26 D.C.C. wire is suitable.

A simple, but not very efficient, method of mounting the formers in a home-made coil-holder is shown in the lower photograph (2). The cardboard formers are fastened to wooden pillars which are mounted side by side in holes drilled for the purpose. Connections are made by the flexible ends. For simple tuning a variometer effect is obtainable by joining one coil to the next, and then "swinging" one of the coils to vary the coupling. Such a "tuner" has a limited

The method of connecting the coils in a home-made coil holder.

wave-length range, but it covers this fairly well. Many foreign stations have been picked up on the set from which the photographs shown here were taken.

STRAIGHT THREE-VALVE SET.

"STRAIGHT 3-VALVER" (Warrington).—Where can I obtain details for building a straight 3-valve set, (H.F., Detector, and L.F.)? I should like to use the "Tuned

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from previous page.*)

Anode" type of H.F. coupling, the set to be built on a flat panel so as to reduce cost as far as possible.

Details of a set of this type are given on the "P.W." Blue Print, No. 19.

GRID LEAK SUPPORTS.

F. L. (Northampton).—I am making an L.F. amplifier and wish to support the grid leaks by the wiring, as there is hardly room for clips. Is there likely to be a loss of efficiency if this is done?

Provided that good springy wire is used, and the contacts between the leak and wires are of large surface area, there should be no loss of efficiency. A

good plan is to use square section wire (as shown in the accompanying photograph). The area in contact with the leak is then much larger than when rounded edges are used to support the leak.

VALVE POSITIONS.

S. T. G. (Redlands, Bristol).—I have an H.F. and Det. receiver, using D.E. 3 valves. I am going to add a 2-valve amplifying unit to this, using one transformer and one resistance-capacity coupled stage. What valves should I use to go with the D.E.3's on hand.

The ideal arrangement for such a set using the D.E.3 type valves, is as follows: H.F., D.E.3 B; Det., D.E.3; 1st L.F., D.E.3 B; 2nd L.F. (Power valve, D.E.4).

As you already have two D.E.3's on hand, we should try the following combination: H.F., D.E.3; Det., D.E3.; 1st L.F., D.E.3 B; 2nd L.F. (Power Valve) D.E.4.

As the makers recommend the D.E.3 B for the first and the third positions, we should try the effect of changing over the first and third valves, to see in which position best results are obtainable with the valves you have on hand.

"P.W." COIL TABLES.

No. 3.—BASKET OR SPIDER-WEB COILS.

(A) AERIAL COILS WITH SERIES TUNING CONDENSER.

No. of Turns.	Gauge of Wire S.W.G.	Wavelength, in Metres. Capacity of the Series Condenser. = ·0003 Max.	Min.	Capacity of the Series Condenser. = ·0005 Max.	Min.	Suitable No. of turns in reaction coil.
20	24	150	95	160	100	20-40
30	24	200	130	215	135	20-40
40	24	260	170	280	180	20-40
50	26	325	210	345	220	25-50
60	26	390	255	415	265	30-60
70	26	465	305	495	315	40-80
80	28	535	350	570	365	40-80
90	28	610	395	650	415	40-80
100	28	690	450	735	470	40-80
125	30	875	570	930	595	40-80
150	30	1100	710	1160	740	40-80

A SIMPLE TWO-VALVE SET.

"DET. & L.F." (Maidenhead, Berks).—I built the "P.W." Blueprint No. 11 (Det. and L.F.), and having obtained excellent results with this, I wish to make up a similar set, with several alterations to suit rather different conditions.

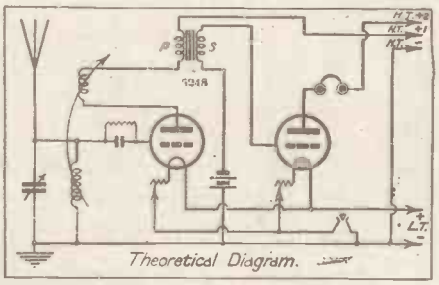
The new set will be used constantly as a two valver, so no switching is required. Also,

(*Continued on page 716.*)

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from page* 714.)

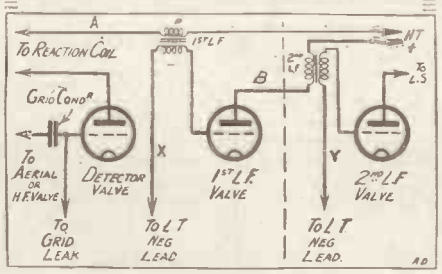
as it is for an elderly gentleman to operate, I do not want series and parallel tuning, but parallel only. I should like an "on-off" switch for the filaments, and also provision for grid bias, if this is recommended. Please give a diagram (theoretical) of this arrangement.



Theoretical Diagram.

The diagram (reproduced herewith) shows the required arrangement. Grid bias and extra H.T. for the last valve have been incorporated. Although 'phones are shown in the plate circuit of the second valve, a loud speaker can be used here when the incoming signal is fairly strong. No 'phone or loud speaker condenser is shown, but of course this can be used if required.

For the Constructor



No. 9.—GRID BIAS.

Grid Bias is essential for the second L.F. amplifying valve, and often improves results if applied to the first L.F.

For L.F. transformer-coupled valves it is inserted at the points X and Y, shown above. The lead is broken here, and that end which is now joined to L.T. is connected to a red wander plug, which is plugged into the + socket of a tapped grid bias battery.

The other wire (which is connected to grid via Secondary) should have a black wander plug, and is then plugged in the G.B. battery, at the tapping which gives best results.

(NOTE.—Many receivers have switches at the points A or B, but this does not affect the principle.)

EBONITE.

J. B. C. (Chelmsford).—What is ebonite made of, and is there much difference in the various grades?

Ebonite is largely composed of rubber and sulphur, which have been mixed and vulcanised at a high temperature. As there are great variations in the quality, it is advisable to buy from a reputable source.

H.T. AND L.T. BATTERIES.

A. J. S. (Wallington).—Why are two separate batteries necessary to operate the ordinary valve?

Because two different conditions are necessary in order for the 3-electrode valve to work. In the first place, its filament must be heated in order to liberate electrons (this is done by the L.T. battery).

Secondly, this liberation has to be helped by a large difference of potential between the heated filament and the plate of the valve. This potential difference is supplied by the H.T. battery.

CORRESPONDENCE.

Letters from readers discussing interesting and topical wireless events, or recording unusual experiences, are always welcomed: but it must be clearly understood that the publication of such does in no way indicate that we associate ourselves with the views expressed by our correspondents, and we cannot accept any responsibility for information given.—Editor.

THE "SPIDER."

The Editor, POPULAR WIRELESS.

Dear Sir,—I shall be very glad to hear of anyone in the Tonbridge or Tunbridge Wells district who has constructed or is constructing the "Spider" set described in POPULAR WIRELESS No. 228.

Yours faithfully,
J. HOLLOWAY.

"Grasmere,"
52, Lionel Road,
Tonbridge.

FILADYNE IN AUSTRALIA.

The Editor, POPULAR WIRELESS.

Dear Sir,—I feel it due for me to write in praise of your "Filadyne." I have followed your Filadyne articles very closely and to-day, Saturday, unearthed all my junk and made up your 1-valve Filadyne, and put it on our local station, 6 W F, 1,250 metres. To my astonishment, "Hello 6 W F" fair shouted at me as if I was deaf. My friends now are listening on a B.T.H. concert grand. "What do you know about that" on one valve?

Considering I am 6 miles from 6 W F and practically under the nose of V I P Applecross spark station, which I can cut out completely—something that I can hardly do on my "four valver"—this is in itself another feature.

Now as to parts, 1 old-type ·0005 Ormond condenser (Rolls-Ford), 3-way coil-holder, 1 old Yankee valve holder, 1 rheostat, junk, 1 Condor valve, 3·8 ·06, the choke coils are 200 on the plus side and 150 on the minus side, 1 4-volt accumulator, 90 volts on the H.T., wiring faithfully followed from your instructions.

I am convinced that properly wired and good parts reception will be even better (here comes a friend of mine—a dealer—to listen).

Reference to modulation it is perfect, reproduction of voice is remarkable. Can tell immediately the parson moves in the pulpit, as his voice is reflected accordingly. I am making this note especially as I've often remarked that one cannot tell from what part of the auditorium the sound comes from, back, front or side of micro.

Let me thank Mr. Dowding first for the "Filadyne," then yourself and paper for the pleasure and education it gives one who thoroughly reads it.

Yours faithfully,
W. E. GREENFIELD.

199, Hensman Road.
Subiaco, Perth, Western Australia.

IT PAYS TO "BUY BRITISH."

The EDITOR, POPULAR WIRELESS.

Dear Sir,—I have discovered that it pays to buy British components of a make with a good reputation.

I bought a set of Brandes headphones about three years ago, and some weeks ago, while I was in Shetland, a winding burnt out.

I had no spare set and removed the cap from the offending earpiece and short-circuited the coil which was defective. The results with only one side of the electro-magnet were excellent, and it was difficult to distinguish the faulty 'phone.

I returned the 'phones to Brandes for repairs, and in spite of the fact that I had removed the cap and diaphragm against their printed instructions, and in spite of the fact that their guarantee had expired two years ago, they very kindly repaired my 'phones free gratis, and fitted not only a new winding, but apparently new diaphragm as well.

Such treatment is wonderful advertisement for British goods.

The set I was using in Shetland was a small one-valver, and I picked up on a poor aerial and poorer "earth" practically all B.B.C. main stations and many foreigners, German, Norwegian, French and even Spaniards coming in quite well. Newcastle was audible in bright sunlight at 4 o'clock, but Daventry was never good.

In Rothes, in Morayshire, Daventry is poor compared with London, Bournemouth, Dublin or, indeed, almost any main station.

Yours faithfully,
WM. R. CUMMING.

19, Holburn Road.
Aberdeen.

CRYSTAL SETS ON LOW WAVE-LENGTHS.

The Editor, POPULAR WIRELESS.

Dear Sir,—An expert in the trade states that he has never heard of a crystal set which could get below a 200 wave-length. Would you allow your readers to say what is the lowest they have reached and how they managed to reach it?

P. R. T.

84, Westcombe Park Road, S.E.3.

TECHNICAL NOTES.

(Continued from page 674.)

the end of the vertically-mounted transformer and may be held down by a screw or bolt on either side.

"N" Crystal Set.

Referring to the Lodge "N" circuit, I have a letter from a reader who states that he has used this circuit in a crystal set with the choke aerial and has obtained very good results. The circuit, he states, is a very easy one to use in this way and the signals are distinctly louder than with the ordinary tuned-aerial circuit. Readers who are devotees of the crystal and want something new to try may be interested in experimenting with the above.

An Interesting Effect.

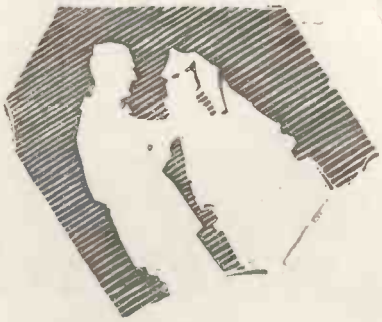
I wonder how many experimenters have noticed the effect which is sometimes obtained when placing the loud speaker in close proximity to the set. I am not referring here to the L.F. microphonic influence of the sound waves from the loud-speaker upon the detector valve; that, of course, is a very well known influence, which sometimes leads to annoying L.F. howling.

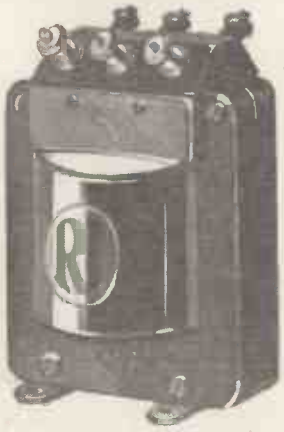
I am referring in this case to the inductive and capacitative influence of the loud speaker, considered merely as a large metal object. I have a set which employs two stages of H.F. amplification and one stage of L.F., the set being used with a special frame aerial enclosed within the cabinet and using a reaction system of rather a peculiar kind. With this set, the placing of the loud speaker on the top of the cabinet has quite a pronounced influence upon the volume obtainable. It is easy to see why this should be so, for the loud speaker is equivalent (it is an ordinary metal-trumpet loud speaker) to a comparatively large metal sheet placed in close proximity to the reaction coil (which latter, in the case under discussion, forms part of the frame aerial). Not only does the loud speaker cause a considerable change in the electrical capacities involved, but its influence upon the distribution of the electro-magnet fields in the region of the frame aerial must be considerable.

Compound Rheostats.

I notice that this season quite a number of compound or multiple rheostats have made their appearance on the market. In some cases these consist of an arrangement of two resistance elements which may be used alternatively. This recalls that about two years ago the writer invented a rheostat which employed two resistance elements in a special way and another which employed three resistance elements. The number of different maximum resistances which can be obtained with three resistance elements is surprisingly large.

If I remember rightly, the number with certain values of resistance was about 17. The reader can easily work it out for himself, for if we call the resistances A, B, C, we have the following resistance values: A, B, C, A and B in parallel, A and C in parallel, B and C in parallel, A, B, C, all in parallel, A, B in parallel and the combination in series with C, B, C, in parallel and the combination in series with A, etc., etc., etc., etc.





PERFECTION BY ELIMINATION

Perfection is not attained by any sudden flight but by the slow process of elimination.

When you build your wireless set, you can hardly expect perfect results first time out, small adjustments and alterations will have to be made before you get reproduction that will please you.

But you can certainly cut this work down to a minimum by using the R.I. Multi-Ratio Transformer. Here you have an instrument capable of operating correctly in conjunction with any valve and in any circuit you may select. Instead of having to experiment with a number of different transformers you can apply the process of elimination to this one unit and easily find the ratio or impedance value which is absolutely suited to your requirements.

The R.I. Multi-Ratio Transformer offers certain satisfaction, for its available range of seven ratios, and three impedance values precludes any risk of failure due to unsuitable characteristics for the work in hand.

Price 25/-

R.I. Ltd., 12, Hyde St., New Oxford St., London, W.C.1

The mark of Better Radio

The WONDERFUL P.M. FILAMENT WITH THE HIGHEST FIGURE OF MERIT

MULLARD
P.M. VALVES
GIVE YOU MOST VALUE FOR MONEY

For 4-volt accumulator or 3 dry cells
THE P.M.3 (General Purpose) 0·1 amp. 14/-
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For 2-volt accumulator
THE P.M.1 H.F. 0·1 amp 14/-
THE P.M.1 L.F. 0·1 amp. 14/-
THE P.M.2 (Power) 0·15 amp. 18/6

These prices do not apply in Irish Free State.

The higher the figure of merit of a filament the greater the efficiency and the more you get for your money.

For the same input the wonderful P.M. Filament gives you twice the out-put of the ordinary dull filament and 20 times that of the best bright filament.

Couple this with the huge life of the P.M. Filament due to its operating temperature being as low as 180° below the pyrometer scale and you will understand why it pays to demand

MULLARD P.M. VALVES WITH THE WONDERFUL P.M. FILAMENT.

Mullard
THE · MASTER · VALVE

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R/R

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THE STATION MASTER—By PERCY W. HARRIS

Popular Wireless

Every Thursday PRICE 3d.

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Special Features In This Issue

WHEN X's ARE USEFUL — THE IMPORTANCE OF LAYOUT — SOME COMMON FAULTS

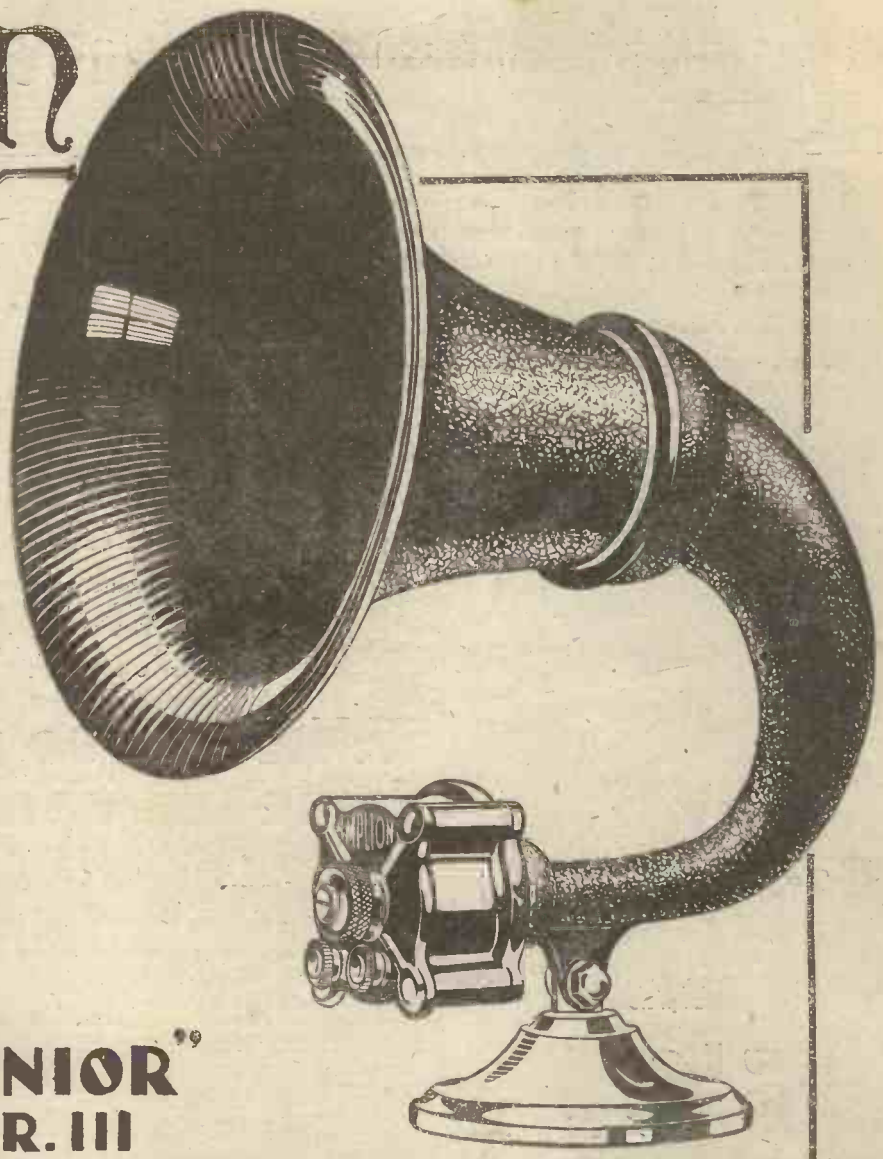
HOW TO MAKE FIXED RESISTORS — AN H.F. INTERVALVE COUPLING UNIT

SPECIAL EIGHT-PAGE SUPPLEMENT FOR THE CONSTRUCTOR

Edited by Percy W. Harris

Our cover photograph this week shows the transmitting plant of W R N Y which is owned and operated by the "Radio News" of America.

DRAGON AMPLION



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48/-
Other AMPLION models from 38/-

A member of the famous Amplion "Dragon" series. Finished in a pleasing crystalline chocolate shade and fitted with the new high-efficiency light-weight unit.

Obtainable from Accredited AMPLION Stockists, Radio Dealers, or Stores.

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AMPLION - SUPREMACY - IS - THAT OF - ACTUAL - PERFORMANCE

For Dull Emitter Valves

NOW that the Dull Emitter Valve has finally ousted the extravagant bright emitter from the market it has been necessary to evolve a new type of Accumulator suitable for two and three-valve Sets. The present day demand is for an accumulator small in size, light in weight, low in price, which will hold its charge for weeks and even several months without attention. The ordinary Accumulator was good enough for bright emitter valves consuming ·75 ampere each. Its plates never had a chance to become sulphated. No sooner was the accumulator charged up than the Set began to drain away its energy. After a week or so a further charge was necessary. But to put an ordinary accumulator to serve a 2-valve Set equipped with Dull Emitters is a waste of money. The plates are almost certain to sulphate if the accumulator is not given a regular charge—whether it is exhausted or not.

The unusual construction of the new Oldham O.V.D. (patent applied for) makes it the ideal Accumulator for small Receiving Sets. Its low initial price, coupled with the few pence only required for recharging, will enable every user to lower his maintenance costs immediately.

Where else can you find these seven features?

Type O.V.D.

2 volts—for use with Dull Emitter Valves. Fitted with the new Laminode Plate. Dimensions 6 ins. by 3 ins. by 2½ ins. 10 amp. hours.

5/6

Charged ready for use
Add acid only

Other Oldham Accumulators

Your Dealer can show you a wide range of other Oldham Accumulators — all made under the Special Activation Process. Ask to see particularly the Oldham H.T. Accumulator, which is made under expanding bookcase principles. With its handsome lid and base, it is the finest H.T. Accumulator on the market. Price 10d. per volt. Catalogues free—write to-day.

1 Charged ready for use

Every O.V.D. is charged ready for immediate use at the factory. It is only necessary to add acid and wait half an hour or so for the cell to be ready for use. No tedious and annoying delay while the cell is put on charge.

2 Laminated buckle-proof plates

The plates are laminated for extra strength and to permit the free circulation of the electrolyte. Standard plates are used which cannot shed their active material. No separators are required.

3 No leaking away of charge when not in use

In the ordinary accumulator the positive and negative plates are closely interleaved together. Some local action therefore is inevitable when the accumulator is standing idle. In the O.V.D. the plates are welded together in sets of three with a generous space between the positive and the negative groups. This eliminates interaction and enables the plates to hold their charge even for months without attention.

4 Large coloured terminals

Even the external appearance of the O.V.D. is distinctive and workmanlike. Note its generous coloured moulded terminals, indicating correct polarity at a glance. A man's size terminal which will grip any wire quickly and securely.

5 Quick charging and slow discharging

Never before has it been possible to combine these two requirements in an accumulator. The usual way to ensure a slow discharge has been to use a thick plate. But thick plates need a prolonged charge. Compare a thick plate, if you like, to a thick mass of absorbent material plunged into a liquid. It will take a long time for moisture to penetrate to its inmost recesses. But cut the material into strips and they absorb moisture at once. This, in non-technical language, is the principle of the Laminode Plate. It is the equivalent of a thick plate, but the electrolyte can flow through it immediately and get to work upon its several surfaces without hindrance. Any O.V.D. Accumulator can be recharged within 8 hours—speedy charging won't harm its plates.

Quick charging and slow discharging *(continued)*

6 Stout glass cell

The glass cell used in the O.V.D. offers further evidence—if such were needed—of the care and forethought put into its manufacture. Crystal clear and robust, it has ample mud space at the bottom to trap all the sludge.

7 Plates made under the Special Activation Process

The secret of the popularity of Oldham Accumulators among wireless enthusiasts lies in the efficiency of the plates made under the Special Activation Process. This process, because it produces a plate active right through, not merely on its surfaces only, gives that smooth unfluctuating current flow that is so essential for good broadcast reproduction. And at the same time it ensures a length of service which is truly remarkable.

Special Activation Process Batteries

OLDHAM

Oldham & Son, Ltd., Denton, Manchester

Also 6, Eccleston Place, London, S.W.1 *Phone: Sloane 2701.*

Gilbert Ad. 6428

"WELL FOUND"

When the tall Clippers in all their pride raced for the wool and tea markets of the world, they had to be well found and seaworthy.

And being well found didn't end with having good "sticks, rigging, and running gear," it implied a tip top condition from the varnish on the truck down to a clean bottom.

It was attention to details more often than not which decided the issue of these stern chases—the details which, as far as one could see, "didn't matter."

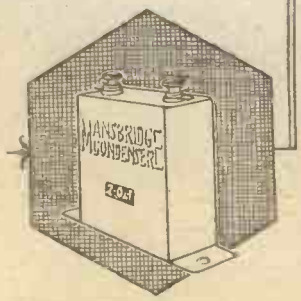
It is, perhaps, a far cry from Clippers to Condensers, but it is certainly a fact that many people regard Condensers as being a detail that "doesn't matter."

And still more numerous are the people who say that cheap condensers seem to give just as good results as expensive ones.

The fact is that cheap condensers do *not* give as good results as expensive ones. If they did, we should not be interested from any point of view in making the more expensive variety.

And the second fact—namely that the Dubilier Condensers sold number more than all other makes put together—points to the fact that the great majority of people value a well-found wireless set and insist on seeing that it is equipped with Dubilier Condensers.

Do you?



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E.P.S. 245

ADVT. OF THE DUBILIER CONDENSER CO. (1925) LTD. DUCON WORKS, VICTORIA ROAD, N. ACTON, W.3

Now Grannie *can* listen!

"THAT Wireless" Grannie used to say, "was no good—she never *could* hear what 'the man was saying!" That was before the **Brown** Crystal Amplifier came. Now she sits and listens to the Loud Speaker working from the little Crystal Set. For hours and hours! Now she appreciates the boon broadcasting can be. Mostly everyone, now, can work a Loud Speaker from a Crystal Set without the use of a single valve. If you live within fifteen miles of a B.B.C. Station (or eighty miles from Daventry) the **Brown** Crystal Amplifier will enable you to obtain pure, faithful Loud Speaker reproduction from your Crystal Receiver. No Valves. No accumulators. Just the Crystal Amplifier connected to your Set and the Loud Speaker. The only accessory needed is a 4½ volt dry battery. What more ideal way of enjoying the broadcast? You get the results of your friend the valve-user without any of the worry, trouble and expense his accumulators cost him.

Brown

—for faithful Radio interpretation.

See your Dealer about the Crystal Amplifier to-day. Get him to demonstrate it on one of the nine **Brown** Loud Speakers. You'll be sure to want one for yourself.

The H.Q.
20 inches high
2000 or 4000 ohms.
£6 0 0

The H1.
120 ohms. £5 5 0
2000 ohms. £5 8 0
4000 ohms. £5 10 0

S. G. BROWN, LTD., Western Avenue, North Acton, W.3.

Retail Showrooms: 19, Mortimer Street, W.1; 15, Moorfields, Liverpool; 67, High Street, Southampton. Wholesale Depots: 2, Lansdown Place West, Bath; 120, Wellington St., Glasgow; 5-7, Godwin Street, Bradford; Cross House, Westgate Road, Newcastle; Howard S. Cooke & Co., 59, Caroline Street, Birmingham. Robert Garmany, Union Chambers, 1, Union Street, Belfast, N. Ireland.

An economy which is no economy

FROM hedge to hedge the ploughman slowly cuts the furrow. Yard by yard the gleaming steel turns over the rich brown earth. In one working day Hodge and his two companions may be able to plough a whole acre. Over the horizon is to be found quite a different scene. A fussy little tractor, cutting several furrows at one time, is noisily eating up the ground at an amazing pace. In fifty minutes this machine will do as much work as a man with two horses can do in a whole day.

The tractor works under a big handicap—its initial cost is many times greater than the cost of a pair of horses. But in spite of this, mechanical ploughing is rapidly driving the horse from the land. Sensible farmers no longer look at first cost—they seek results. The extra expense of the tractor is amply justifed by the big reduction it can make in the cost of ploughing and by its superior work.

There are still tens of thousands of wireless enthusiasts who could take this lesson to heart. They are still using bright emitters or foreign dull emitters—like the two horse plough—they are low in first cost. But although they may be cheap to buy, they are not economical to use. They are extravagant in current and last only a comparatively short time.

Compare, on the other hand, the wonderful new Cossor Point One taking only one-tenth of an ampere. An accumulator which would last a 2-Valve Set fitted with Bright Emitters for ten hours would last more than 200 hours if Cossor Point One Valves were substituted. *190 hours of free Broadcasting every time your accumulator is charged.* Think of the money you will save in charging costs alone.

But economy is not the only advantage you get with Cossor Point One Valves. They are fitted with a kalenised filament which throws off a terrific stream of electrons without visible glow. The destructive effect of heat has been eliminated. Most valves—even dull emitters—come to an untimely end because their filaments have become brittle through excessive heat and are readily fractured. The Cossor kalenised filament, on the other hand, retains its lifelong pliability, is abnormally tough and is capable of resisting hard knocks with ease. *No valve will outlast a Cossor.*

See your Dealer about these remarkable Valves—he has them in stock in three types.

The new Cossor Point One
No. 210D. With Black Band. An ideal super-sensitive Detector. Consumption 1 amp. at 1·8 volts - - 14/-

The new Cossor Point One
No. 210H. With Red Band. Pre-eminent among H.F. valves. Consumption 1 amp. at 1·8 volts - - 14/-

The new Cossor Stentor Two
No. 215P. With Green Band. For Power Valve use—ideal for Super Sets. Consumption ·15 amp. at 1·8 volts 18/6

Cossor Point One

Advt. A. C. Cossor, Ltd., Highbury Grove, London, N.5

Gilbert Ad. No. 6400

Popular Wireless

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RADIO NOTES AND NEWS.

The Royal Charter—"P.W." Radio in Rhodesia—More Curious Atmospherics—Marconi and Mussolini—Remarkable Daylight Reception—"The Ranger."

The Royal Charter.

THE draft of the Royal Charter, settling the lines upon which broadcasting will be conducted after December 31st, 1926, has now been issued. It has aroused much comment, but all I am going to say about it is this. We read that the Chairman is to get £3,000 per annum; the vice-chairman, £1,000; and each other governor is going to get £700. But *what is John Listener going to get out of it?* That is the acid test.

Free Wireless for the Blind.

THE House of Commons was dramatically stirred by the first reading of the Bill to provide free wireless licences for the blind. Captain Ian Fraser, the sightless M.P., walked up the floor of the House and handed in the Bill, and in a brief speech he asked for the support of all parties, in the hope that the Bill would become law by Christmas. By tense silence during the ceremonial, and by warm cheers at the end, the House marked its approval of the measure—and of the man.

Remarkable Daylight Reception.

MY recent remarks upon how well KDKA was coming over in daylight, brought me numbers of letters from readers who have been getting this station. One Leeds business man picked him up in an hotel, where the aerial was just an odd length of insulated wire hung from an upper window, using a portable 2-valver (Reinartz and L.F.).

It was this reader, too, who, getting loud-speaker results one night, left the dials set, and next day (Sunday) could distinctly hear KDKA at 3.15 p.m. Not at enjoyable strength, of course, but still, it was KDKA's telephony, on two valves, in the middle of the afternoon!

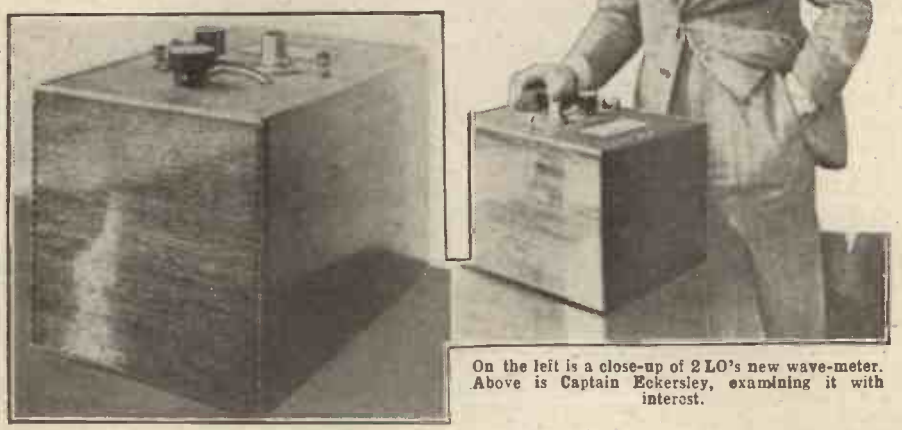
More Curious Atmospherics.

YOU remember that queer instance of the "atmospherics" in the 'phones, caused by cat-stroking, that I related two weeks ago. Well, I've had so many letters about similar cases, that I'm beginning to believe that these fish-eating, fur-licking pussy-cats that ornament our hearthrugs, are nothing more or less than generating stations! Apparently, when programmes are dull, dozens of listeners draw a spark from Fluffy, or Tiddlums, or Satan (or whatever the name is), listen to it in the 'phones, and think nothing of it!

Clicks from a Dog.

ONE Lambeth reader noticed the same effect when "someone standing near-by happened to draw a comb through their hair." This was repeated several times, the set being a 2-valver, Det. and L.F.

But one Heaton Moor reader carried out a little test one night that must have been really funny. He says: "I was listening in on a crystal set, when I touched our dog's nose, and was surprised to hear a loud click in the 'phones! This was repeated many times for experiment that day, but I have never been able to do it since."



On the left is a close-up of 2 LO's new wave-meter. Above is Captain Eckersley, examining it with interest.

"The Ranger."

"NUMBERS of British and foreign stations on the 'phones, and the local excellent on the loud speaker," seems to be the general experience with the "P.W." Ranger, described in October 23rd issue.

One Birmingham reader says, "Best two-valve's-worth I've ever struck." And, after all, how many of the multi-valvers get much more than can be tuned in with this two-valve straight circuit?

Helping the Hospitals.

"I'VE only got one kick coming against 'P.W.'" writes a London reader, "and that is that now it's so splendidly enlarged for threepence, it takes up too much room to keep all back numbers. Do the hospitals want them?"

Just to make sure I called up St. Thomas's and one or two others—any I could think of. They all said the same: "If readers will kindly send them along, we shall be only too delighted to have them."

More "Beam" Tests.

I HEAR that tests with South Africa from the new "beam" wireless station at Bodmin, have been a great success. Communication to and from the corresponding stations near Cape Town was carried out over long periods, and it is expected that this link in the Imperial Wireless Chain will soon be ready for public service.

"P.W." Radio in Rhodesia.

A RHODESIAN reader who built the short-wave set described in "P.W." by G2OD (Mr. E. J. Simmonds, of Gerrard's Cross), recently picked up signals sent from this well-known British amateur

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

station. On a QSL card to G 2 O D, he says: "Receiver used: Your own 'P.W.' (Det. and L.F.")
Remarks: "Suits me fine!"

This is not the first time that Mr. Simmonds's signals have been picked up thousands of miles away, on a set that was built from the artic'e which he wrote for "P.W."

Sir Oliver Lodge.

SAY what you will about talks in general, the fact remains that sometimes a talk can be the most stimulating and enjoyable feature in the programme.

The wonderful one-ness of atoms and solar systems, expounded in the friendly, grave voice of Sir Oliver Lodge, for instance, may not have appealed to *every* listener. But I have been astounded to learn how keen and universal is the intellectual enjoyment of listening to a great man, dealing with a great subject. Sir Oliver is not only *doyen* of English scientists, but he certainly has the *flair* for broadcasting, the incomparable power of personality.

Transmitting Without a Licence.

RECEIVING wireless programmes without a licence is asking for trouble. But *transmitting* without one is not merely asking for it, but getting it! A Cheshire man who had tried this on was fined £10, and £5 expenses, and the magistrates ordered the apparatus to be forfeited. Moral: "The licence must be taken before the ether is shaken!"

A Loud Speaker 300 Years Old.

THE Dear Old Dad of all loud speakers is claimed by Vienna. Three hundred years ago this ancient megaphone was used to shout orders for the defence of the city against the invading Turks. Now it is installed near the top of the cathedral, and is used by the Fire Brigade to signal an outbreak of fire. Recently one of the firemen rigged up a wireless set to while away the night watch, and he used this Venerable Vox for his loud speaker. The three-centuries-old veteran pushed out the programmes in perfect style!

Dominion Premiers Lost.

YOU wouldn't think that motor-coachfuls of Dominion Premiers could fail to find the Rugby wireless station, with its 800-feet masts, would you? Yet so it was! Hopelessly lost, the coaches drove up to a Warwickshire shepherd.

One of the party got out and explained: "I am the Postmaster-General."

The shepherd promptly replied: "Oh, yes! And I'm the Prince of Wales!"

So, after this question of identity had been satisfactorily cleared up, the shepherd took the Premiers in tow, and finally brought them to the Rugby station, all safe and sound. A few moments later the Premiers were exchanging messages with the Antipodes, whilst the shepherd was chuckling over his experiences with rulers of Empire.

Professor Fleming's Portrait.

TO commemorate the 42 years of Professor Fleming's service in the Chair of Electrical Engineering at University College—during which period he hitched up the first valve to a wireless set—his portrait is to be painted by Sir William Orpen.

The committee of the Portrait Fund will welcome any gift, however small, for it is felt that doubtless many listeners would like to associate themselves with this recognition of the Professor's pioneer wireless work. Subscriptions should be sent to Professor W. C. Clinton, University College, London, W.C.1.

New Wave-lengths.

THE B.B.C. announce that the Union Internationale de Radiophonie notify six revisions of the decisions previously made with regard to the wave-lengths of Continental stations. They are as follows:

	New wave-length.	Fixed previously at
Frankfort	428.6	394.7
Hamburg	394.7	428.6
Leipzig	357.1	322.6
Breslau	322.6	357.1
Königsberg	303	241.9
Münster	241.9	303

Marconi and Mussolini.

MUSSOLINI, who is quite unmoved if they try to stab, shoot, or bomb him, is not unmoved at the latest success of his countryman, Senatore Marconi. In a telegram of congratulation upon the opening of the "Beam" service, he says: "Permit me to express to you . . . my own feelings of profound and affectionate admiration." And so say all of us.

SHORT WAVES.

Truly, many are the uses of radio. Failure to answer an S O S message broadcast throughout the United States resulted in a man being declared officially dead, and a divorce was granted to his wife or widow.—"News of the World."

This must *not* be taken as a precedent.

* * *

Wireless has this advantage over the schoolmaster: What it says never comes in at one ear and goes out at the other. Not when you use headphones.—"Daily Herald."

* * *

We understand that a man who had been deaf for over twenty-five years recently heard a jazz band on the wireless. We hope this will be a warning to him.

* * *

"Wireless howlers a nuisance in London." The B.B.C. 2 L O cate them.—"The Star."

* * *

By the use of headphones and a specially constructed microphone an experimenter has listened to the sounds made by grubs while devouring apples. It is understood that the noise they made when spitting out the pips came through at loud-speaker strength.—"Electrician."

* * *

A special programme was broadcast recently under the title of "The Inns of Old London."

A case of Listen Inn.

* * *

"But when the Canon says the wireless is a way of the spirit I do not quite know what he means."—Extract from letter in newspaper.

Perhaps some of our readers who listen in at their clubs could enlighten us on this point.

* * *

The Popular Radio Weekly says: "3 L O is enterprising, too. The London Station, 2 L O, broadcast noises of several animals from the Zoo. So far we have only had comedy musicians."

* * *

"Do they really pay you to be funny, dad?" asked the young son of a comedian, after hearing his father on the wireless.

"Yes, my boy," replied the great man.

"Well, why aren't you?"

Heard at the B.B.C. Concert.

Phyl: "See that fellah with the stick? He's the conductor!"

Bill: "You don't suppose I should take him for the *insulator*, do you?"

The Latest.

I SAW a funny thing in one of the motoring papers the other week. An "expert," was writing about wireless, and about the disgraceful way the technical radio papers kept their readers in ignorance of the latest advances, and as an instance he gave the new American system of push-pull amplification!

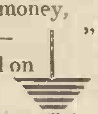
Those who remember this old stunt (it was useful before power valves came in), will realise that somebody has been push-pulling the expert's leg!

"P.W." Presents Silver Cups.

"POPULAR WIRELESS" is giving the first prize—a silver cup—in both sections of the Constructor's Competition, to be held in connection with the Hull Wireless Exhibition. Full details are being announced locally, and a list of successful competitors will be given in the Hull and district newspapers on Dec. 10th. The Exhibition opens on December 4th.

TECHNICAL TERMS ILLUSTRATED.

The Earth.

A HARD-LOOKING young woman
of Perth,
Had never been kissed from her
birth;
Till she came into some money,
Then—wasn't it funny?—
Men said, "You're the best girl on  "

To-night's National Concert.

THE fourth of the B.B.C. National Concerts will be held in the Albert Hall to-night (Thursday).

Sir Edward Elgar himself is conducting the Orchestra and the programme will consist entirely of selections from Sir Edward's own works.

A Gentle Reminder.

I SAY—just one word before I close down to-day. About this Christmas business. This week's number of "P.W." is not only the Christmas Number, but it's the biggest number, the best number, and altogether the most dinky, astonishy, and bargainy number that ever graced a bookstall.

Worth Extra!

IF they want to charge you extra for the Christmas Number, repudiate them with scorn. It certainly would be worth the extra, but 3d. is the price, so don't go and pay more! But be sure and have your three circular metal discs all ready, and go to the shop good and early. For if your copy of "P.W." is sold—well, you'll feel that way, too!

ARIEL.

WHEN "X's" ARE USEFUL

By J. F. CORRIGAN, M.Sc., A.I.C.
(Staff Consultant.)

HOW many readers are vitally aware of the fact that their receiving sets possess the inherent power of affording weather forecasts which very often prove to be really amazingly accurate? By this, of course, I do not mean to imply that some genius has discovered a method of connecting up the set to an ordinary barometer, and of reading off the state of the weather as one reads the intensity of the valve current from an ammeter dial. Such a means of weather prediction is rather too easy to be true.

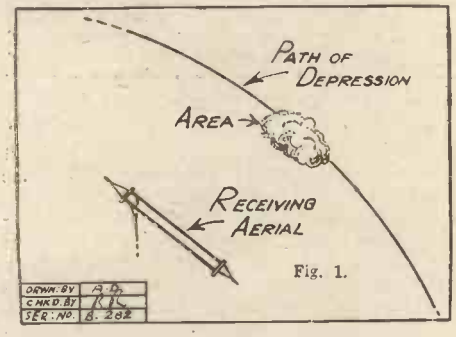


Fig. 1.

But, nevertheless, it is a feat quite possible of achievement to read the forthcoming state of the weather by carefully observing the behaviour of the set under various atmospheric conditions. All radio set owners, and especially users of multi-valve receivers, know only too well of the existence of various types of atmospheric disturbances which are fundamentally electrical in nature, and which, for convenience, are usually referred to under the one class of "atmospherics," "statics," "strays," or "X's."

Atmospherics are the bugbear of the long-distance radio worker, amateur and professional alike, and it is very natural that one of the modern trends of radio research should be in the direction of the total elimination of these unwanted disturbances.

The Radio Barometer.

The annihilation of atmospherics is not yet an accomplished feat, despite the great amount of careful thought and experiment which has been given to the subject within recent years, and therefore the ordinary radio amateur has just got to sit tight and put up with the nuisance until more efficient and universal filter circuits and other devices for eliminating atmospheric disturbances have been discovered.

But everything, it is said, possesses some use or other, and even the atmospheric curse under which all radio receiving installations labour may often be applied usefully in an endeavour to obtain reliable information as to the forthcoming state of the weather.

The radio receiver, in short, can be made to undertake the functions of a barometer simply by observing the type of atmospheric disturbance to which it is subjected at any particular time. Atmospherics, as the reader will well know, may, for ordinary purposes be divided into two general classes with respect to their source of origin. First of all, there is the ordinary type of atmospheric disturbance which produces violent clicks and gratings in the headphones of the receiver, especially in hot thundery weather. This "close range" type of disturbance is due to various electrical leakages between the earth and the clouds.

Simple Weather "Rules."

There is another type of atmospherics, however, which is far more mysterious in its origin. It is the "high altitude disturbance," and atmospherics of this type are more prolonged in duration in the 'phones than the "close range," or "low altitude" variety. Apart from the fact that the high altitude atmospherics are due to some type of continual electric disturbance in the upper regions of the earth's atmosphere, very little is known about them.

The enthusiast who wishes to read the forthcoming state of the weather in the cacophonous symphony of atmospheric disturbances which pass into the receiver may easily do so after a little observation and the application of a few simple rules. Needless to say, such "rules" are quite general ones, but nevertheless they are very useful to memorise when one embarks upon a day by day study of the weather's effect on atmospheric generation.

Rule No. 1.—If atmospheric disturbances suddenly arise in the 'phones, or if those already audible suddenly increase in number and intensity (especially intensity) it may be inferred generally that the state of the weather is about to change for the worse.

Rule No. 2.—If the opposite phenomena to the above occur (that is to say, if the disturbances suddenly cease, or even fairly rapidly decrease in number and intensity) an immediate favourable change in the weather may be expected.

Rule No. 3.—If, however, atmospheric disturbances picked up by the receiver appear to remain fairly constant over a period of one or two days, the weather conditions may be expected to remain unchanged.

Meteorological Depressions.

With regard to the last "rule," during settled summer weather it is a fairly frequent experience to have a continual slight display of atmospherics in the 'phones over a period of many days. Such audible disturbances, of course, signify the occurrence of disturbed weather conditions somewhere or other within the set's "atmospheric range," but the meteorological "depression," if we may employ that term, which is responsible for the creation of the atmospherics will, under the above conditions, be moving along a curved path, all the various points of which are approximately the same distance from the receiving aerial.

Consider the diagram, Fig. 1, however. The area enclosed by the dotted lines

The barometer should be carefully watched and compared with the observations taken during listening periods.

represents the immediate area of the meteorological depression. Its path is represented by the curved line. Now, if we imagine the area within the dotted lines to be an area responsible for the generation of atmospherics, it is easy to see that, provided the depression travels along its

(Continued on next page).

WHEN "X's" ARE USEFUL.

(Continued from previous page.)

appointed path, it will not come materially nearer the receiving aerial. Thus the frequency of atmospheric disturbances picked up by the receiving aerial, and their intensity, will remain fairly constant.

If, however, as in Rule 1, the depression area considered as an atmospheric generator moves directly towards the receiving aerial, the result will be that the number and intensity of the atmospheric disturbances will increase, thus foretelling the coming unfavourable weather change.

Predicting Thunder.

And, of course, as in Rule 2, if the opposite state of affairs takes place, and the depression moves away from the receiving aerial, the atmospheric disturbances picked up by the set will decrease in number and intensity.

Sudden thunderstorms which arise quite locally during hot weather are predicted by violent atmospheric crashings in the 'phones of the receiver. And it is not difficult to understand the reason for this effect. The presence of highly charged thunder clouds in the immediate neighbourhood gives rise to electrostatic discharges or electrical leakages. A proportion of such invisible or silent leakages collects upon the aerial and is discharged to earth, causing crashing noises in the 'phones of the set.

Now as to the various general types of atmospheric disturbances which may be distinguished with the aid of any ordinary receiver. Violent crashings, as we have just seen, signify thundery weather almost immediately. On the other hand, atmospheric noises of the "grinding" variety point to an approaching, but not immediate, change for the worse in the weather conditions.

"Sizzling" Noises.

"Sizzling" noises in the 'phones which are due to atmospheric disturbances, provided they are not too frequent, nor of great intensity, may be taken to predict no weather change. Such atmospherics as these are frequently due to the passage of a distant meteorological depression area at right angles to an imaginary line drawn from the receiving aerial in a horizontal direction.

Sizzling noises which are of frequent occurrence, however, very often predict rain, unaccompanied by thunder. Sometimes, however, these peculiar sizzling noises occur in cold weather when frost is about, and they are more prominent in industrial districts. Their exact cause is obscure. One explanation is that they are due to the deposition of minute particles of dirt-contaminated moisture, each of which has received an electrical charge from the atmosphere, and which gives that charge up on reaching the receiving aerial. Sudden frosts and imminent falls of snow are preceded by this atmospheric change, and therefore there is very probably a large amount of truth in the above supposition. Often, during winter-time, the sizzling noises take upon themselves a peculiar rhythmic character, especially at those times at which the weather is about to become colder.

Quite a fascinating study may be made by noting the influence of the weather upon the types of atmospheric disturbance received, and, indeed, a good deal of very valuable data may be compiled by the amateur who has the necessary patience to take up the matter systematically. Any ordinary valve set suffices, in most cases, for the work, and even a crystal set will often record the more prominent atmospherics. But it must be remembered that many crystal rectifiers have the property of filtering out all but the very strong atmospheric disturbances to quite an appreciable extent, and therefore for the work mentioned above a crystal receiver is by no means an ideal instrument.

Needless to say, the aerial must be an out-of-doors one, and it should be situated as high as possible. The length of the aerial does not matter particularly; nor does the actual type of aerial employed. It is a well-known fact that most atmospheric disturbances are generated on all wavelengths (within certain limits), and therefore in taking up the study of weather forecasting by means of the radio set, there is no need to trouble about any particular mode of tuning the receiver. Manipulate the tuning controls so that the set brings in the local station satisfactorily, and any atmospherics present will soon show themselves.

In many cases, however, and particularly in those where the receiver is situated near to the local station, searchers after atmospheric indications will have to "stretch out." In this case, the best thing to do is to concentrate on receiving a fairly distant station. And without a doubt, if there are any atmospherics within range you will soon hear them!

Effect of Wave-trap.

A well-constructed wave-trap, besides cutting out the local station, will quite frequently minimise a good deal of the atmospheric disturbances received by the set. Hence it is necessary when searching for atmospheric indications with a set fitted with a wave-trap for the purpose of eliminating the local station, to detune the wave-trap so that it works inefficiently and allows the local broadcast to be heard faintly. Under such circumstances, the trap will have no appreciable eliminating influence on atmospherics, and although the set will not produce its most efficient broadcast reception, it will be in a sensitive state for the reception of the desired disturbances.

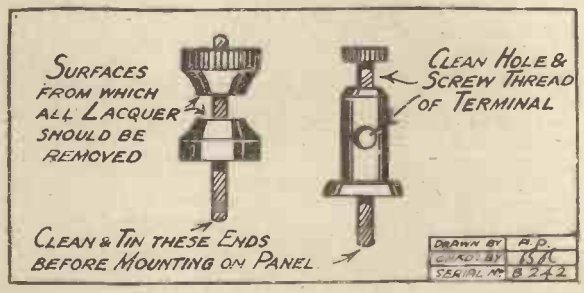
HINTS ON TERMINALS.

By J. F. C.

IT is difficult to imagine a more hardly used radio article than the average terminal. Such vitally indispensable articles of radio practice suffer a good deal in general arrangement and management, and yet they very seldom complain, or give rise to well-defined trouble.

A terminal is a simple thing. But, like every other simple device, there is a right way and a wrong one of using it.

In the first place, many constructors find a difficulty in making neat soldered connections to the ends of the terminal shafts when they are mounted in position on the panel. This is chiefly due to faulty tinning. It should be remembered that most terminals are turned out on to the market in a heavily lacquered condition. Rub the end of each terminal vigorously along a rough file until the end is perfectly bright and clean. Also, tin the end before the terminal is assembled. By these means subsequent soldering operations will be rendered much easier.



Screw down terminals, and terminals of the push-through type, require the lacquer to be removed from their business surfaces. Many reception troubles have been caused through the imperfect removal of this insulating lacquer coating.

Many, for some mysterious reason or other, will persist in placing the terminals in H.F. circuits very close together. This is bad practice. Place all H.F. terminals as far apart as is conveniently possible. You will thus minimise the chance of any stray leakages taking place across the panel.

Another trouble with some sets is that their terminals are placed too near to the edge of the panel. Under these conditions, the terminal shafts projecting downwards underneath the panel may possibly touch the woodwork of the cabinet, thus resulting in electrical leakage, and an improper fit of the panel into the cabinet.

The Best Type.

Another disadvantage of placing the terminals too near to the edge of the panel is that when drilling the necessary holes the ebonite is often very liable to break away at the edges.

Large, solidly made terminals are, as a general rule, more reliable in action than are their smaller brethren, and on this account their use is preferable whenever feasible.

And finally, nickel-plated terminals look well on a set, but nevertheless, if the receiver is to be used in city atmospheres, there is nothing like a good honest lacquered brass terminal for keeping its bright appearance.

An H.F. Intervalve Coupling Panel

By C. E. FIELD, B.Sc.
(*Staff Consultant.*)

THERE are three methods in general use for coupling an H.F. amplifying valve to a detector, or to a second H.F. amplifier, and there are conditions under which each method in turn is to be preferred to either of the other two.

The first of these utilises what is known as *resistance* or *resistance-capacity* coupling.

Fluctuations in the current flowing out from the first valve set up voltage variations across a resistance, which should have a value of from 50,000 to 100,000 ohms, connected in the anode circuit, giving rise to voltage impulses on the grid of the second valve. The corresponding amplified variations in the plate current of this valve are handed on in a similar manner to the grid of the detector, or the next H.F. stage.

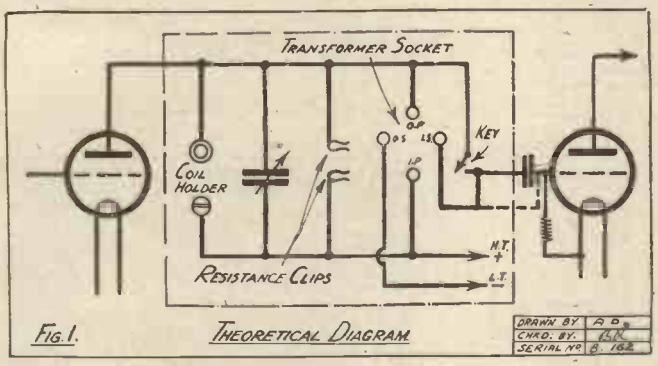


FIG. 1. THEORETICAL DIAGRAM.

Tuned Anode Coupling.

A blocking condenser is necessary between each pair of H.F. valves in order to prevent the positive voltage of the H.T. battery from getting on to the valve grids, and a grid leak must be employed to prevent the grids from accumulating a charge of negative electrons.

Before the detector valve, the blocking condenser also serves the purpose of rectifying grid condenser.

The second method of coupling H.F. valves is known as *tuned-anode* coupling, and is perhaps the most popular for the reception of short-wave broadcasting. The circuit in this case is exactly similar to that employing resistance coupling, except that each anode resistance is now replaced by a tuned circuit, consisting usually of a plug-in coil shunted by a variable condenser.

The third method makes use of an H.F. transformer, the primary winding of which is connected in the plate circuit of the first valve, the secondary being joined to the following grid and filament. In this case a blocking condenser and grid leak are required only before the detector.

It is obviously a great convenience to be able to change quickly from one type of coupling to another without having to alter the wiring of the receiver, or to introduce complicated switching arrangements.

Simple Method.

One method of carrying this out consists in connecting up a valve socket in the ordinary way for the reception of plug-in H.F. transformers, and making a special adaptor by means of which an anode resistance or a series of tuned coils can be inserted in the same socket. This, however, calls for a series of special coil plugs, or a somewhat complicated adaptor, the construction of which is probably beyond the scope of the average amateur.

The intervalve coupling panel described here makes use of the simple expedient of permanently connecting in parallel sockets for the reception of standard types of plug-in coil, transformer, and anode resistance. The only switching introduced is a simple break-key to disconnect the plate of the first valve from the following grid or grid condenser when transformer coupling is employed, the key being operated by the insertion of the transformer.

A diagram of connections is shown in Fig. 1.

The Shorting Key.

Assuming the use of conventional types of plug-in coils and transformers, and cartridge anode resistances of the Dubilier type, the components may conveniently be mounted on an ebonite panel measuring 7 in. by 6½ in. This should be drilled as indicated in Fig. 2, the method of mounting the components being clearly shown in the photograph of the front of the panel.

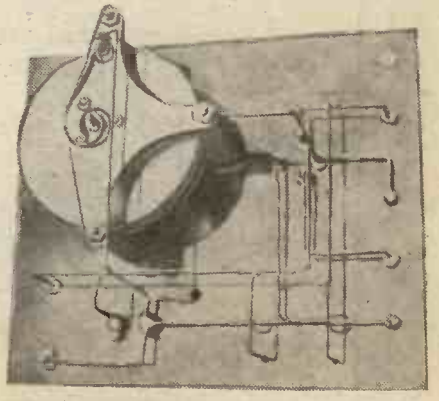
If a Dubilier anode resistance is employed, special clips should be made, as shown in the photograph, out of spring brass or copper strip, and mounted 1½ in. apart, connections being taken from the ends of the fixing screws at the back of the panel. This arrangement occupies less space than do the clips and terminals supplied with the resistance.

For the construction of the key previously referred to, two strips of spring brass or copper $\frac{5}{16}$ in. wide, and 2¾ in. and 2 in. long respectively, are required. These should be bent and drilled as shown in Fig. 3, and screwed on to a piece of hardwood, well dried and soaked in wax, measuring 1¾ in. long by 1 in. wide.

In this connection it should be remembered that when waxed wood is employed for any purpose, it should be waxed before being finally cut to size, for the waxing causes the wood to shrink considerably.

Automatic Action.

The longer strip, when secured in position, must be given a slight upward set, so that it is normally pressing upwards against the other, which is slit with a saw-cut for about half its length in order to provide two contact points, and thus ensure a good connection.



The single nature of the panel wiring can be seen by the above photograph.

(*Continued on next page.*)

AN H.F. INTERVALVE COUPLING PANEL.

(Continued from previous page.)

In order to ascertain the height of the mounting block, a transformer should be pressed home into the socket, and the block then made to the same height as the underside of the transformer spool above the panel. When the key is in position and the transformer inserted, the bottom key spring will then be deflected by about ¼ in., due to the bent-up portion at the end.

Connection may be made to these strips either by securing the wire under the head of one of the fixing screws, or by soldering it directly on to a clamped portion of the strip.

Wiring Up.

Five terminals are provided on the panel. Numbering from left to right, these are connected respectively to the H.T. positive, L.T. negative, plate of first valve, grid condenser of second valve, and grid of second valve (i.e. to the other terminal of the grid condenser).

The simplicity of the wiring will be evident from the photograph of the underside of the panel and the wiring diagram in Fig. 4; point-to-point connection being as follows.

Terminal 1 (H.T. +) is joined to one plug-in coil terminal, one anode resistance clip, inner primary transformer winding, and moving plates of variable condenser.

Terminal 2 (L.T. −) to outer secondary transformer winding.

Low Loss.

Terminal 3 (first valve plate) to the other plug-in coil terminal and anode resistance clip, outer primary transformer winding, fixed plates of variable condenser, and one key spring.

Terminal 4 (second valve grid condenser) to the other key spring, and the inner secondary transformer winding.

Terminal 5 is only made use of when transformer coupling is employed *between two H.F. stages.* It must then be strapped to terminal 4, thus short-circuiting the grid condenser, and connecting the secondary winding of the transformer directly to the second valve grid.

It will be obvious that in a circuit of this kind there is a risk of introducing considerable unwanted capacity, giving rise to instability and loss of efficiency. The following points, therefore, cannot be too strongly emphasised.

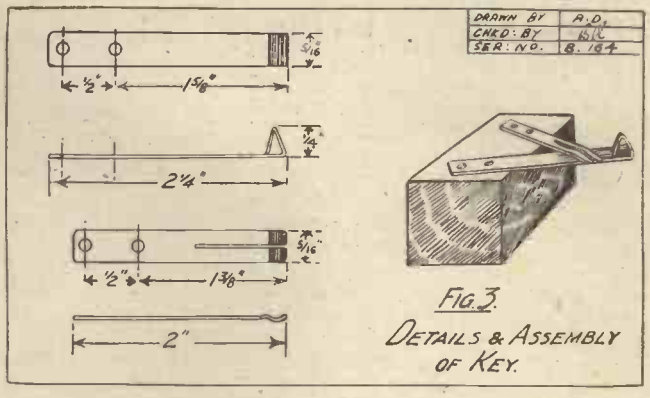


FIG. 3. DETAILS & ASSEMBLY OF KEY.

The coil holder should consist of a separate brass pin and socket, or should be of the low-capacity type, as made, for instance, by Lissen Ltd.

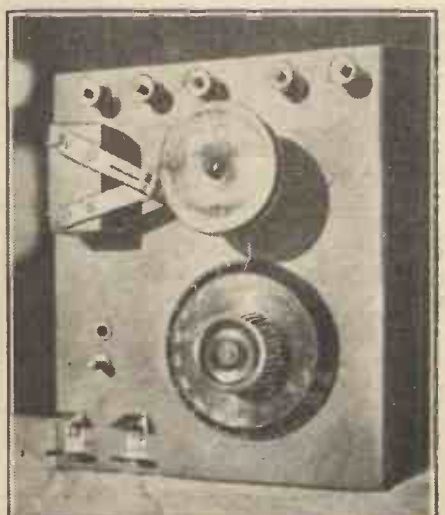
Separate valve pins, and not an ebonite valve holder, should be employed for the plug-in transformer.

A condenser should be chosen having a very low minimum capacity. This will be the case if, when in the all-out position, there is a clear space between the edges of the fixed and moving plates. The maximum capacity should be ·00025 mfd.

An Important Point.

The condenser is then suitable for tuning the primary transformer winding, and will be no detriment if the latter is required to be aperiodic.

When using the panel, it is necessary simply to insert the resistance, transformer, or coil, according to which type of coupling



The coupling unit forms a neat and compact item in the experimenter's workshop.

is desired, the condenser being kept all-out unless it is required to tune the anode coil or transformer winding.

A word of warning must be given here, however.

When the transformer is plugged-in, unless the key opens before the four legs have made contact with the sockets, it is possible for the two windings to be connected in series with the valve filaments, across the high-tension battery.

The high-tension should therefore be

(Continued on next page.)

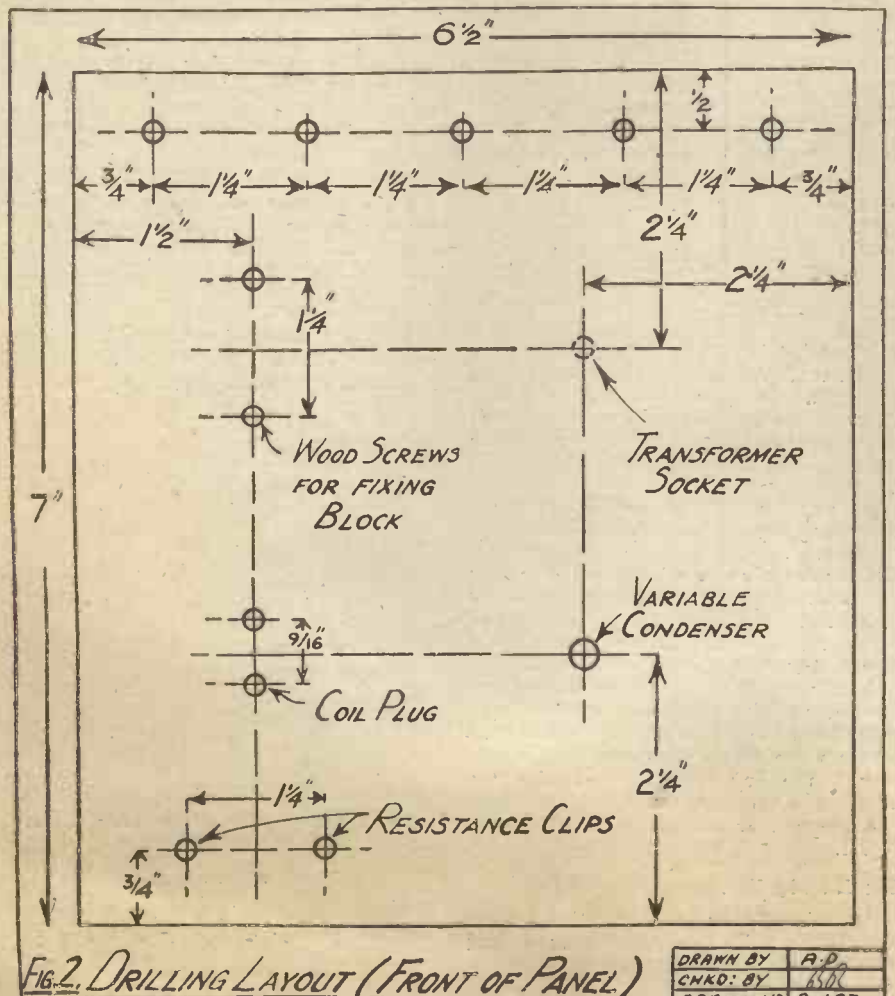


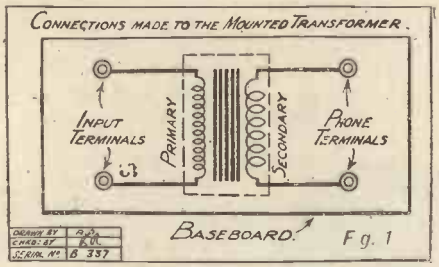
FIG. 2. DRILLING LAYOUT (FRONT OF PANEL)

THE TELEPHONE TRANSFORMER

By J. F. C.

TELEPHONE transformers are instruments of a bygone age. At least, so far as the average crystal set owner is concerned, they are. But nowadays one sees whole consignments of these articles on the market at very low prices, and it is certainly worth while for the keenly interested enthusiast in crystal and valve reception to procure one of these articles, and to conduct a few experiments with its use.

Transformers of this type, which are obtained from one or other of the various suppliers of surplus War Office goods, are generally articles which have been taken from old pattern Government receivers.



Fg. 1

Usually they are in good order, and can be relied upon to give a long period of useful service.

Preliminary Preparations.

Having obtained a telephone transformer of this description, the article should be mounted. The most convenient method of effecting this end is to utilise some old discarded wooden base for the purpose. A pair of terminals should be placed at each end of the wooden base (the transformer itself being mounted in the middle), and connections from the primary and secondary windings of the transformer led to each pair of terminals respectively.

A transformer mounted in this manner will be seen at Fig. 1 showing diagrammatically the mode of making the necessary connections from the primary and secondary windings of the transformer to the baseboard terminals.

The average resistance of the primary winding of a telephone transformer is of the order of 4,000 ohms. This winding is connected directly to the set. The telephones are included in the secondary circuit of the transformer (Fig. 2), the secondary transformer winding having a resistance of approximately 120 ohms.

L.R. 'Phones.

Of course, when a 4,000-ohm pair of headphones is used with the receiving set, there is no advantage to be gained by the use of a telephone transformer. It is only in those cases in which the experimenter has at his disposal one or more pairs of low-resistance (120 ohm) 'phones that a transformer of this type comes into real service. Most low-resistance 'phones in the possession of amateurs are little used nowadays. A telephone transformer, however, will immediately place these discarded 'phones on an equal level with the high-resistance ones.

Some experimenters in crystal reception claim that the use of low-resistance 'phones in conjunction with a telephone transformer results in a better clarity being given to the signals, and a complete freedom from local interference, such as generator hum. It is doubtful, however, as a general rule, whether these claims can be substantiated.

However, be this as it may, there are many useful purposes which a telephone transformer will serve in crystal and valve reception, whether by headphone or loud speaker, and as these articles are to be readily obtained nowadays at a fraction

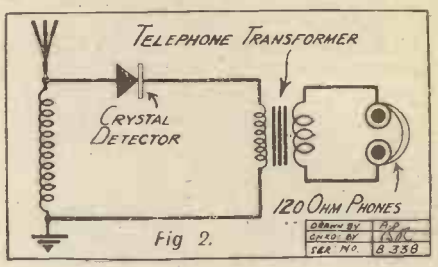


Fig 2.

of their original cost, it is certainly well worth while investing a "bob" or two on one of them, if only for the purpose of making a closer acquaintance with the properties of this useful type of radio component.


A good example of the trend of radio design in America. The model illustrated is a multi-valve Grebe receiver.

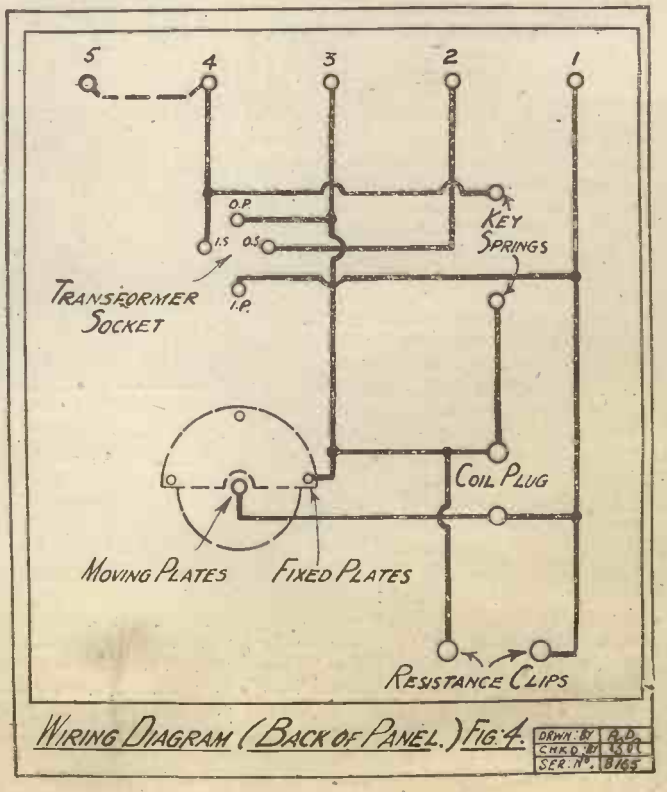
AN H.F. INTERVALVE COUPLING PANEL.

(Continued from previous page.)

switched off before inserting the transformer.

As an additional safeguard, one transformer leg may be cut short, so that it does not enter its socket until the key has broken circuit.

It will be realised, of course, that similar arrangements could be incorporated in the permanent wiring of a receiver without the necessity for introducing a separate panel.



TECHNICAL NOTES.

A Weekly Feature Conducted by

Dr. J. H. T. ROBERTS, F.Inst.P.
(Staff Consultant.)

A NEW type of aerial was submitted to me recently which, although I have not yet had time to test it myself, is claimed to have great advantages in regard to its property of picking up electro-magnetic waves. This aerial may be described briefly as being of the spiral-spring type, but with the convolutions of the spiral metallically connected together. For example, suppose a spiral spring be taken and a bare copper wire passed down the centre, the copper wire then being stretched across a room and acting as a support for the spiral spring which is threaded upon it. So long as the copper wire and the spiral spring are both clean, there will be a reasonable chance of the convolutions—or, at any rate, many of them—making electrical contact with the copper wire. But after a little time it is certain that, owing to dirt and corrosion, the contacts will become very bad, and, in effect, the aerial will be equivalent to the more or less familiar type consisting of a spiral metal spring strung upon an insulating cord.

A Novel Aerial.

In the new aerial, however, the convolutions are separately and individually soldered or spot-welded to the main longitudinal conductor, the whole resembling somewhat closely the grid of a valve, except that the longitudinal conductor is within the spiral instead of being external to it, as it usually is in the valve grid.

It will be seen that the result is the same as though a large number of metal wire rings were separately soldered to a straight conductor, except that by utilising a spiral spring in the manner indicated above the labour of producing the product is infinitely reduced.

For electrical purposes, the aerial must be regarded, however, as a straight conductor with a large number of metal rings electrically attached to it at small and regular intervals. I understand that this arrangement is patented, but there would appear to be no reason why experimenters should not try similar arrangements for themselves.

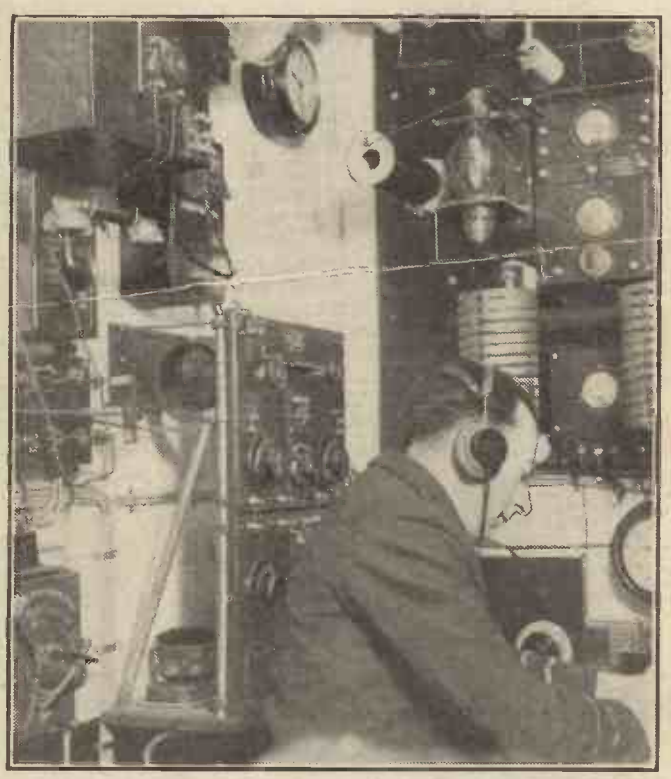
Avoiding Interaction.

The lay-out of a set is a matter of much more importance than is commonly appreciated by the amateur constructor, especially the beginner. It is often stated in articles describing the construction of particular types of receivers that the components should be arranged in such and such relation to one another, and it is, perhaps, not unnatural that the beginner should regard these instructions as being capable of a fairly liberal interpretation. If he happens to have a panel of a somewhat different size or shape from that described in the instructions, he sets to work to rearrange the layout so as to suit the panel.

It is true that in many cases a perfectly good result can be obtained with an arrangement quite different from that used by the author of the article in question; but, at the same time, it should be borne carefully in mind that there are some rearrangements which may make little difference, whilst there are others which may make all the difference to the efficient functioning of the set.

So far as possible, the components should be arranged in a regular sequence from the H.F. to the L.F. end, and conductors carrying H.F. currents should not be brought into proximity with conductors carrying L.F. currents. Similarly, of course, H.F. conductors should be kept away from earthed conductors. Long leads should be avoided as far as possible, and the parallelling of leads is particularly objectionable. I have already mentioned in some recent notes the importance of avoiding interaction in the case of L.F. transformers, and the same applies in the case of H.F. transformers.

In order to emphasise the importance of a correct lay-out (that is to say, an arrangement based upon a careful consideration of the foregoing principles), it should be sufficient to mention that a set which is found to be operating badly, or to break into howling on the slightest pretext, may frequently be corrected and put into perfect condition by removing the components from the panel, or baseboard, rearranging them in the proper way, and rewiring. So if you are using a lay-out which is different from that in the book, and you are not getting the results which you were led to expect, it is always a question worth considering as to whether the set should not be dismantled and components and wiring rearranged.



The wireless cabin of ss. "Jervis Bay" which kept in daily touch with Sydney (Australia) on its recent voyage to Plymouth.

New Type of Loud Speaker.

I recently mentioned an invention in connection with loud speakers which I believe is novel, although on that point I am not quite certain. However, beyond describing the idea for the information of readers of this journal, and examining some experimental models, the invention, although patented, was shelved owing to the pressure of other work.

The idea, in brief, was to employ a double-sided electro-magnetic system for a loud-speaker unit employing the same or similar coils and a similar magnetic system, except that the latter was provided with pole-pieces at the two opposite sides of the unit. The unit is then fitted with two diaphragms facing the two pole-pieces respectively.

It can be shown, theoretically, that with proper arrangements the addition of the second diaphragm does not seriously detract from the power available for functioning the first, and it evidently gives a considerable additional means of communicating sound energy to the air.

I notice that in the United States a new type of loud speaker has been placed on the market using a double-cone loud speaker, the unit being at the centre of the two cones, fitted on opposite sides. Whether it employs the system mentioned above, or not, I cannot say.

In Phase.

It is interesting and important to note that with the double-diaphragm arrangement mentioned above the two diaphragms are in phase; that is to say, they both move inwards together and outwards together, so that when a wave of compression is being generated at the one a wave of compression is also being generated at the other, and similarly with the waves of rarefaction. In the case of a single-cone loud speaker it might be argued that the sound proceeds from both sides of the cone; but here it should be observed that when a wave of compression is being generated at one surface of the cone, a wave of rarefaction is being generated at the opposite surface which may to some extent neutralise the effect of the first-mentioned.

If there is anything in "P.W." that you do not like, please tell us about it when writing.

How to make Fixed Resistors

By OSWALD J. RANKIN.

IF the filament potential of a modern dull-emitter valve is permanently set at the makers' specified figure, no further adjustments are necessary, for the valve will function efficiently at all times providing the accumulator is kept up to the mark. This means, of course, that we can use a very simple and compact form of fixed resistance or "resistor," in place of the usual variable resistance, or "rheostat," and the result is a great saving of space on the panel or baseboard of the set, and *fewer control knobs*. Moreover, a number of fixed resistors may be easily made up at home at a trifling cost.

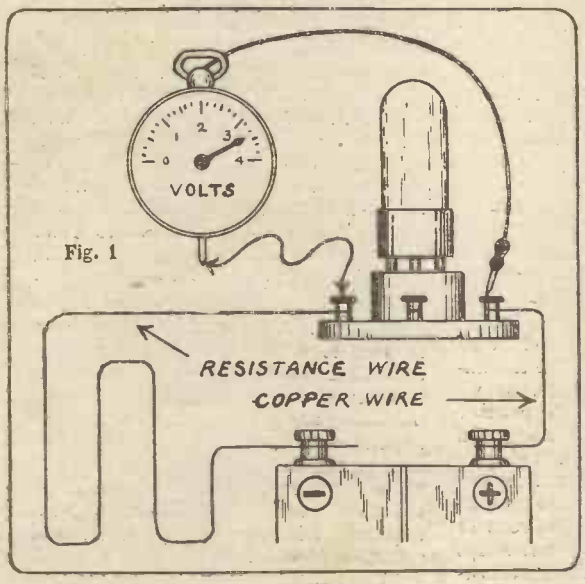


Fig. 1

The Wire to Use.

To find the approximate length and correct gauge of resistance wire to use it is only necessary to study the figures on the valve, glance at the table given below, and observe the simple rule: resistance equals the voltage to be dropped divided by the filament current.

EUREKA RESISTANCE WIRE.

Size S.W.G.	Ohmic Resistance per yard.	Current Capacity
18	·37	4·0
20	·66	3·0
22	1·10	2·0
24	1·77	1·5
26	2·65	1·0
28	4·0	0·75
30	5·58	0·5
32	7·35	0·50

Thus, assuming a 4-volt accumulator and a valve requiring, say, ·1 ampere at 3·5 volts, the voltage to be dropped, or "resisted," is ·5, and if this is divided by the current consumption of the valve, which is ·1 ampere, we get ·5 ÷ ·1 = 5 ohms.

Now for the length and gauge of resistance wire. From the table it will be seen that No. 28 gauge is a likely proposition, this giving a resistance of 4 ohms per yard; thus, for a resistance of 5 ohms we shall require 1¼ yards. But the smaller the gauge of wire the greater the resistance per yard, and since our aim is compactness, it would seem better to use a shorter length of finer wire, such as No. 30 gauge, which gives a resistance of 5·58 ohms per yard.

In this case we can use *less* than a yard, but what of the current carrying capacities of these finer wires? Will the resistance become overloaded, and heat up when in use? This may be quickly ascertained by glancing at the third column in the table, where it will be seen that the safe load capacity of No. 30 gauge wire is ·5 ampere. Our valve takes only ·1 ampere, so there is, of course, a large margin of safety.

Having now decided upon the gauge and approximate amount of wire, we will pass out of the "office" into the workshop, and find the *exact* amount by carrying out a practical test with the voltmeter. It is assumed, of course, that one cuts off a length of wire several inches in excess of the amount indicated in the table, for it is always better to cut off too much than too little.

A Similar Test.

There are two methods of carrying out this simple test, one is indicated in Fig. 1, where the correct *length* of wire is found, carefully noted for reference, and then wound on a suitable former. The other method is shown at A B in Fig. 2; here the whole length of wire is first wound on a former of the same diameter as the former ultimately used, the coil then being tapped until the best position is found, when the number of *turns* in circuit are then carefully noted and rewound on a former of suitable length.

To proceed with the first-mentioned test (Fig. 1), place the valve in a spare holder, connect one filament terminal to one side of the accumulator with a length of copper wire, and the other filament terminal to the other side of the accumulator with the selected length of resistance wire, which, assuming No. 30 S.W.G. Eureka wire and a dull-emitter requiring a resistance of 4 or 5 ohms, should be about 30 or 36 inches in length. Arrange this wire so that it lies flat on the bench, in worm fashion, connect the voltmeter across the two filament

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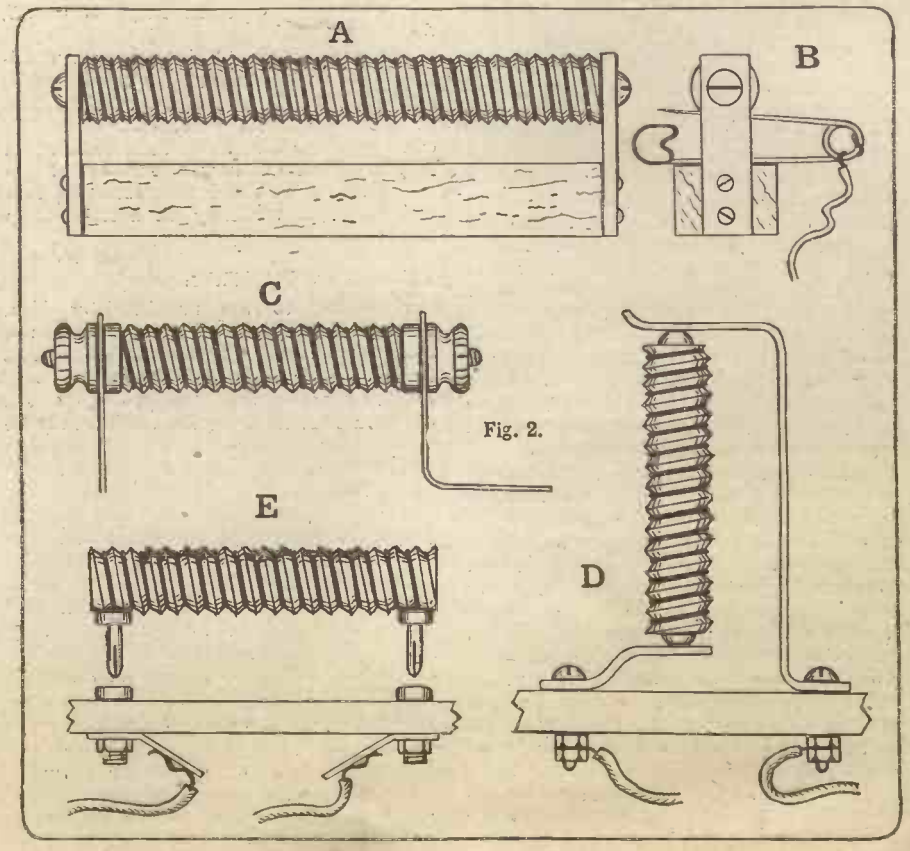


Fig. 2.

HOW TO MAKE FIXED RESISTORS.

(Continued from previous page.)

terminals, and gradually decrease the length of the wire until the voltmeter accurately registers the voltage specified by the makers of the valve. If now the exact length of wire is carefully measured, and noted, it is a simple matter to cut off similar lengths and make up any number of resistors for use in conjunction with valves of the same type.

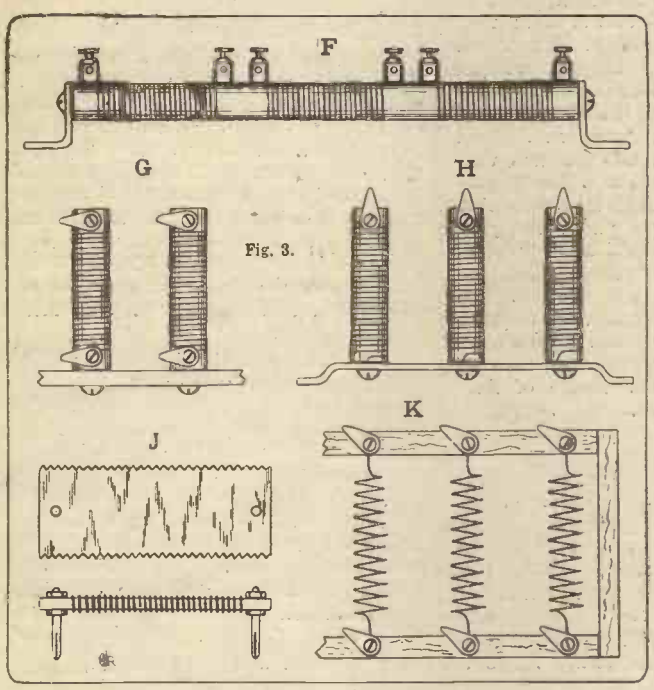


Fig. 3.

Mounting the Resistor.

Before passing on to the winding and mounting of the resistor, we will consider the second method of finding the correct amount of wire (A B, Fig. 2). Here the former receives first consideration. This is made from a 2½-in. length of ⅜-in. ebonite rod, which is screwed ⅜ in. Whitworth. Each end of the rod is previously drilled and tapped to take 8 B.A. screws, small brass links then being fitted as shown. The windings lie in the threads cut on the rod, the ends being secured under the links or screwheads. The lower ends of the links are then screwed to the ends of a rough wooden base, and a connection is taken from one of the links to one filament terminal on the valve holder. One accumulator terminal is connected, via a flexible lead, to a small safety-pin which is inserted between the wooden base and the under side of the winding in the manner shown at B (Fig. 2), so that the moving limb will make contact with any turn of the winding. The other side of the accumulator, and the voltmeter, are connected as shown in Fig. 1, the pin then being moved about until the desired voltage is obtained. The number of turns between the valve filament terminal and the pin are then counted; it is then only necessary to prepare another former having a corresponding number of threads, and fill the threads with the same gauge of wire.

Diagrams C to E (Fig. 2) show three simple methods of mounting resistors arranged on the latter principle; at C the ends of the rod are fitted with small terminals, which, of course, are connected to the ends of the winding, so that if fairly stiff wire is used for wiring up the set, the resistor needs no other support than the actual connecting wires. Round-headed screws may be fitted in place of the terminals, the device then being placed between two spring brass clips, in grid-leak fashion, or mounted vertically, as shown at D. The resistors may also be arranged on the plug-in principle as indicated at E, so that when removed from the sockets they act as switches for cutting off the filament current.

When the correct length of resistance wire is found by the Fig. 1 method, the design and general arrangement of the former is of little importance, since, as we have seen, the number of turns are not taken into account, and providing the turns are well spaced the wire may be wound on plain rods or tubes, or on flat strips of any suitable insulating material. If insulated wire is used the turns may, of course, lie close together.

Diagram F (Fig. 3) shows how a multi-resistor may be wound on a single length of rod or tube, the windings being connected to small terminals which also form the contact points for circuit connections, and diagram G shows how a number of resistors might be fitted with soldering tags and mounted vertically on a small strip of ebonite.

Multi-Resistor Possibilities.

Returning to the multi-resistor idea, there is no reason why we should not connect one side of each winding to a common lead, or busbar, for in most sets the resistances are "tapped" off the common L.T. negative lead. This may be effected by mounting the resistors on a strip of sheet brass in the manner shown at H, and connecting the lower ends of the windings to same. The strip may then be screwed down to the baseboard and connected to the L.T. lead at any convenient point. Such a method will only apply in cases where the resistors are all connected to the same L.T. lead. Different types of valves may be used providing the resistors are wound to conform with their requirements, and the upper end of each resistor correctly joined to its respective valve socket.

Diagram J depicts a simple flat type of resistor former which consists of an odd piece of hardwood, fibre, or ebonite, having its edges notched in order to separate the turns of the winding. If good, dry hardwood is used, the most suitable method of notching the edges is to procure a long ⅜ in. Whitworth bolt (screwed up to the head), place this in the fire until it becomes red hot, and then press the edges of the former lengthwise on the thread. The impression left by the heated thread forms the necessary spacing notches, which may be deepened, if necessary, with a small three-cornered file or a hacksaw. Such a resistor may be mounted in many different ways. The plug and socket system will be found most effective, since, as pointed out above, the component then serves a double purpose.

Converting Existing Rheostats.

The possibilities of the open coil resistor may interest some readers. Such a device, in multiple form, is shown at K, where the wire is first wound over a pencil and then stretched out in spring fashion and attached to the sides of a simple frame built up from strips of hardwood. The coils might be enclosed in small insulated tubes provided with metal end-caps so as to resemble ordinary grid leaks.

The problem of converting existing rheostats into fixed resistors is also worth considering. One simple method is shown in Fig. 4, where an ordinary rheostat is connected up in place of the length of resistance wire in Fig. 1, and carefully adjusted until the required voltage is registered. The position of the arm will, of course, depend upon the type of rheostat to be converted. Assuming one-third of the entire winding sufficient to give the required resistance, we then obtain three separate resistors by simply dismantling the rheostat and cutting the ring into three equal sections. Each section might then be flattened out, again tested, and finally screwed down to the baseboard of the set and connected to the valve.

Scope for Experiment.

The compressed carbon type of filament rheostat does not lend itself so readily to the purpose. At its best it is never so reliable as the wirewound resistance, and if it cannot hold its own as a variable resistance it would indeed stand a poor chance as a fixed resistor. Readers are therefore advised to adhere to the more reliable method of using *wire*, even at the expense of a little inconvenience and loss of space. The wirewound fixed resistor has come to stay, and experimenters will do well to devote a little effort towards improving present designs.

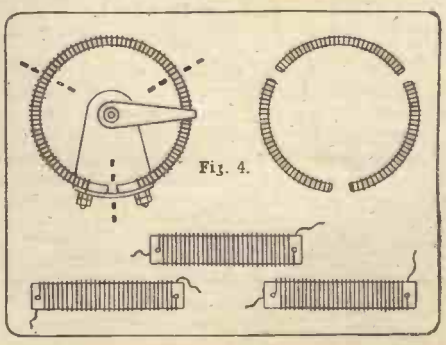
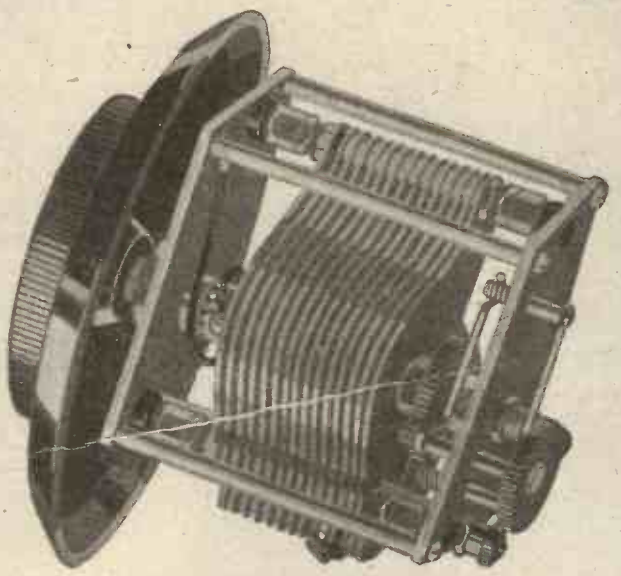


Fig. 4.

NOW A Brandes CONDENSER

STRAIGHT LINE FREQUENCY SLOW MOTION LOW LOSS

It will be obvious from the table of new B.B.C. wave lengths given below that a condenser in which the dial reading varies directly as the frequency will give a more uniform separation of stations than one in which the dial reading varies directly as the wave length. This is particularly apparent in the lower wave lengths.



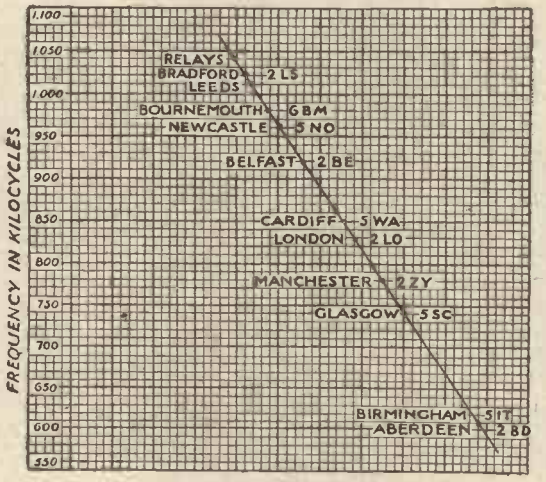
Brandes Straight Line Frequency Slow Motion Low Loss Condenser has been specially designed to provide a straight Line Frequency tuning characteristic and to bring in the B.B.C. Stations well spaced out over the major portion of the dial, whilst **at the same time maintaining the compact form which is so very essential in the back-of-panel instrument.**

A typical tuning curve is shown below :—

With this condenser a positive movement for approximate setting is obtained by turning the 4" diameter dial which is provided with finger grips for this purpose. The final critical setting is obtained by turning the 2½" knob which actuates the slow motion mechanism.

Low dielectric losses and the complete absence of backlash are ensured.

Price ·0005 - - **18/6**
·0003 - **18/-**



Actual curve of Brandes ·0005 mfd. S. L. F. Slow Motion Condenser used with a loose-coupled circuit comprising No. 35 untuned aerial coil and No. 50 tuned secondary coil.

The following table shows the new wave lengths of the B.B.C. stations with their corresponding frequencies :—

Call Sign	*Station*	*Wave Length*	*Frequency.*
2 BD	Aberdeen	491.8 metres	610 k.c.
5 IT	Birmingham		
5 SC	Glasgow	405.4 ,,	740 ,,
2 ZY	Manchester	384.6 ,,	780 ,,
2 LO	London	361.4 ,,	830 ,,
5 WA	Cardiff	353 ,,	850 ,,
2 BE	Belfast	326.1 ,,	920 ,,
5 NO	Newcastle	312.5 ,,	960 ,,
6 BM	Bournem'th	306.1 ,,	980 ,,
2 LS	Leeds ..	297 ,,	1,010 ,,
	Bradford	294.1 ,,	1,020 ,,
Other	Relays	288.5 ,,	1,040 ,,

Numerous Advantages :—

1. A handsome 4" dial engraved with clearly marked divisions and provided with finger grips for the approximate setting of the condenser.
2. The large knurled knob 2½" diameter operates the patent vernier mechanism for fine or critical tuning.
3. A minimum quantity of highest quality ebonite ensures low dielectric losses.
4. The single hole fixing bush has a knurled face to ensure a firm grip on the panel.
5. Ball bearings fitted into cone shaped races prevent shake and backlash.
6. A pigtail flexible connection ensures perfect contact between the frame and the moving vane system.
7. Brass vanes and spacing collars chemically cleaned ensure perfect contact.
8. Conical bearings at base prevent shake and backlash.
9. The Slow Motion is transmitted to the moving vanes through a carefully designed friction clutch by means of a train of wheels having a finely knurled surface which ensures a very smooth reduction movement without jump or slip.
10. Specially designed spring bearings keep the train of wheels in intimate contact and by exerting a gentle pressure on all the moving parts entirely eliminate backlash.

This Condenser will provide a Straight-Line-Frequency tuning characteristic with the stations within the B.B.C frequency range well spaced over the dial. The shape of the moving vane is designed to provide a small compact condenser having a straight-line-frequency tuning characteristic without taking up a large back-of-panel space. Most other S.L.F. Condensers have a long narrow vane with a very wide swing, taking up a lot of valuable space at the back of the panel.

BRANDES LTD., 296, REGENT STREET, W.1. WORKS : SLOUGH, BUCKS

The IMPORTANCE of LAYOUT

An example of well-spaced coils. They have been so mounted that their magnetic fields will not interact.

By K. D. ROGERS.
(*Assistant Technical Editor.*)

THE term "layout" is such an often-used one that probably not one of my readers is unfamiliar with it, but I wonder how many fully realise what it is intended to convey. "Oh," you say, "it merely means the position of the various components in a receiver." Yes, it means that, but not merely that, for it also embraces each lead and connection made between those various components.

Let me explain. Most are familiar with the circuit employed in a one-valve set with one H.F. stage, and most of you, probably, realise that there can be all kinds of designs, flat panel, American type, and so on, incorporating that circuit. With those designs all sorts of layouts are possible, *but* you will find in ninety-nine cases out of a hundred that the layout decided upon by any one experienced constructor will be very similar to that employed by any other constructor who knows what he is doing. In short, the components are so arranged that the stages come in their proper sequence and the wiring is simplified as much as possible.

No one in his senses would put—in the case of an American baseboard design—the variable condenser on the right, the aerial on the left and the coil holder up near the aerial terminal. This would leave long tuning leads between the condenser and the rest of the circuit and would be asking for inefficiency.

That is an obvious case, but where more complicated receivers are concerned, or where ultra-sensitivity and efficiency have to be considered, layout plays an extremely important part. And here, when I say layout, I also include *panel* layout, or the relative position of the controls.

Arranging the Controls.

Where easy control is to be obtained, the various tuning dials, rheostat knobs, etc., must be placed ready to hand so as to simplify the handling of the set as far as possible, but, unfortunately, a compromise between extreme operating efficiency and appearance has to be made in a great many cases, or the set would look very strange and unorthodox. However, as far as possible, the operation side of the question should be considered before that of mere appearance, because, to a large extent, the success or failure of the set, however well made the components may be and however good the *circuit*, will depend upon the ease with which the set can be handled, quite apart from the efficient arrangement of the interior of the receiver.

So the first thing to do when you decide to build a wireless set and have chosen the circuit and type of panel (either upright or flat), is to think carefully over the layout from all points of view.

Take your components and place the control dials on the panel in the positions you would *like* them to occupy—the positions that appeal to you most from the point of view of handling the set. Then re-arrange them until the *appearance* and efficiency point of view are merged and you have the best compromise between the two, bias always being given towards the efficiency part.

Then place the interior components in position, as you think they will fit in best with the layout of the panel, and you will probably have a shock. Maybe the coil holder won't clear the variable condenser or the L.F. transformer, and so on, and you will have to rearrange things again.

Well-Spaced Components.

All this takes a long time to describe, but it can be carried out quite rapidly in practice and is not nearly so tedious as it sounds.

This time arrange things so that they have ample space between them—keeping to the original panel layout as far as possible. This part of the business must be done much more carefully, for you should visualise the various connections as you move the components about and should avoid long plate and grid leads like the plague. From a sheer efficiency point of view I like to layout most of my components in the exact order in which they occur.

In other words, imagine you are a wireless signal and follow its path, dropping the components into position as you go along and keeping all "live" wires (H.F. and L.F.) as short as possible. It is not an easy task to get things *exactly* as you would like them and still to make the set look nice, but by carrying out the operation as described you will make a much better job of it than by studying appearance alone or by merely laying out the components *equally* so that the baseboard and panel are evenly covered.

Short Leads Essential.

When the components have been placed in their final positions, the wiring up can be commenced, and here it is best that the filaments, all L.T. wiring in fact, be done first. This is because in the majority of sets these connections can be tucked away anywhere and arranged so that maximum space is left for the other wiring. The L.T. wiring is at earth potential so can be carried along all round the set if desired, without causing any trouble.

Not so the grid and plate leads, which should be as short as possible and well separated—grid and plate leads *never* being allowed to run parallel to each other unless they are a considerable distance apart. In this respect, the word "never" should be your maxim if possible, but if "sometimes" has to be employed, it should be very seldom.

I recently had a case of the most annoying kind, which shows how careful one must be even when hooking up an apparently "harmless" receiver. I had occasion

(*Continued on next page.*)

Members of the Tottenham Wireless Society demonstrating coil winding during the recent radio exhibition held by that Society.

THE IMPORTANCE OF LAYOUT.

(*Continued from previous page.*)

to try out a circuit which employed three valves, all resistance-capacity coupled and using no reaction whatever. There it was, one valve, the detector, acting on the anode bend principle, resistance-coupled to another and this latter resistance-coupled to a third. That was all there was to it—*apparently.*

On the face of it it looked as if a nice compact receiver could be built, and as no reaction was employed and the plate circuits of the valves were quite aperiodic, I did not expect any trouble. Furthermore, no components capable of giving out a magnetic field (except the wire itself) were employed.

I built the set, beautifully compact but not crowded, and ideal from an operating point of view. On test I received about 30 per cent. *more* amplification than I expected, *but*—and a very big but it was—the results were anything but pure. What was happening? The set was resistance coupled, had matched valves and impedances and all that sort of thing, and yet, although amplification was good, results were not at all satisfactory.

An Unexpected Effect.

The tuning of the set gave me the clue. Instead of being flat on the local station—two miles away—as I had expected, it was dead sharp, almost like a super-het. and with two degrees on the .0005 aerial condenser (the only one) *all trace of the station was lost.* Connections throughout the set were perfect, so only one thing could be causing that sharpness—the set was all but *oscillating,* at H.F.

What had happened was that the first valve plate lead ran alongside the aerial lead (the set was loose-coupled with aperiodic aerial coil of 50 turns) for about 1½ in., and this, together with the self-capacity of the valve and the fact that a negative bias was employed on it in order to use the anode bend principle, was sufficient to cause an H.F. feed-back.

In other words, reaction was taking place and the set was not far from oscillation. Consequently, tuning was sharp and the H.F. component in the plate of the detector got mixed up with the L.F. and so caused serious distortion. The build-up of amplification was remarkable and on spark the set would have been ideal. But it was no good for telephony.

Watch the Wiring

More careful spacing cured the trouble and now the set, with the same components and valves, is operating perfectly. Purity of reception is obtained and the tuning is as it should be—flat. This is, of course, a detail, for the set is solely intended for local loud-speaker work, and for such has finally completely justified its existence.

That, I think, is a very unusual example of the effect of thoughtless layout. The circuit appeared so harmless that I was taken off my guard, and although no obvious errors in spacing were committed the wiring was not laid out as carefully as it would have been if I had more carefully considered the matter.

So, in building *any* set, no matter what it may be, you cannot be too careful about that all-important feature—the layout. It is no good having super-efficient components and expensive valves if a bad or careless layout is going to ruin the whole affair. Watch those H.F. leads and then—watch the L.F. Suspect every wire of possible interaction and you won't go far wrong. It may not always be necessary, but if you neglect it you will come up against a snag some time or other, and it may take a long time and much searching before the cause of the trouble is ascertained.

Sets designed and described in these pages can be relied upon as regards layout, but where deviation from design and where home-made sets are made up independently of published details, then every constructor should carefully consider his layout and act accordingly.

Where multi-valve sets are concerned it is sometimes advisable to sacrifice a little of the appearance of the wiring and use direct leads of round tinned copper wire rather than employ square wire and those beautiful right angled bends that add so much to the internal appearance.

A portion of the crowd assembled at the Memorial Hall, Dayton, Ohio, to listen to the broadcast of the Dempsey-Tunney fight.

SOLDERING TAGS.

By HUMPHREY PURCELL.

SOLDERING tags are fashionable. They "came in" with square wire, but even though one may prefer to wire up with the easier, and equally efficient, No. 18 S.W.G. round wire, there is a definite advantage in using them.

The alternatives to the use of soldering tags are either to screw down the looped wire under a nut and washer, or to solder direct on to the shank of the terminal or component with which contact is desired.

The screw-down method might, at first sight, seem at least as efficient as the use of soldering tags, because in the one case there is only one joint with a simple mechanical contact, as compared with a double joint consisting of the mechanical contact between the tag and the fixing nuts, and the additional soldered contact between the wire and the tag. But there is a difference between the value of a screw-down contact on to a loop of wire and a screw-down contact on to a tag. When screwing down a loop of wire it is seldom possible to use great pressure, because to do so may either splay out the loop or twist the wire out of the direction in which it is desired that it should run. When a tag is used, to which the wire is to be soldered later, there is no restriction as to the force that may be used in screwing down, and the nuts will bite into the tag, thus giving a greater area of contact than is possible with a loop of wire.

Direct Soldering

Soldering direct on to the end of a terminal does of course give a very satisfactory contact when it is properly done, but the practice introduces several complications:

1. A poor connection is easily made, due to faulty adhesion of the solder to the terminal, and if this should occur, the chance of its escaping detection is greater than when the joint is made by means of a tag.

2. The application of heat to the terminal may loosen its hold on the panel.

3. If the terminal should work loose in course of time, there is danger that the wire may break away, with disastrous results.

4. The joint is mechanically weaker than when a tag is used, and a joint of this kind cannot be relied on to hold components (such as fixed condensers) in position.

5. If the set is not intended to last for ever, the task of dismantling will be more troublesome.

Simplifying the Wiring

Soldering tags have, therefore, the advantages that they simplify the task of wiring up, and add strength to the structure of the set if they are used properly. Suitable tags of plain brass, or tinned brass, should be used; they should be provided with a small hole at the end, into which it is possible to insert the connecting wire, if a right-angle bend is made in this about ⅛ in. from the end. It is remarkably easy to get a good blob of solder to cover this contact, so that the wire and the tag are for all practical purposes one piece of metal. Needless to say, the tag should always be held between two nuts, and should not be used between one nut and the panel.

Turn your gramophone into a powerful radio Loud Speaker for 13/6 this Christmas—

(Here in four weeks !)

THIS is easily done with the LISSENOLA Loud Speaking Unit, and with equal success you can attach the LISSENOLA Unit to any kind of horn—or by following the full size patterns and clear instructions given with each LISSENOLA unit you can build a horn for it for a few pence which when finished will stand 24½ ins. high with a flare 9 ins. square. This is all you need to add to the LISSENOLA unit to make it a big, powerful, senior model loud speaker.

Put plenty of power through the LISSENOLA—220 volts and more and you will not make it dither or resonant. That is because of its splendid magnet, non-resonanting case and strong, concentrated mechanism.

SEVEN DAYS' TEST AT HOME. Test the LISSENOLA at home against the most expensive speaker you can find —if you don't prefer the LISSENOLA for tone and power take it back to your dealer or send it back to us and your money will be refunded.

It is no miniature loud speaker you build when you use the LISSENOLA—its tremendous power and fine tone quality are now appreciated in tens of thousands of homes.

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THE LISSENOLA

Made golden-toned for your enjoyment **13/6**

Full directions and full-sized patterns for making this horn are given with every "LISSENOLA."

A cone diaphragm loud speaker can easily be constructed. The illustration shows one method of mounting.

The "LISSENOLA" instantly converts any gramophone into a loud speaker.

The "LISSENOLA" Reed Attachment (pat. pending) for use with cone diaphragm loud speaker. Price 1/-.

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L. 122.

SOME COMMON FAULTS.

FROM A CORRESPONDENT.

THE following is a brief account of some of the faults which commonly occur in receiving sets and the best means of repairing them. The partial or total failure of a receiver may be due to some very small cause which could easily be put right if the owner only knew the proper way of going about the business.

A fall in signal strength is a very common mishap. Unfortunately it may be due to one of many causes, and it is therefore advisable to run over these points to see whether everything is in order. First examine the batteries; the H.T. battery especially is a frequent source of trouble. Test the battery with the aid of a flash-lamp which is placed across each 3-volt tapping at a time. Faulty cells should be short-circuited with a piece of wire.

Causes of Fading.

The accumulator should be tested under actual working conditions. Otherwise the voltmeter gives a misleading indication of its true state, because when the accumulator is switched off the set its voltage rises rapidly.

Then examine the earth connection. In dry weather the soil around the earth plate loses its conductivity and sets up a high resistance in the oscillatory circuit. The result is a mysterious falling off in signal strength. The remedy is to prepare a solution composed of a quarter of a pound of common salt to three gallons of water, and to pour this solution over the soil in the neighbourhood of the earth plate.

The peculiar phenomenon known as fading may be due to several causes. When it occurs during the reception of a distant station it may be due to atmospheric or geographical conditions, unfortunately beyond human control. If it occurs when the local station is being received it is probably due to a faulty grid leak or possibly the swaying of the aerial. Try the effect of a grid leak with a lower resistance and tighten the aerial.

Eliminating Distortion.

Scratchy sounds are apt to be very troublesome, and the source of the trouble is often difficult to trace. Scrape the valve pins free of oxide with a penknife, clean the switches with a soft rag. If the vanes of the variable condenser are bent at all, carefully adjust them so that they do not cause a "short." Make sure that the H.T. battery is not run down; dry batteries when in an exhausted condition are apt to produce annoying buzzing and crackling. Examine the leads to the headphones. When the flex is frayed partial short-circuits often occur.

Distortion is a very serious fault and is generally due to too much reaction or a fault in the L.F. amplifier. On no account use more reaction than is absolutely necessary, and when receiving the local station it is better to do without it altogether.

The standard broadcast receiver at the South Kensington Science Museum which is demonstrated regularly for the benefit of the public.

Make sure that the transformer in use is a reliable one. If not it must be scrapped, and the owner would be well advised to exercise great care in the choice of its successor. The chief point to remember is that the L.F. valve must always be kept working on the straight portion of its characteristic curve; therefore use a high anode voltage of 100 volts or so with about 4 volts on the grid as negative bias.

Occasionally distorted signals are due to a neighbour's carelessness or ignorance in allowing his set to oscillate. In such cases a tactful note, together with helpful advice on the subject of reaction, will generally put matters right.

IS EBONITE WORTH WHILE?

By HUMPHREY PURCELL.

THE present fashion is to mount as few components and terminals as possible on the panel itself, and at the same time to space things out more and more. The 3-valve or 4-valve set of to-day frequently measures 24 or 30 inches in length, and, as everyone knows, ebonite is sold by the inch. To buy a really good ebonite panel for an up-to-date set may cost fifteen or twenty shillings, and it may then carry merely a couple of variables, a rheostat, and a jack or two.

What is the advantage of an ebonite panel? It looks pretty when it is new; but the colour fades, and it shows up dust badly. It is fairly strong; but the panel is no longer required to bear any great weight. It is "safe" electrically; but no severe electrical strain is applied to it. *All the parts that touch the panel nowadays are at earth potential.* Some of them may be connected to L.T. minus and others to H.T. plus, but it is not necessary to use ebonite to guard against a leakage of direct current. Dry wood is quite satisfactory.

Points at "Earth Potential."

Let us consider the points of a set that require careful insulation. The aerial terminal: there is no need for this to be on the panel; it may be on a small piece of ebonite at the back of the set, or it may be provided on the coil itself if auto-coupling is employed in the aerial circuit. Valve holders, coil mounts, neutrodyne condensers, grid condensers, grid leaks: these are all arranged to mount on the baseboard, and are adequately insulated. Variable condensers: the later types are constructed so that the fixed plates do not come in contact with the panel, and the moving plates are usually connected to earth (or to one of the batteries, which are, of course, at earth potential). Rheostats: many are suitable for baseboard mounting, but in any case they are at earth potential, as are telephone jacks or terminals.

There is really nothing that requires a big sheet of ebonite. A terminal strip, or even two, will be necessary, but for the rest, a piece of ¼ in. mahogany or oak, nicely figured and polished, will be just as efficient as the most expensive black stuff, and if well selected and fitted, will probably improve the appearance of the set.

BROADCAST NOTES.

FROM OUR BROADCASTING CORRESPONDENTS.

The Dead Hand—Xmas Programmes—A Question of Cash—Broadcast News Service—Opera News.

The Dead Hand.

AS prophesied in this page, the new Constitution of British Broadcasting has departed radically from the recommendations of the Crawford Committee. The point which the latter placed pre-eminently in the foreground was freedom from Post Office interference on the programme side. The new Licence devotes several clauses to making sure that no such freedom is attained. The censorship of the Post Office officials is to be much more intrusive and absolute than it has been under the regime of the company.

The assurances of the P.M.G. in the House of Commons have not quieted misgivings. It is notorious that the inner junta of officials at the Post Office were determined to make Broadcasting a permanent subsection of their Department. So far at least as the written constitution is concerned they have succeeded in flouting both Parliament and public opinion. But the Corporation would be well advised to exploit the collateral assurances of the P.M.G. to the utmost.

The only really satisfactory feature of the new documents is the inclusion of Mr. Reith as first Director-General. Even this is qualified by the obvious blunder of not putting Mr. Reith on the Board of Governors. The real reason for this, of course, is that the Post Office officials are terrified of Mr. Reith, and they feel the need of placing him under a constitutional handicap. Where they have miscalculated, however, is in failing to recognise that handicaps of this kind only spur him to greater effort, and a more relentless policy.

Christmas Programmes.

Among the programmes already arranged for the Christmas period are the following: Humperdinck's Opera, "Hansel and Gretel," for Tuesday, December 21st; a special Radio Pantomime for Boxing Day; Bach's Christmas Oratorio, Sunday, December 26th.

On New Year's Eve there will be a special transmission reminiscent of the many and varied phases of Broadcasting during the four years of the B.B. Company.

Variety Events of Interest.

National Wireless Week programmes did succeed in proving one thing conclusively, and that was that the real trouble in connection with B.B.C. variety and vaudeville is lack of money. The variety shows of the special week were all first class. They were organised and gathered by the normal staff. The only difference was that a reasonable amount of money was available.

On Wednesday, December 1st, there will be a special performance of Felgate King's Revels of 1926, a concert party including the following artistes: Elsie Mayfair, Gladys Holliday, Anna Clive, Henry Hearty, Charles Baines, and Felgate King. Holt's Saxophone Octet will make their microphone début on Thursday, December 2nd. Marie Dainton, of music-hall fame, will be heard on Tuesday, December 7th.

A Question of Cash.

Exposures in POPULAR WIRELESS were largely instrumental in arousing such a volume of public opinion against the original plans of the Treasury that at the last minute the Government yielded, and the financial arrangements of the new Broadcasting Authority are much more satisfactory than there was any reason to anticipate. There is established, of course, the dangerous principle of the "right to raid" before the service is developed. But in practice the Corporation should not be unduly hampered, especially as it can

A good example of a camouflaged American radio receiver: the Bosch "Ambaroda".

borrow up to £500,000. The money available for current expenditure during 1927 will be of the order of £800,000. There should, therefore, be no further delay in at least some of the ambitious programme projects the B.B.C. has been impatiently nursing for months past.

Broadcast News Service.

According to its constitution the new Corporation can collect and distribute its own news. It is understood, however, that the policy of the Broadcasting Company in this respect will be closely pursued. There is no present intention to set up in opposition to the press or the news agencies. Negotiations are actually in progress for another agreement similar to that which has enabled the company to provide its attenuated news service during the past four years. It is hoped that the new agreement will allow a considerable extension of present facilities. For instance, it is almost certain that at the next Derby a narrative account from the course will be broadcast. Other similar occasions will be the subject of descriptive broadcasts, if impending discussions are successful. If they are not successful, then the Corporation may have to fall back on its own resources and enter into a cut-throat competition with the press. This is regarded as a most unlikely eventuality.

The Prime Minister's Son.

On Saturday, December 4th, Mr. Oliver Baldwin, the Prime Minister's son, will broadcast through all stations from Birmingham one of his own short stories. He is reported to have an excellent microphone voice and manner.

The German at Dundee.

A sign of stiffening Post Office surveillance is contained in the announcement that at the last minute a talk on the League of Nations by a German professor at Dundee was cancelled by the Post Office after acceptance by the B.B.C.

Clamour About Cackle.

The wise B.B.C. decision to eliminate a large proportion of the public dinners from programmes has led to protests from interested quarters. Some parliamentary pressure is now threatened. It is to be hoped that interference of this kind through parliament will not be successful. If it is, there will be a new and grave menace to the entertainment value of the programmes.

Chief Obah Mehewhe.

London will provide an absolute novelty programme on Wednesday, December 8th, when Chief Obah Mehewhe and a group of his Yoruba tribe of natives from Central Africa will put on a typical native show. There will be a call to morning prayer, a march of the tribe to battle, a return from victory; after which the chief will broadcast a special message to British listeners in his own tongue. This will be translated by another member of the tribe who has acquired some little knowledge of English.

Opera at Aberdeen.

The current revival of the quality of broadcasting from the Scottish stations is reflected in the announcement that on Saturday, December 4th, Aberdeen will give a repeat performance of the concert opera, "The Romance of Spain," written by Norman Ingram with music by Vincent Thomas. The chorus will be from the Lyric Opera Company, and the soloists will include Miss Alice Moxon, Miss Dorothy Forrest, and Mr. Stuart Robertson. The opera will be under the direction of Mr. Irvine S. Cooper.

New York Calls Britain.

THE surprise birthday greeting from America, which was relayed to listeners during the closing programme of the B.B.C.'s Birthday Week, was by common consent the best American relay we have had. Reception was exceptionally good, and as the speech was addressed to us over here, it was far more significant than just a chance-heard American programme. I hope the Keston receiving station will continue to look out for a chance to snap up these overseas programmes now and then.

PLANNED FOR POWER, PLANNED FOR PURITY

—it makes a whisper loud.

LISSEN has produced a transformer which has revolutionised all previous ideas about transformer performance and price.

It is not always the best transformer available that may be specified in any circuit. You are free to choose your own parts—we give you seven days to find out that you cannot get a better transformer than the new LISSEN.

Never again pay a high price for a transformer. No matter what may be specified always use a new LISSEN in place of it. You will save money and distinctly gain in tone, purity and power by using the new LISSEN. Compare this against any, no matter what price—you cannot beat it for tone, purity and power. It fully amplifies every tone, every note, every harmonic, every overtone—many expensive transformers will not do that—BUT THIS NEW LISSEN DOES IT.

That is why we have withdrawn all our own expensive transformers which have been on the market and largely sold for several years past.

SEVEN DAYS' TEST

If you don't prefer the new LISSEN against every other transformer you may test it against, take it back to your dealer or send it back to us.

8/6

AND GUARANTEED FOR 12 MONTHS.

TEST IT FOR 7 DAYS.

Turns ratio 3 to 1
Resistance ratio 4 to 1

Use it for 1, 2 or 3 stages L.F.

It will suit every circuit and every valve you will want to use.

The unheard of low price for such a high grade master part is made possible by a huge production programme, special plant, a determination to place big powerful amplifiers within the reach of all who care to build them, and our new direct-to-dealer policy of distribution which cuts out all wholesale profits.

USE LISSEN FIXED CONDENSERS, TOO, Mica & Mansbridge Type

LISSEN Mica Type CONDENSERS

Small energy-conserving condensers—note the new case which enables the condenser to be used upright or flat. At present the new case is available only in the most used capacities, but will quickly become a LISSEN standard.

Capacities—
·0001 to ·001 1/- each (much reduced).
·002 to ·006 1/6 each (much reduced).

Accurate to 5%—they never leak—they never vary.

LISSEN Mansbridge Type CONDENSERS.

To a fine LISSEN quality condenser is added the specially moulded case—the condenser cannot short circuit on to its case. The new LISSEN case protects you if the condenser is used in any circuit connected straight on to the electric light mains. And due to our new policy of direct to dealer distribution this LISSEN Condenser costs no more than the ordinary type.

·01 to ·09	2/4
·1	2/6
·2	2/8
·25	3/-
·5	3/4
1·0	3/10
2·0	4/8

LISSEN FIXED GRID LEAKS

A case of these was left on our factory roof during the summer of 1925, soaked in rain, baked by sun and the resistance value of these leaks never altered.

All capacities, previously 1/8, **Now 1/-** each.

Improve every circuit by using LISSEN parts wherever you can—save money too—for now you get keen prices as well as fine quality.

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Many are using LISSEN Transformers in "N" Circuits.

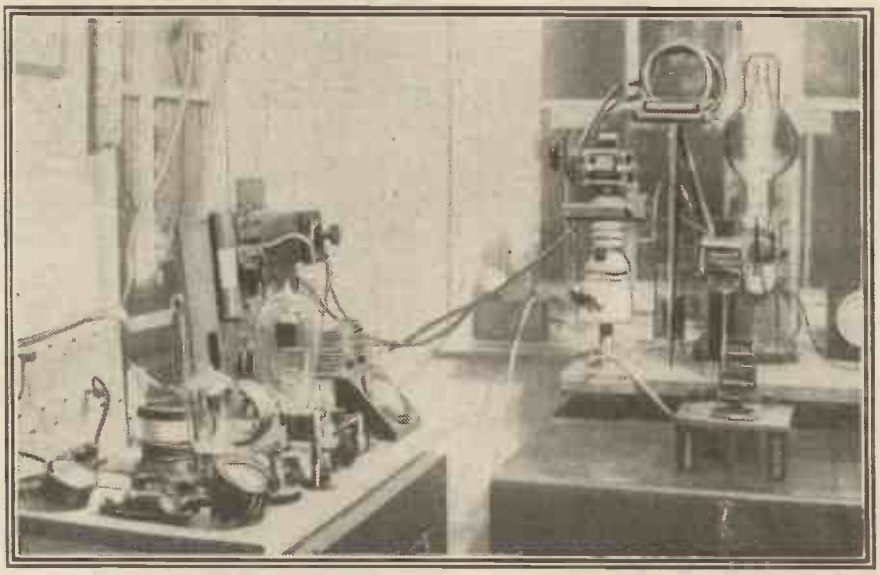
L. 121

A 32-METRE CRYSTAL CONTROLLED TRANSMITTER.

By E. J. SIMMONDS, M.I.R.E., F.R.S.A.
(Staff Consultant.)

THE following short description of the quartz crystal transmitter which has been in operation on 32·2 metres at Radio G 2 O D for some time now will be of especial interest to those readers who have so kindly forwarded reports on the transmissions.

The photograph here reproduced shows the lay-out of the apparatus, which consists of four stages of H.F. couplings progressing in input powers from 6 watts in the first stage to 100 watts in the final stage, which is inductively coupled to the aerial system. The first stage, which is seen on extreme left, consists of an L.S.5 valve with 300 volts on the anode, controlled by a quartz plate in the grid circuit in the usual way. The output from this stage is passed to the next valve, an Osram Det. 1. In this stage, by choosing suitable valves of negative grid potential and plate voltage, and the use of filter coils on the anode circuit, the frequency is doubled—that is, the wave-length of the first crystal controlled valve is halved. This arrangement allows the use of crystals of longer wave-length, and consequently greater mechanical strength.



Mr. Simmonds' latest short-wave receiver, some interesting details concerning which are given in the accompanying article.

The output of this frequency-doubling stage is passed to the third stage, which is a 250 Osram valve run at a relatively low input power; and finally the output of the third stage is passed to last stage, called the "power amplifier."

This valve is one of the special short-wave valves developed by the Osram Company for operation at high frequencies.

The last two stages of amplification are carefully neutralised and balanced in much the same way as the H.F. stages are neutrodyned in a broadcast receiver, although in view of the frequencies used in this transmitter, neutralising is not quite as straightforward as it would be at broadcast frequencies.

The aerial proper is an elevated horizontal half-wave oscillator-radiator, fed at the voltage node by two parallel radio-frequency lines, which are balanced so that the current readings in each feed wire are exactly equal. Numerous reports from all parts of the world have been received on these transmissions, and on Sunday last between 18.00 and 19.30 G.M.T. two-way communication was maintained with places as far apart as Singapore, Cape Town, and Australia. All reports received on these transmissions emphasise the extreme steadiness of the frequency and purity and quality of note, which qualities are the outstanding characteristics only possible where some form of crystal control is embodied in the transmitter.

THE RADIO WATER-DIVINER.

By A. J. BOYINGTON.

THIS possibility was suggested at the World Power Conference at Wembley, in 1924, by Mr. Oskar Taussig, of Vienna, that radio waves can be used to discover something about rock strata, ore deposits, or water channels deeply buried in the earth, without actually digging down to them.

As far back as 1910, another Austrian—Dr. Heinrich Loewy—discovered that when a radiating aerial or antenna is brought within reasonable distance from a conducting body, the presence of the latter in the field of the radiation will affect the shape and nature of the field and may affect the nature of the radiation itself.

Mr. Taussig proposed a practical application of Dr. Loewy's principle by equipping a small dirigible with radio transmitting apparatus and aerial, and surveying the world's great deserts from the air, with a view to determining the character of their mineral and water deposits. The surface soil of these areas, being dry, will not act as a conductor—consequently the working of the transmitter will be unaffected.

A Step Further.

But supposing that the airship crosses a location where there exists a considerable body of underground water. This water will form a conductor and its reaction on the transmitter will be to alter the wave-length of the aerial, or what amounts to the same thing, it will alter the capacity between aerial and earth. As this alteration can be detected and measured, Mr. Taussig believes it possible to locate those parts of any desert where drilling would be most likely to develop supplies of water.

The possibility may be carried a step further in the detection of metalliferous strata by transmitting waves downward into the earth and detecting the upward reflection of these same waves from underground conducting layers. The latter may be water-saturated strata, or they may be ore-bearing beds having a higher conductivity than is normal for barren rock.

German Inventor's Success.

The plan is undoubtedly interesting. A German inventor named Pastor has already developed a "mine-finder," which operates on the reflection principle and has succeeded in detecting the presence—from the surface—of metallic ores underground.

To carry out the same project from the air, however, involves difficulties which are not at first apparent. The mere surface of the ground may act either as an absorbing or reflecting layer, while rock strata—though similar in composition—may differ among themselves in conductivity. Much exhaustive experimental work must be carried out before the aerial water-diviner becomes a certainty, but there is more than a chance that radio will play no insignificant part in causing the desert to "blossom as a rose."

A two-valve set made by the Lorenz Co., of Germany.

The RADIO CONSTRUCTOR

Edited by PERCY W. HARRIS, M.I.R.E.

This valuable eight-page supplement, devoted to the interests of amateur wireless constructors, appears every week in POPULAR WIRELESS. Tell your friends about it, for it is only in "P.W." that they will find the radio articles by the leading constructor expert, Mr. Percy W. Harris.

FIRST of all this week I want to thank the almost innumerable correspondents who have written to me giving me the results they have obtained from the Hale circuit. A selection from these letters will be published next week, and many more would be printed but for the limitations of space.

That the Hale circuit will give thousands of readers just what they want for local reception I have not the slightest doubt, for the combination of purity with volume given by this receiver is unequalled by any other combination.

I notice, too, that readers are now recording results which, had I listed them in the first article, might have appeared as exaggerated claims. This gives me an opportunity of publishing a few opinions on the subject of test reports, and the policy of "The Radio Constructor" in regard to them.

Every home constructor, whether he writes for the Press or keeps his results for a limited circle of friends, must submit to a number of temptations when he builds a successful receiver. Human nature being what it is, we are all rather liable to exaggerate our results in the enthusiasm which comes from achieving that success.

Unfortunately radio conditions differ from day to day, hour by hour, and are rarely the same at a given time in two places separated twenty or thirty miles from one another.

Again, the immediate surroundings of the receiving installation, the size, shape and disposition of the aerial, the efficiency or otherwise of his earthing system, and the individual skill of the operator, all represent factors which make for a wide difference between results obtainable by Mr. Jones and those by Mr. Brown.

Wireless receivers can be reported upon in regard to sensitivity, selectivity, and quality. So far as sensitivity is concerned, in skilled hands and with the use of an accurately calibrated wave-meter, stations can be found and made clearly audible which otherwise would not be picked up at all. With some very sharp tuning sets, fitted with reaction control, no little skill is required to get the best results, both in regard to sensitivity and selectivity.

On the Loud Speaker.

Then there is the question of that much worn phrase "picked up on the loud speaker." I am afraid in very many test reports that have appeared in the past the picking up on the loud speaker, while being a true statement in so far as the operator preparing the test report did not use telephones throughout the experiment, has created the impression that the station so picked up has been of sufficient strength to provide entertainment in the average living-room by means of the loud speaker.

Frequently the results "on a loud speaker" have been so faint that, unless one were standing close up to the horn, they would not have been heard at all. Frequently, too, owing to the variations in natural conditions which occur from night to night and hour to hour, it has not been possible to repeat such tests on two successive evenings, and I have often known cases where on one evening really genuine loud-speaker strength, sufficient for any living-room, has been obtained on a foreign station, while on the following evening the best that could be obtained was a faint whisper from the horn on the same station.

Though, by taking readings over a number of evenings, it is possible with many receivers to compile a test report giving a very large number of stations as received at "loud-speaker strength" due to the conditions previously outlined, the impression given by such test reports is that once the receiver has been built by a constructor he can turn from degree to degree and obtain the list of stations at full loud-speaker strength.

For Average Conditions.

Many an excellent receiver has been prejudiced in the eyes of the public by test reports which have not been reproducible in the manner suggested on the first reading, and by awakening expectations which have not been fulfilled have done much more harm than good.

The test reports which have been appearing, and which will appear in connection with sets described in "The Radio Constructor," will endeavour to reflect their average conditions such as are likely to be met with by the majority of readers of these pages. Many will get far better results than I shall indicate, and such people are to be congratulated for their local conditions, and other factors which place them above the average.

Among the hundreds of letters received from readers giving their views on the subject of modernising existing receivers a very large number have asked for details of how to bring the "Four-Valve Family Receiver" up to date. Laboratory tests on this set have shown me that results comparable with those of some of the best of modern receivers can be obtained with relatively few changes, and in this week's issue a short article shows how grid bias can be fitted. In next week's issue a long article, fully illustrated with photographs and diagrams, will describe how semi-aperiodic aerial coupling, neutrodyning for the H.F. stage, grid bias, and separate H.T. for H.F., detector and two note magnifiers can be fitted, together with jack switching. These changes make for a much higher efficiency all round, and will ensure the user obtaining really modern results for the expenditure of less than thirty shillings.

Before closing this week's chat I must also thank the many readers who have given me expressions of their views on the subject of their ideal set. I hope shortly to collate many of these letters, and give you some kind of an analysis of their contents. Meanwhile I am delighted to find that my new receiver, "The King of the Air," to which I have already referred, fits in so well with what so many people ask for.

This is the time of the year to examine your aerial. Test all your guys and halyards for rot!

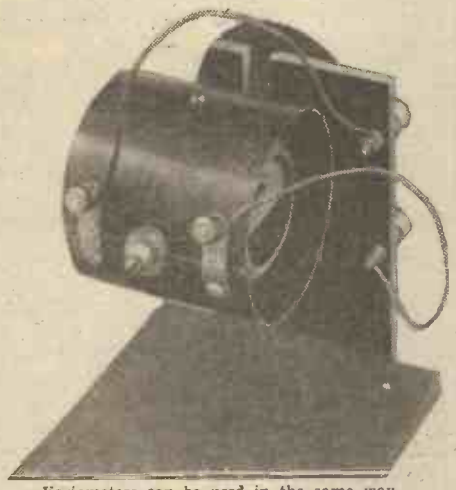
Percy W. Harris

A USEFUL STAND FOR TEST WORK

AND OTHER HINTS.

BY THE EDITOR.

WHEN new circuits appear the first desire of most experimenters is to "hook them up," and try them out as speedily as possible. If the circuit turns out to be a desirable one, then the work of building it into a finished receiver can be undertaken at leisure or by following the published design. Here are a few ideas which will help you in quickly rigging up the circuit for trial without robbing yourself of apparatus which you will subsequently need for the finished receiver.



Variometers can be used in the same way.

The Condenser Stand.

One of the most useful devices I possess is a stand made to hold any variable condenser temporarily in position. It consists, as you will see from the photographs reproduced herewith, of a simple baseboard cut from a board, an ebonite front panel (slotted), and a pair of terminals. A suitable baseboard can easily be found, while the ebonite is any scrap from an old set or from your "junk box." The slot is made $\frac{3}{8}$ in. wide, so that any of the "one-hole-fixing" condensers can be slipped in and the nut tightened in a moment. Flexible wires join the fixed and moving plates to the terminals.

Two or three of these stands will be found extremely useful when trying out a circuit, as whenever desired, the particular variable condenser can be removed and used for set building.

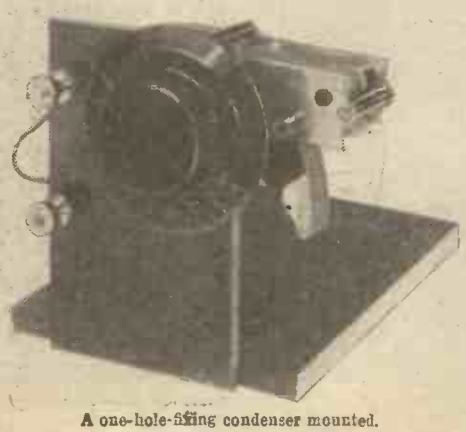
I make very good use of a length of board some 9 in. × 30 in. × 1 in. thick, planed and supported on six rubber feet. These feet serve the double purpose of preventing scratches on furniture, and of stopping any slip that might occur during operations. The wood being soft deal, components such as fixed condensers, grid-leak holders, L.F. transformers, and the like, can be screwed down in a moment and just as easily removed. So many components are now sold mounted upon their own insulating bases that circuits can be rigged up very quickly and with a minimum of trouble. The condenser stands, by the way, are often useful for holding other one-hole-fixing components, such as neutralising condensers, filament rheostats, variometers and many other devices.

Unless a considerable amount of experimental work is being done with a particular circuit, it is not usually necessary to solder connections or make neat wiring; unless, of course, you are dealing with some neutralised circuit where the actual disposition of every wire is important. In such cases the whole design must be worked out with great thoroughness, but such work is generally too tedious for the general experimenter.

Circuit Wiring.

The wiring up of the circuit with the components in place is often hindered by the absence of suitable lengths of wire, and indeed one can waste a great deal of material in this way. Home constructors do not generally realise the great utility of the small brass "pinch-on" tag, which gives a useful finish to a wire without soldering and with the minimum of effort. These tags can be purchased from most wireless dealers at about 2d. per dozen, and are an excellent investment.

The method of fitting is to bare the end of the insulated wire, lay it on the tag and pinch over the projecting fingers, with pliers. I keep a whole boxful of leads finished off in this way, and although the cutting and "tagging" of these leads originally occupied an hour or so, the initial investment of time has yielded a rich dividend in subsequent time-saving.



A one-hole-fixing condenser mounted.

A small baseboard, an odd piece of ebonite, and two terminals are all that is required.

The experimental board should have permanently mounted at one end and behind a terminal strip with an adequate supply of terminals fitted with nuts. You will generally require low-tension negative and positive, high-tension negative and, say, three high-tension positives, while provision should also be made for at least three pairs of grid-bias terminals, if you are doing experimental work with multi-valve circuits.

Semi-Permanency.

You will find, by experience, that quite a considerable amount of apparatus will be kept permanently mounted on the board. For example, the detector and two note-magnifying stages will stand for many circuit arrangements. I find it useful to keep such apparatus on the board but without transformers, arranging flexible leads with spade terminals so that any make of transformer can be connected in a moment or two, without cutting and fitting special wires. It is also convenient to keep a couple of resistance stages "alongside" ready for comparison purposes.

The STATION MASTER

By PERCY W. HARRIS, M.I.R.E.

Designed for headphone listening, this self-contained super-heterodyne brings all Europe to your ears. The complete cost with all valves, batteries, etc., is under £16.0.0.

ON a number of occasions recently, and again when answering readers' queries at a big London store, I have been asked for a design of receiver which would enable the user to sit quietly in a room and listen to a wide variety of stations without interference from the nearest, and without using a loud speaker for the purpose. In a phrase, what was needed was a long-distance "telephone" set, with real simplicity of control.

Of course, for high selectivity and simplicity of control a super-heterodyne has many good points, but the large number of valves generally necessary, the complicated make-up, together with the large demand made upon the H.T. battery, and not the least the expense involved, generally put the super-heterodyne out of the ordinary man's way.

Sitting down to think about the matter, it occurred to me that by cutting out the note-magnifying stages we should still get ample strength for telephone use, while the other advantages, simplicity of control and selectivity, would be retained. Furthermore, a five-valve set should be amply sufficient in this form, and a five-valve set is neither expensive to run nor particularly expensive to build, especially if, as in the set to be described, due precautions are taken to keep the costs down.

All in One.

Now, self-contained sets have great charm for me, and one of my first requirements in laying out the design was to find some way in which the receiver could be built in which both batteries were inside the cabinet without making it too bulky. Batteries themselves cannot be reduced in size, so the space would have to be saved elsewhere. In one direction a saving of weight and bulk could be effected by using a two-volt battery, particularly as good two-volt valves of all types are now available in a number of makes.

It so happens that one manufacturer is now producing a "super-heterodyne unit" containing many of the essential parts of this receiver in a very small compass. The simplified unit referred to is extremely compact, and contains the combined oscillator and detector unit, the intermediate frequency transformers, and the necessary fixed condensers and grid leaks with the valve holders mounted on the top.

Additionally there are required two variable condensers, the potentiometer, jack, on-and-off switch, and a Mansbridge condenser. On carefully laying out the parts I found it possible to get the five-valve super-heterodyne equipment into a space generally occupied by a three-valve set, and by obtaining a cabinet slightly deeper than usual, the batteries could be placed behind, while still making a very compact instrument.

There are several other points of interest in the design. For example, by adopting a fairly new type of cabinet with a special front, it is possible to use not only a slightly smaller ebonite panel than would otherwise be required for this size of cabinet, but any irregularities in cutting the panel—and many home constructors find trouble in obtaining a neat edge—is covered up by the overlapping woodwork. Furthermore, the "cut away" effect is very pleasing, and will be definitely preferred to the older type of panel presentation by most people.

How It Works.

Seeing that we are using a complete unit for the supersonic portion there is no need to go into details of the circuit, but for the benefit of those who have not previously handled a super-heterodyne, a few notes will be useful on the general principles of working.

Although the name "super-heterodyne" may seem formidable to the beginner and suggestive of technical mystery, this type of receiver is one of the easiest to operate, but it is not always the most easy to design and construct. To obtain long-distance results it is necessary that our signals should be magnified by H.F. amplifiers before being detected, and, indeed, most of the energies of designers during the last three years have been devoted to evolving new and more efficient means of H.F. amplification.

The valve itself is, of course, a magnifier, and it would seem easy to arrange a number of valves one after the other so that each should magnify signals passed on from the previous one. If, for example, we tune our aerial circuit to the wave-length we wish to receive, then the valve will magnify the small current set up and, if these currents induce further currents in the next stage, still greater magnification will be obtained.

It will be observed that to carry out this amplification each stage must be separately tuned to the wave-length we desire to receive, and this means that in most sensitive receiving sets there are several tuning controls—one for each stage of magnifica-

(Continued on next page.)

All components are of the best, including high-grade vernier dials. The appearance has been much admired.

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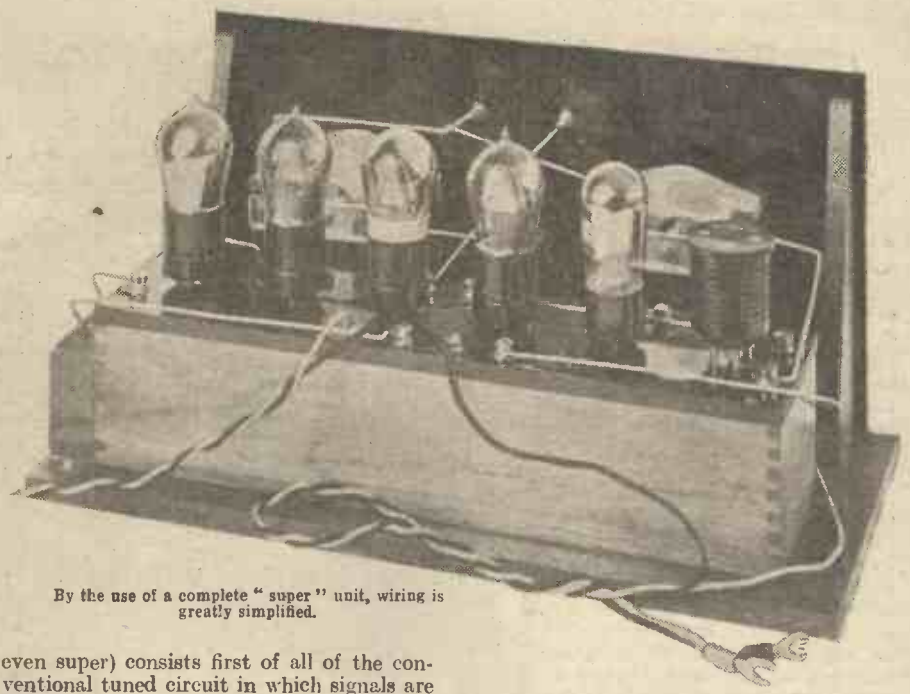
tion. Within the last year or so attempts have been made to simplify the handling of such receivers by joining all the variable condensers to one shaft so that all can be rotated at the same time.

This method is known as the single control method, and if carefully matched condensers and equally matched coils are used, and if, furthermore, certain precautions are taken in the initial stages, it is possible to obtain a practical receiver using several stages of H.F. amplification with only one tuning control. However, such receivers are generally expensive, and completely dependent upon accuracy of matching, and personally I have never felt very enthusiastic about them. It is much easier and far less expensive to use two or three controls, and it is probable that many experimenters will still prefer this method until the technique is still further improved.



By the use of a complete "super" unit, wiring is greatly simplified.

Fixed Tuning.

Now, it will be obvious that if our receiver is designed to receive one wave-length only, then the various stages could be tuned to that particular wave-length and left so set. Such a receiver once tuned would always give us good signals from that particular station, but the simplicity so obtained would hardly be worth while seeing that we should be limited to one station only.

In the supersonic heterodyne receiver the real merits of a single frequency in amplification are taken advantage of, while the ability to tune to any desired wave is obtained by a very ingenious special device. For simplicity's sake we can say that a supersonic heterodyne receiver (generally abbreviated to super-het. or even super) consists first of all of the conventional tuned circuit in which signals are picked up.

This may take the form of a small frame aerial across which a tuning condenser is placed, or it may be the conventional tuned circuit such as we use in conjunction with an outdoor aerial. In view of the extreme sensitivity of a super-heterodyne receiver it is usually the former as, with the frame aerial a much higher degree of selectivity is obtained than with the outdoor type. Against this must be set off the reduction in general sensitivity which a frame aerial gives.

The Inventors.

The frequencies to which the first tuned circuit is adjusted range over all the wave-lengths that we commonly desire to receive, and therefore if we wish to obtain high-frequency amplification of an efficient type by ordinary methods, each stage of high frequency would have to be simultaneously tuned with the first tuned circuit. By a highly ingenious method, invented by Dr. Lucien Levy and Edwin H. Armstrong about the same time, the oscillations set up in the tuned circuit are combined with separately generated oscillations from a special valve so as to produce a still different frequency which is kept the same for all wave-lengths.

Thus, we may have oscillations on a 300-metre wave-length giving a frequency of

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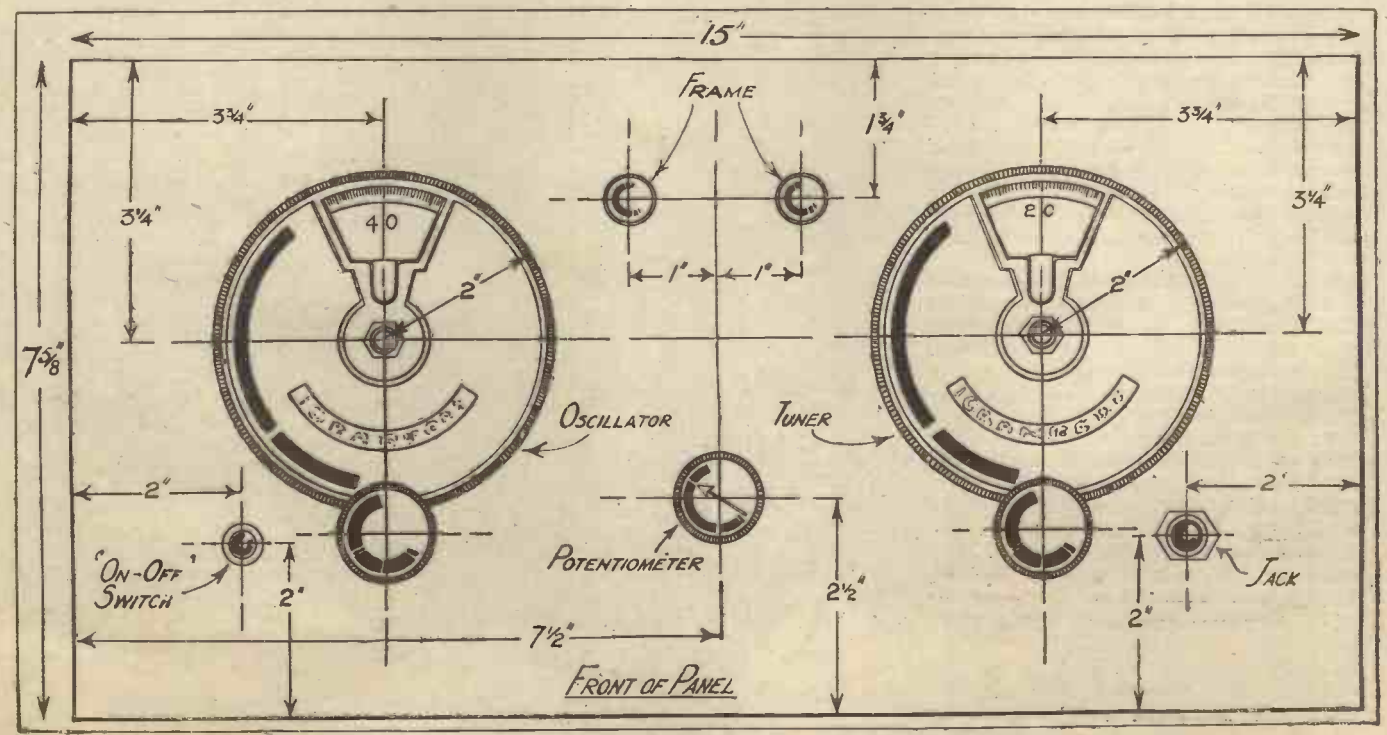

Although the actual panel shown is smaller, a standard 16" x 8" panel is equally suitable.

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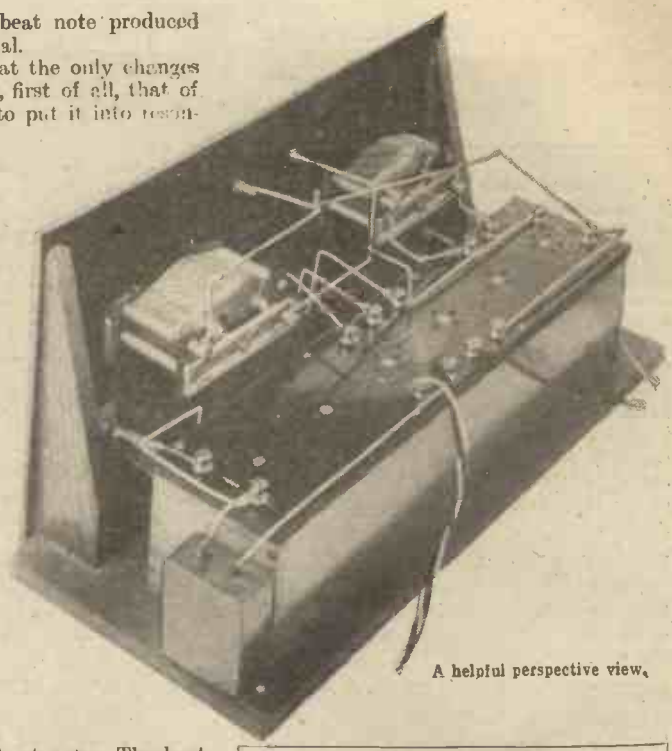
1,000,000, and by our oscillating valve we can produce simultaneously oscillations of a frequency of 1,100,000. The 1,100,000 frequency can be superimposed upon the 1,000,000 frequency, and there will be produced "beats" which can be rectified by a detector valve and will produce a frequency of only 100,000 cycles corresponding to a wave-length of 3,000 metres. This new "beat frequency" carries the modulation of the received signals, and if we put this through an amplifier designed to amplify at 3,000 metres and at no other frequency, we can utilise the method which does not require special tuning other than the initial tuning in the 3,000-metre wave-length.

The Oscillator.

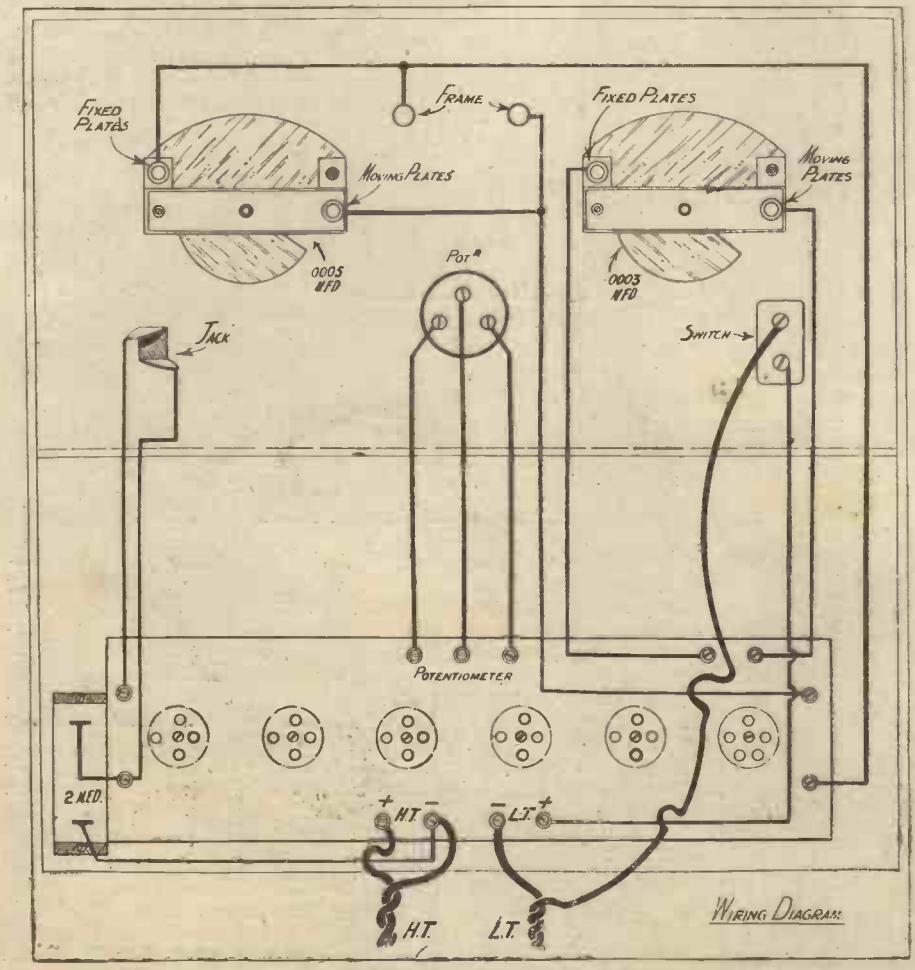
Now let us assume that we wish to tune to a wave-length of 600 metres, corresponding to a frequency of 500,000. When we change our tuning, at the same time we change the tuning of our oscillator to produce a frequency of 600,000, and again the beat note will be produced. This beat note will be the same as before, viz., 100,000, corresponding to a wave-length of 3,000 metres above referred to. In this way the amplifier which has been tuned once and for all to 3,000-metre signals can be used again to magnify the beat note produced *from* the 600-metre signal.

You will thus see that the only changes necessary in tuning are, first of all, that of the first tuned circuit to put it into resonance with the incoming signal, and secondly that of the oscillator to keep the difference of frequency between the two sets of oscillations always the same, namely, the 100,000 or 300 metres frequency. No matter what wave-length we wish to receive within the range of the instrument, we are only required to readjust the oscillator to keep the beat frequency the same.

You are now in a position to understand the general principles of a super-heterodyne receiver. It consists, then, of a tuned circuit into which are induced oscillations from a separate oscillator valve to produce the beat note. The beat note is then rectified, giving what is called the intermediate frequency signals, and these are magnified with a fixed amplifier to correspond with the frequency of the beat note.



A helpful perspective view.



Wiring is of the simplest character. Note that the conventional terminal strip is unnecessary.

PARTS REQUIRED.

One McMichael supersonic Unit. (L. McMichael, Ltd.)

One special cabinet to take a panel measuring 16 by 8 by ¼ in. The cabinet illustrated is made by the Unica Cabinet Company.

One ebonite panel 16 by 8 by ¼ or ⅜ in. Any good guaranteed ebonite.

Two variable condensers, one of ·0003 mfd. and one of ·0005 mfd. Those illustrated are the Bowyer-Lowe "Popular," but any good make of variable condenser of the value given will do, provided the securing nut of the one-hole-fixing method does not project too far from the front, so as to foul the vernier dials.

Two vernier dials. Those shown are the Igranic Indigraph, but any other suitable vernier dials can be chosen if the reader so desires.

One potentiometer; 300 or 400 ohms, any good make, will do here. That shown is a Yesley.

One on-and-off switch. Here again you have a wide variety of choice. That shown is an Igranic.

One single circuit open jack. Bowyer-Lowe, Igranic, Ashley, or any other well-known make will do.

Two terminals. I have used the Belling-Lee bakelite covered terminals, which give a smart appearance.

One plug to suit jack. As plugs and jacks are now standardised any good make will suit.

Suitable baseboard to fit in the cabinet. Most cabinet-makers supply these with the cabinet.

One 60-volt high-tension battery.

One 2-volt accumulator.

Five valves, 2-volt variety. (See notes next week.)

One suitable frame aerial.

One 2-mfd. Mansbridge condenser.

Two yards two colour twin flex.

Most of the components can be obtained in different makes, which will naturally vary a little in price, but if the parts used in this particular layout are adopted, the total cost will not exceed £16.

(*Continued on next page.*)

THE STATION MASTER.

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After they have been amplified at this intermediate frequency by two or three stages of high-frequency amplification, they are rectified in the usual way and passed out of the telephones direct or through the intermediary of audio-frequency amplifiers to our loud speaker.

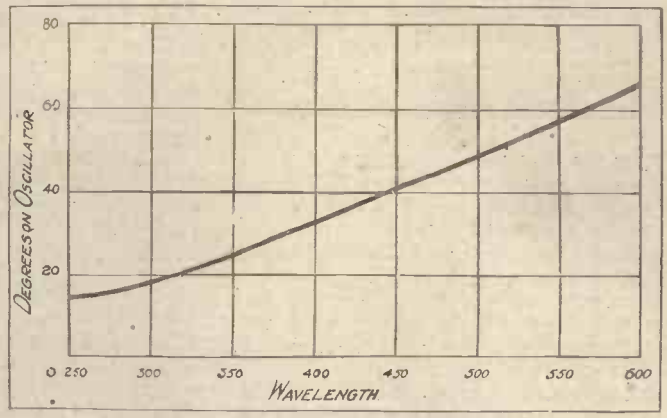
We can, of course, choose a wide variety of frequencies for the intermediate frequency amplifier, and indeed the commercial intermediate frequency transformers used in these amplifiers are designed for widely different wave-lengths. Some are tuned to a frequency corresponding to 10,000 metres, others to one corresponding to 2,500 or 3,000 metres.

Intermediate Frequencies.

There are advantages and disadvantages in the various frequencies, but so long as we are careful to choose one which does not happen to fall on one which is occupied by a loud signal, such as that from high power station which is liable to give interference, we have quite a large variety of efficient wave-bands to choose from.

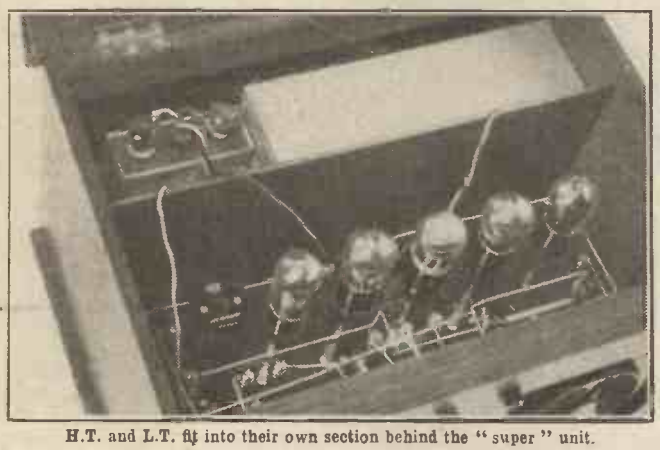
Many super-heterodyne receivers consist of a first detector, a separate oscillator valve for rectifying the beat note to produce the intermediate frequency, three intermediate frequency stages, a second detector and two stages of note magnification. By several ingenious adaptations it has been found possible to combine the functions of the first detector and oscillator in one valve, and sometimes only stage of audio-frequency magnification is used.

In the present receiver, which is designed purely for telephone work, economy of valves has been sought after. There are but five valves, the first acting as a combined oscillator and first detector, the second, third and fourth are intermediate frequency amplifiers, and the fifth as the second detector.



Approximate tuning guide for the oscillator dial.

In order to give the greatest simplicity of construction a special unit has been incorporated in the set. This unit contains within a small compass all the intermodiate transformer, condensers, oscillator coils, etc., going to make up the supersonic portion of the outfit, together with valve holders and terminals. This unit is made by Messrs. McMichael, Ltd., and greatly simplifies the construction of the set.



H.T. and L.T. fit into their own section behind the "super" unit.

Frame Aerials.

For the time being I may mention that you can buy from the London Electric Wire Co. 100 ft. of frame aerial wire, consisting of very flexible copper wire silk insulated and identical with that used on the most expensive frame aerials, for 3s. 6d. Next week I will show you how to make a good frame.

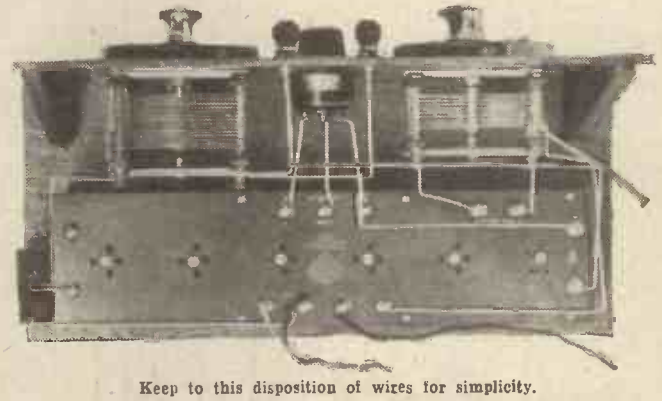
One hundred feet wound on a frame of about the size shown in the photograph, will give you a frame aerial to cover the ordinary broadcast range with a ·0005 mfd. condenser. Actually the instrument with such a frame should tune from about 260 to well over 600 metres.

Although the supersonic portions are contained in a very neat box, properly wired up and sealed by the manufacturers, it must not be imagined that the layout of the remainder of the wiring is unimportant. Although it may surprise many readers, it is a fact that this set had to be re-wired three times before it would give satisfactory working, for the length of the condenser leads and their relation to one another was found to be highly important. I would advise you, then, to follow very carefully the actual wiring of the set shown, as it is the result of very careful experiment and test.

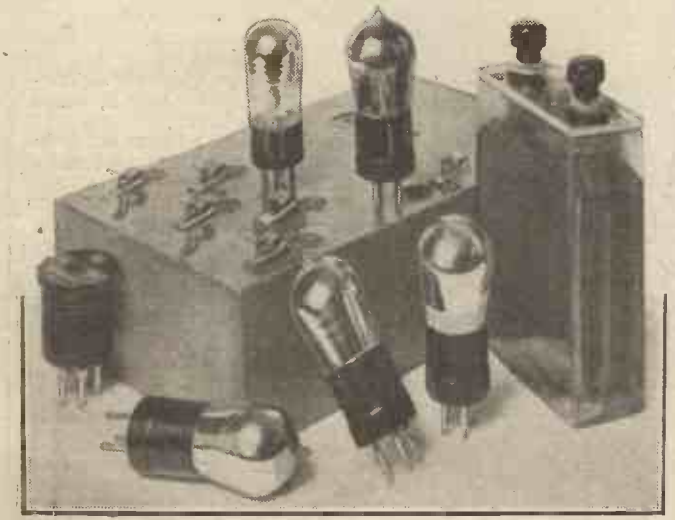
Constructional Hints.

Seeing that the drawings give you all dimensions, the drilling will present no difficulty, particularly as the components on the front panel are, as usual in most of my sets, of the one-hole-fixing variety. Condensers, which mount with three fixing screws, are equally suitable.

Some variable condensers of the one-hole-fixing variety have a very large nut in front which prevents the Indigraph dial being mounted in the proper way, but the Bowyer-Lowe "Popular" one-hole-fixing condenser will be found satisfactory in this regard, particularly if the last few threads of the centre bush, which project in some cases after the locking nut has been screwed on, are carefully removed with a file.



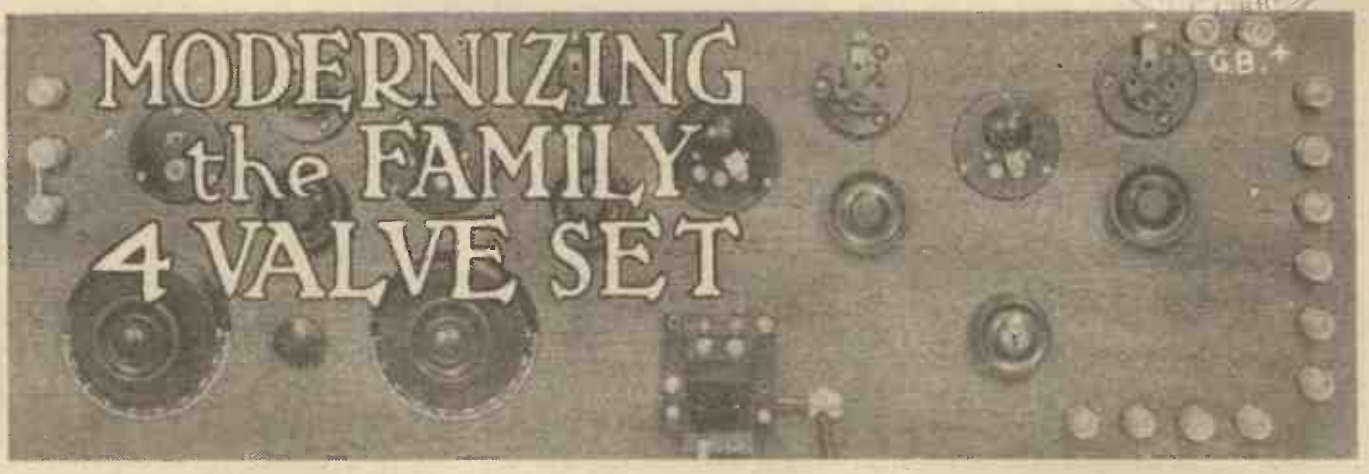
Keep to this disposition of wires for simplicity.



The only accessories needed. The plug-in unit is supplied with the "super" kit.

NEXT WEEK:

Further Details and Hints. Valve Notes. Test Report and Frame Aerial Construction.



MODERNIZING the FAMILY 4 VALVE SET

Simple Changes that Make for Efficiency.

By PERCY W. HARRIS, M.I.R.E.

I HAVE received, in response to my invitation in the first issue of "The Radio Constructor," many letters from readers regarding the modernising of their existing sets. A very large number have written me, asking what can be done to modernise the "Four-valve Family Receiver," which they very kindly say has given them excellent results, and in many ways gives all they require. They do not wish to scrap the set, but if there are any minor improvements which can be made, they are only too anxious to effect them.

The Original Set.

The "Four-valve Family Receiver" was designed several years ago, before the home constructor had such a wide choice of valves and before the selectivity problem became really acute. Improvement in the Four-valve Family can be effected in several ways and with very little expense, increasing both efficiency and quality. The first change which I would strongly recommend is that for introducing grid bias.

In the original receiver a slight bias is given to the grids of the note magnifying valve by a voltage drop in the filament resistance which is placed in the negative lead. For example, when the set was first produced practically everyone was using four-volt valves on six-volt accumulators. By placing the filament resistance in the negative lead and by joining the I.S. of the L.F. transformers to the negative low-tension lead, a drop of two volts for grid bias was obtainable in the filament resistance.

In the sets I now design I always place the filament resistance in the positive lead, and provide a separate grid bias battery, for there are so many varieties of valves in use, that one can no longer rely upon the use of a filament resistance to give sufficient grid bias. In any case with modern power valves much more grid bias is necessary than can be obtained by this means.

On this page you will find two photographs of the front and back of panel respectively of the original "Four-valve Family Receiver," as reproduced in the original description. On the photographs I have marked clearly the positions for the terminals for grid bias, and the changed connections behind the panel have also been indicated.

Other Improvements.

This is the simplest change that can be effected for making an improvement in the set, and is given at once so that readers who desire to obtain the benefit of modern valves and grid bias can do so. However, in the next issue, I will show a number of very important improvements in design, both in the high and low-frequency sides, which will enable readers to bring this set much more up to date with relatively small expenditure.

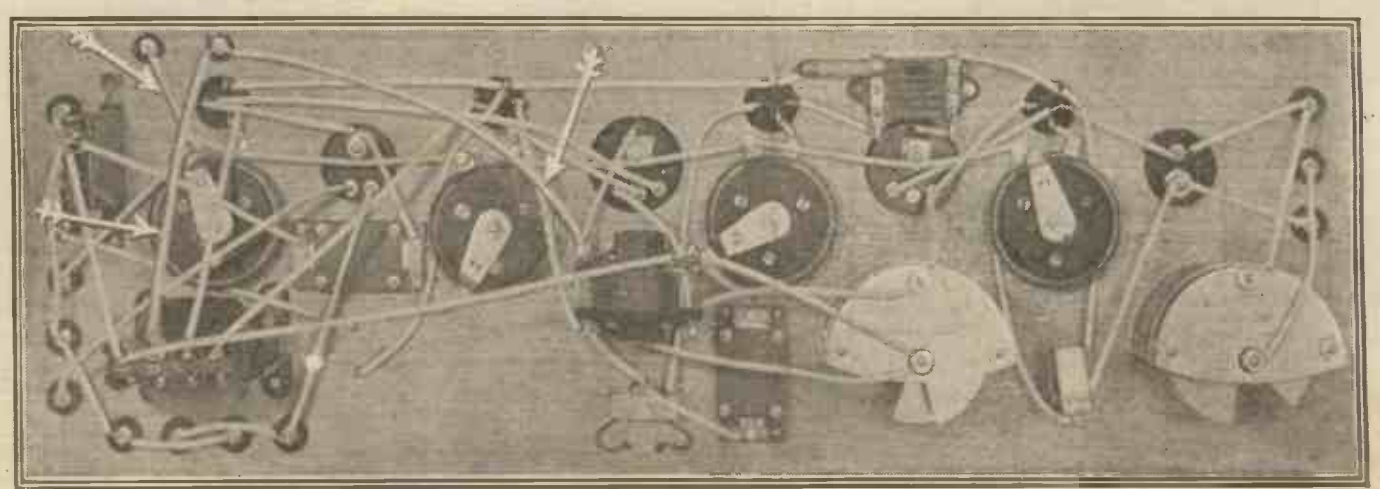
To indicate what these changes will be, and in order to give the more advanced reader an opportunity of making the changes himself at once, I may say that the H.F. side will be neutrodyned, still using plug-in coils and retaining the advantage of reaction, while plug and jack switching will be introduced so that different voltages can be used for the H.F., detector and note magnifying valves. This cannot be done with the present arrangement, which has a special method of switching precluding the use of separate H.T.

A Quality Hint.

Meanwhile readers who are not quite satisfied with the quality they are obtaining in the Four-valve Family set, due to transformers not being suited to one another, may try the scheme of connecting either a 100,000 ohm resistance or a quarter megohm grid leak (whichever they happen to have on hand) across the secondary windings (I.S. and O.S.) of the second L.F. transformer.

In many cases the inclusion of this resistance or grid leak makes a very considerable improvement in quality without much reduction in signal strength, or, if there is a reduction, the improvement in quality much more than compensates for the loss of strength.

In using the simple grid bias arrangement described in this article, the same grid bias is used on both magnifying valves, which may be of the small power type, the high tension being raised to about eighty or a hundred. Grid bias in this case can conveniently take the form of a 4½ volt flash-lamp battery.



A photograph of the original set, with arrows showing the changes necessary for applying grid bias to the note magnifying valves. Note the two additional terminals marked "G.B." in the heading photograph.

Note.—In this section Mr. Harris will discuss each week interesting points from the large correspondence he regularly receives. Readers are invited to write to him on matters of interest, and extracts from their letters, together with Mr. Harris' comments, will be published from time to time. It must be pointed out, however, that general and technical queries cannot be answered in this section, but should be addressed to the Technical Query Department, complying with the conditions laid down under the heading "Technical Queries" in each week's issue of POPULAR WIRELESS.

MY "Hale" letter bag is already very, very large, and naturally, as one would expect in the case of a receiver by a vast number all over the country, a certain number of difficulties have arisen.

For example, in their enthusiasm to "get started," many readers have made up the set without taking precautions to see that everything is correct. I have before me five or six letters from readers who report disappointing results, and in describing their "hook-up" either state in words or indicate in the diagram that they have not yet used grid bias.

Owing to the fact that in many receivers the addition of grid bias, as I have previously indicated in "The Radio Constructor," does not make any appreciable difference in signal strength, but merely makes a slight improvement in quality, and, what is very important, cuts down the consumption of high-tension current, they have rather looked upon its application in the Hale circuit as a kind of "finishing touch" which can be left till a later period.

Grid bias in the Hale circuit is essential for its successful working, and makes a tremendous difference to the reaction control, quality and general efficiency. For example, two or three readers have stated that they can hear quite good signals with the cat's-whisker removed from the crystal surface. Unless they are right underneath the shadow of the station this should not be so, save when the closest reaction is being used.

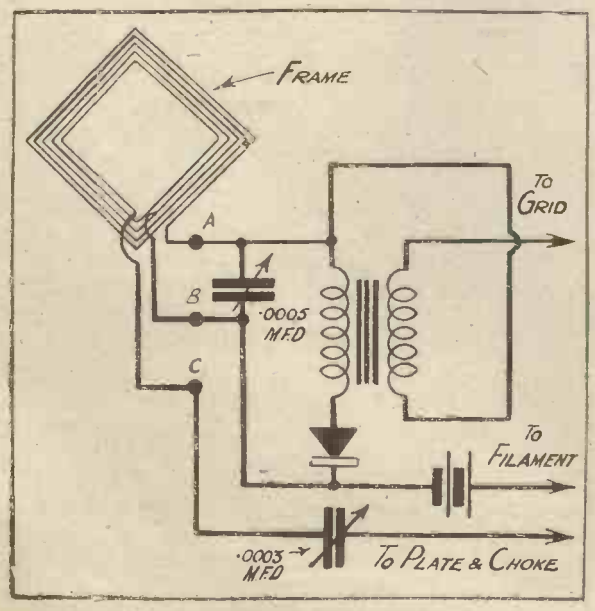
SPECIAL ARTICLES NEXT WEEK:

Neutrodyning the "Four-Valve Family" Set

(Fully Illustrated),

AND

How to Make a Four-Shilling Frame Aerial.



How to use the Hale circuit with a frame aerial.

It is one of the tests of satisfactory adjustment in the Hale circuit to see whether any signals can be heard when the cat's-whisker is lifted from the crystal surface, or in the case of a permanent detector, when the two crystals are separated. With proper grid bias nothing whatever should be heard in the way of signals, for the valve is used purely as an amplifier and not as a detector. Whatever valve you use, a few experiments with grid bias will be well worth while.

Some other queries indicate that the reaction coil has been connected the wrong way round. It is not generally known that even when the reaction coil is reversed oscillation can be produced when the two coils are tightly coupled, for a capacity reaction can then be set up, which is sufficient to produce oscillation.

If all is well with the Hale circuit, and the correct size of reaction coil is being used, one can bring the set gently into oscillation and out again with such delicacy that one hardly notices the point at which oscillation is reached. Before such a state of affairs is possible, however, the right size of the coil must be chosen, and the correct grid bias, for the particular high-tension value used.

In indicating the results obtained with the high voltage and a power valve I was, of course, dealing with the reception on a loud speaker. When the Hale is being used for telephone reception there is no need to use such high voltage, and 60 will be generally quite sufficient.

The "Hale" on a Frame.

Certain other queries relate to the use of frame aerials, indoor aerials and other substitutes for the long outdoor wire supported on a pole. One or two readers have written to say that they have very poor results when using a frame. The reason for this is that the average frame aerial connection does not provide for any reaction, which is one of the most important points in the Hale circuit. However, if the circuit is properly arranged wonderfully good results can be obtained on a frame, but the frame must be tapped, otherwise a reaction effect cannot be obtained.

For the benefit of those readers who wish to use a frame aerial with the Hale circuit I give on this page a diagram showing the connections which have to be changed when using a frame aerial with the form of circuit published on page 488 of the 30th October issue. From this diagram it will be seen that the tapped frame takes the place of both the tuning coil and the reaction coil in the Reinartz reaction circuit. The frame can be of any convenient type, but the tappings should be taken about a third of the way from one end.

The connections will then be as shown in the diagram—i.e. the end of the frame nearest the tapping to the reaction condenser, the tapping to moving plates of the condenser, grid bias battery and crystal, and the other end of the frame winding to the fixed plates of the condenser and the low-frequency transformer, etc. The best position for the tapping will probably be found by trial, but if you begin your experiments as suggested you will find it will be somewhere near the point suggested.

Indoor Aerials.

It should not be forgotten that in this connection only a portion of the frame (approximately two-thirds) is used for tuning purposes, so that the wave-length range with the particular variable condenser will not be so great as it was before. However, if it is a home-made frame, or if it is desired to construct one specially for the purpose, use about one-third more turns than normal.

So far as other aerials are concerned, such as the wire round the picture rail, a wire round the loft, and other forms of indoor aerials, they all work excellently and with much higher selectivity than with the outdoor type, but of course with a reduction of strength. It will generally be found that a much smaller reaction coil is needed with the indoor aerial, and a few experiments are recommended before final decision is taken.

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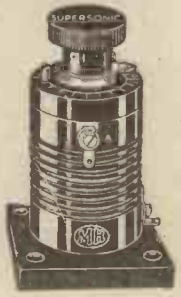

The illustration shows the design of the MH Supersonic Transformer.

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Supplied in case complete together with full size Blue Print—Layout Diagram and Booklet of Instructions. Price £5-5-0, or separately at above prices

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CURRENT TOPICS.

BY THE EDITOR.

The Royal Charter—The P.M.G.'s Powers—More Money Available—The Listeners' Remedy.

THE Government have issued a White Paper containing the drafts of the Royal Charter for which the Postmaster-General proposes to apply for the incorporation of the British Broadcasting Corporation and of the licence and agreement, the terms of which have been mutually agreed upon between the Postmaster-General and the B.B.C.

It is stated in the Royal Charter that more than two million people have applied for and taken out wireless licences, and "in view of the widespread interest thereby shown in the broadcasting service and of the great value of the service as a means of education and entertainment, we deem it desirable that the service shall be developed and exploited to the best advantage and in the national interests."

Power is given to the new Corporation to acquire any undertaking, stations, plant, and assets which may be necessary, to erect and equip stations, to compile and prepare, print, publish, issue, circulate and distribute, whether gratis or otherwise, such papers, magazines, periodicals, books, circulars, and other literary matter as may seem conducive to any of the objects of the Corporation.

The new B.B.C. may collect news of and information relating to current events in any part of the world and in any manner that may be thought fit, and to establish and subscribe to new agencies. It can acquire by registration, purchase, or otherwise copyrights in any literary, musical, and artistic works, plays, songs, gramophone records, news, and other matter!

More Money Forthcoming.

The Corporation is going to be established for a period of ten years. The governors of the Corporation are eligible for office for five years, but may seek re-election at the end of that period, and the remuneration for their services is as follows:

Chairman	.. .. ..	£3,000 per annum.
Vice-chairman	.. ..	£1,000 „ „
Other governors	..	£700 „ „

With regard to finance, the Corporation is to pay to the Postmaster-General a royalty of £10 per annum in respect of each of the stations, while the Postmaster-General is to pay the Corporation:

1. In respect of the first million licences or fractional part thereof issued against payment in the year, 90 per cent.

2. In respect of the second million licences or fractional part thereof issued against payment in the year, 80 per cent.

3. In respect of the third million licences or fractional part thereof issued against payment in the year, 70 per cent.

4. In respect of all additional licences issued against payment in the year, 60 per cent.

A deduction of 12½ per cent on account of the cost of collection of licences will be made from the amount of all sums received by the Postmaster-General in respect of licences before the calculation of the percentage to be paid to the new B.B.C.

The agreement states that the Postmaster-General has agreed to pay the company £620,000, being as to £548,464 the agreed contribution or payment by the Postmaster-General to the revenue of the company in respect of the period from March 31st to December 31st, 1926, and as to £71,536 in respect of share capital to be repaid in full. These sums are in full satisfaction of all claims on the part of the company against the Postmaster-General.

Mrs. Philip Snowden, one of the governors of the new B.B.C.

A supplementary estimate of the Civil Service and Revenue Departments includes a vote for an additional sum of £295,000 for broadcasting!

A perusal of the White Paper shows that the Postmaster-General's authority over the new B.B.C. is to be supreme. His powers of control appear to be much greater on the whole than those contemplated in the report of Lord Crawford's Committee, whose recommendations have generally been followed.

A Bright Spot.

A tremendous amount depends upon the capabilities of the new governors. The "Times" has pointed out that it is not easy to understand why Lord Clarendon, who has been doing first-rate work and gaining invaluable experience at the Dominions Office, should suddenly have been removed to this entirely novel field. We admit it is very difficult to understand indeed!

And the same difficulty arises when we look at the names of the other governors. But the one bright spot is that the chief executive officer, who is to be called Director-General, will be Mr. J. C. W. Reith, who has the whole technique of broadcasting and the management of broadcasting at his finger-tips.

It appears that the governors of the new Corporation will be able to call upon the services of as many committees as they may think fit to appoint, and in turn the committees may themselves appoint sub-committees; and so on paper, at any rate, the new B.B.C. should be well supplied with sound advice and intelligence.

It would seem that the Corporation will receive more money than the B.B.C. has hitherto received from the Post Office, for, instead of the retention by the Post Office of half the amount of revenue derived from licences, there will be a new scale (which we have printed above), and this ought to leave the Corporation richer than the B.B.C.

P.M.G.'s Powers.

The Postmaster-General's powers over the new B.B.C. are, in our opinion, far too sweeping; for example, it is provided that the Postmaster-General may from time to time require the Corporation to refrain from broadcasting any particular matter. Now, this gives the Government a unique hold over the censorship of broadcast news. Supposing another General Strike breaks out, the B.B.C. can repress, at the command of the Postmaster-General, legitimate news which the public is entitled to receive, and it may even, for its own ends, colour that news and so give an entirely erroneous impression of current events.

Furthermore, the Postmaster-General can revoke the licence if, in his opinion, the Corporation does not adequately perform its duties. In other words, the Postmaster-General is in a position of being the master holding the big stick, and if the Corporation does not behave itself to the liking of the Postmaster-General then it can be turned out of office.

The B.B.C. Pie.

There are so many points in connection with this new Royal Charter which show that the Government have got their fingers well into the new B.B.C. pie and intend to keep them there, that it would take many pages of this journal to enumerate them. But there the matter is, and we can only hope that this new B.B.C. Corporation will prove half as successful as the old B.B.C., and that it will not, under this new band of governors, be turned into a highbrow, pedantic institution for feeding the public with what it considers should be "good" for the public.

Primarily it should remember that it is an entertainment industry, and its chief business is to provide its clients with entertainment. The only remedy listeners will have against the new service is to let their licences lapse and not take them out again. And next year if the new B.B.C. does not live up to the standard the present B.B.C. has maintained, there will undoubtedly be a very severe falling off in the number of licences taken out.

THE INTERPLEX.

PART III.

The Final Article on a Very Interesting Experimental System.

By J. ENGLISH.

THE main constructional work has now been described, but before the system is ready for operation there are one or two accessories to be constructed, the most important being the *Filament Control Panel.* This is a device by means of which any valve may be supplied with current at various voltages so that we can use at the same time an R valve (·70 amp. 4 v.), a D.E.R. (·35 amp. 1·8 v.), a D.E.3 (·06 amp. 2·8 v), and a D.E.5 (·25 amp. 6 v). This flexibility of filament current supply is highly desirable in an experimental system, and one has but to experience the ease and certainty with which these various adjustments can be made in order to appreciate the great utility of the panel. As the various voltages are selected without the use of large series resistances, there is no great waste of current.

A Master Rheostat.

An additional control of current is provided by the master rheostat, which should have a resistance of about 30 ohms and be capable of carrying several amperes without overheating. Although current to the valves is cut off by pulling out the supply plugs, a further safeguard against short circuits is provided in the fusebox. The fuse should be adjusted to blow out when passing current of some predetermined value a little in excess of that required for all the valve filaments.

The ebonite panel, 9 by 5 inches, should be drilled as indicated in Fig. 12. The marking out of the four lines of five ¼-inch holes should be done carefully so that the supply plugs will fit properly in the sockets. The distance between the centres of the holes in each line of five must be exactly ½ inch.

A good method of making connection to the rear of the sockets is to drill four ¼-inch holes, ⅜ inch apart, in a 3-inch length of brass or copper strip not more than ⅜ inch wide. When this is placed over the shanks of the sockets underneath the panel and the nuts tightened up, a sound electrical connection is made to every socket. The panel is then wired up as shown in Fig. 12.

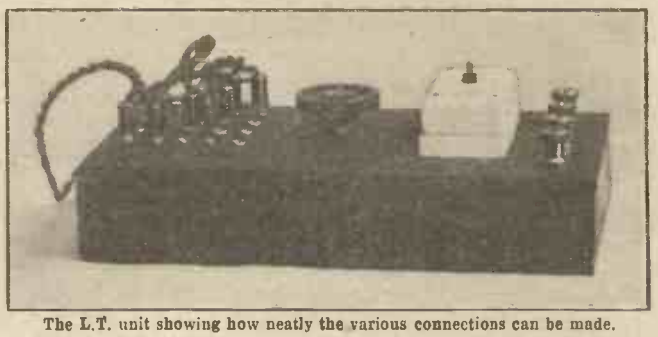
The completed panel is screwed to a wooden framework resembling a flat box without top or bottom. This is constructed from ⅜-inch wood and when finished measures 9 by 5 inches and 1½ inches deep. The filament control panel is screwed underneath the bottom board of the cabinet with the group of sockets to the front and the four terminals for connection to L.T. supply at the back.

As a complement to this panel we need four supply leads complete with plugs at each end. For these we require two 18-inch and two 24-inch lengths of heavy lighting flex, sixteen Eelex plugs in pairs of black and red, and sixteen separators.

The Interplex installed in the author's wireless "den."

From these materials plugs at the ends of each lead are built up as indicated in Fig. 13, and it will be observed from the photograph that the supply leads so formed are very neat and the method of current supply both safe and efficient.

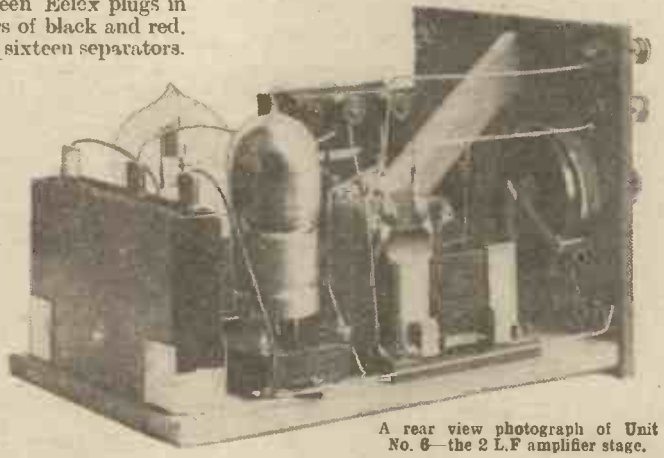
By using black and red discs behind the filament sockets on the valve panels corresponding with the black and red bodies of the plugs, it is easy to differentiate between positive and negative filament connections. Placing a supply plug in sockets A and B of any line of five gives 2 volts, in B and C, or C and D, 4 volts, and in D and E, 6 volts. Sockets B and D are positive and A, C and E negative, so that reversing a plug in any pair of sockets reverses the polarity of the filament connections, which reversal is often required and can be performed here in a moment.



The L.T. unit showing how neatly the various connections can be made.

Testing the Battery Circuits.

Four single leads are also required for anode current supply, and these should be long enough to reach the H.T. battery wherever it is situated. In my own installation, supply batteries, both H.T. and L.T., are placed beneath the operating table, where they are out of the way yet easily accessible. These four leads are furnished at each end with an Eelex plug with different coloured bodies corresponding to the coloured discs of the H.T. sockets on each valve panel, so that the various leads may be quickly identified when plugging into the H.T. battery.



A rear view photograph of Unit No. 6—the 2 L.F amplifier stage.

Except for a few sundries, the system is now complete and ready for operation. Before commencing any experiments, however, it would be well to test the current supply arrangements, all four filament circuits and H.T. positive leads.

The method of connecting the L.T. supply is shown in Fig. 12, while the

(*Continued on page* 767.)

THE INTERPLEX.

(*Continued from page 763.*)

connection from H.T. negative to L.T. negative or positive may be made between the batteries themselves, preferably through a fuse or some current-limiting device, such as a high resistance shunted by a

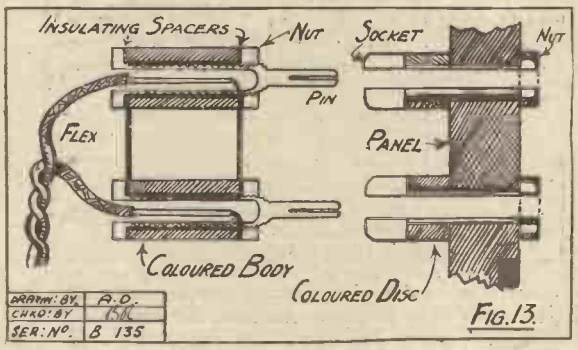
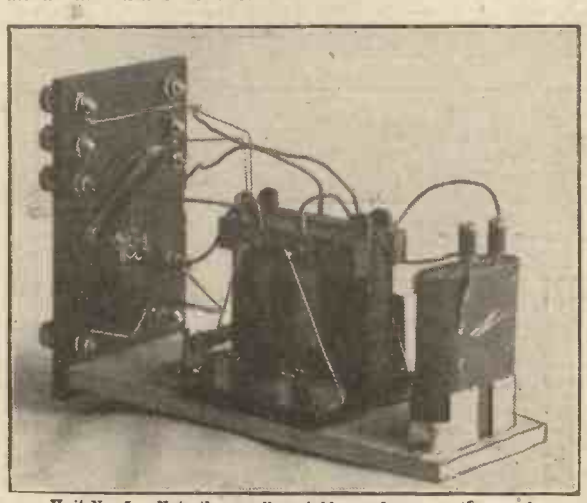


FIG. 13.

condenser. If the H.T. negative lead is brought up and plugged into a socket on the F.C. panel, it is easier to introduce components, where required, between the anode and filament batteries.



Unit No. 5. Note the small variable condenser on the panel.

As regards the use of fixed condensers across the anode taps, this will depend largely upon the nature of the experiment, but in the majority of cases such condensers will be required, and in my own installation a 2 mfd. fixed condenser is connected across each anode tap, these condensers being mounted in the box containing the H.T. batteries.

When all the supply arrangements have been tested and found correct, a preliminary test can be commenced. This will necessitate the addition of all the usual accessories such as valves, 'phones, coils, chokes, etc. Even if the experimenter has a deep pocket, it would not be wise to start off with a huge stock of such accessories, but to acquire them as he goes along. There *are* amateurs, however, who are not happy unless surrounded by as many odd pieces of apparatus as possible.

Returning to the subject of operation, it would be impossible to give here an example of every use of the Interplex system, but in order to convey some idea of how it is operated we will first consider briefly its use as a multi-circuit receiver. No doubt this function is of more general interest and is best illustrated by Figs. 14, 15 and 16, showing how units are connected up to form three well-known circuits. When joining up units short connections are made with lengths of square tinned wire, longer connections being made with ordinary insulated flexible wire terminating in spade terminals.

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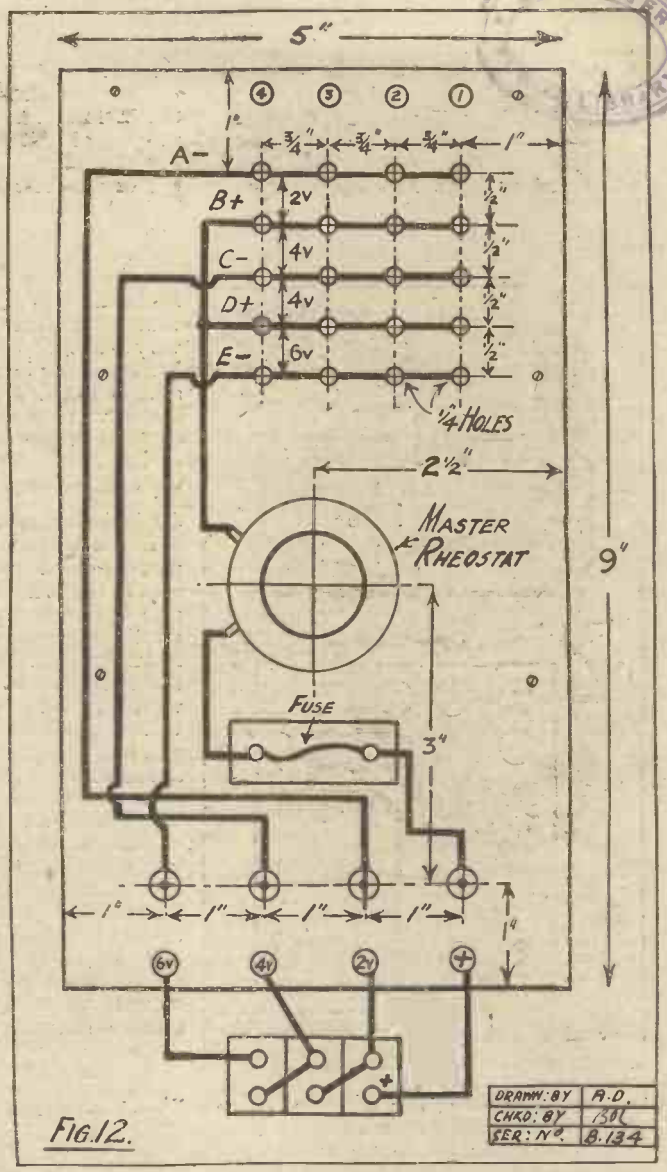
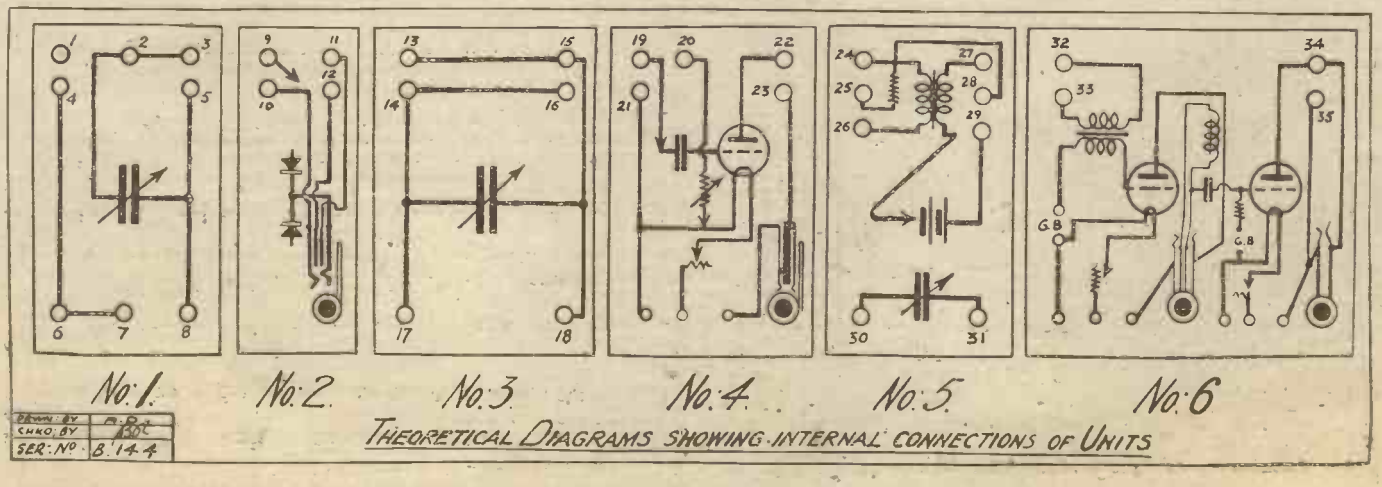


FIG. 12.



THEORETICAL DIAGRAMS SHOWING INTERNAL CONNECTIONS OF UNITS

THE INTERPLEX.

(Continued from previous page.)

The first example, Fig. 14, is a simple crystal receiver with series condenser tuning. The 'phone leads can be connected to terminals 11 and 12, but a better plan

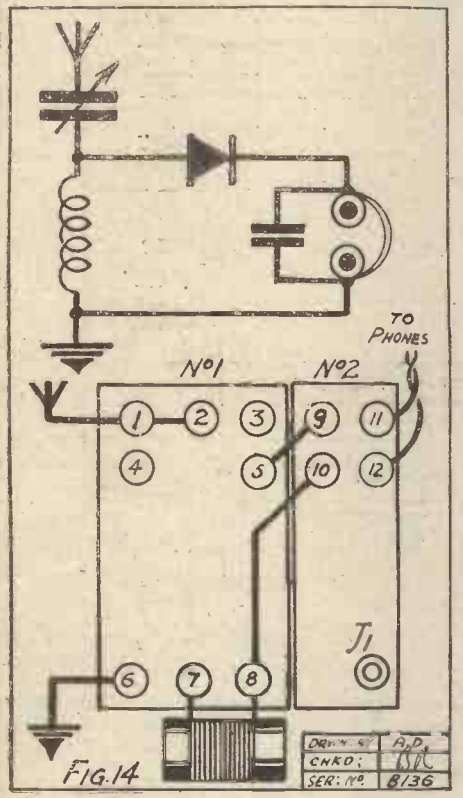


FIG. 14

is to use a length of flex having a 'phone plug at one end and connected at the other to a 'phone box containing the by-pass condenser and terminals for the 'phones or loud speaker. The 'phone plug can then be placed in any jack as desired. There is ample scope here for ideas for 'phone boxes incorporating switching arrangements, etc., and such a device is always of value.

Audio-frequency amplification can be added to the circuit of Fig. 14 by inserting the input plug of Unit No. 6 into the jack of Unit No. 2. This forms one of the best receivers for distortionless loud-speaker reception of the local station.

Fig. 15 (A and B) indicates the connection for a modified Reinartz one-valve receiver, with the addition of an acceptor wave-trap. Connections to batteries have been left out for sake of simplicity, and, as in diagrams to follow, only the terminals of the units are shown, as this is sufficient to indicate the methods employed.

An Adaptable System.

It will be noticed that the primary of the transformer in Unit No. 5 is used as the radio-frequency choke, the variable condenser of the same unit being the reaction control condenser. Also, Unit No. 3 forms the basis of the grid tuning circuit, the condenser of Unit No. 1 being the wave-trap condenser. The control of the valve is effected in Unit No. 4, the value of grid leak and grid condenser being adjusted as required.

The connections necessary to build up this circuit are few and simple, and there is ample scope for experiment with the receiver so constituted, which is admirably suited for DX work. Signals can be brought up to loud-speaker strength by the addition of Unit No. 6 as described above.

Fig. 16 (A and B) shows the connections for a one-valve Trinadyne receiver. Notice how Unit No. 3 is used to form a tuned anode reaction circuit.

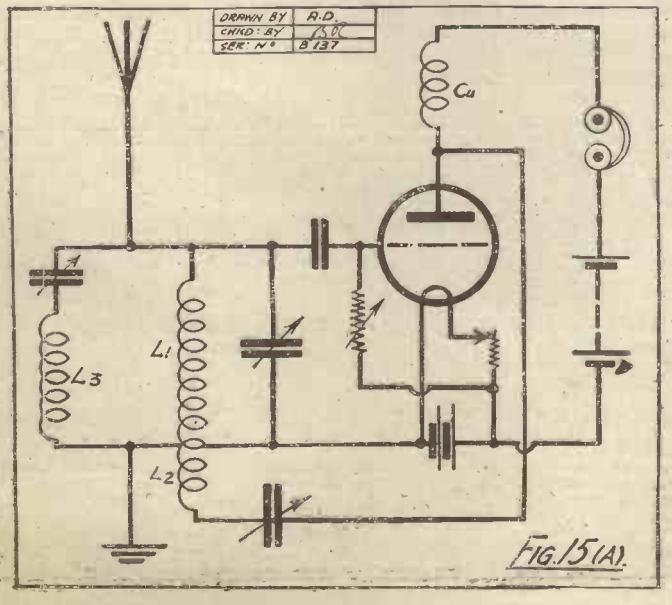


FIG. 15 (A)

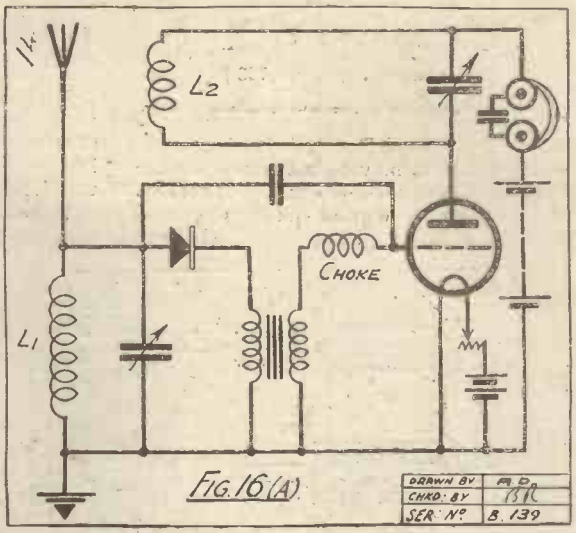


FIG. 16 (A)

The Interplex system is admirably suited for working out ideas for original circuits. New circuits are very rarely discovered by the haphazard connection of apparatus, and embryo inventors should work out their ideas on paper first, rejecting all that is obviously unsound. Then the final project can be tried out on this system, and in this way much time will be saved that would otherwise be wasted in pursuit of fruitless ideas. I might add that the

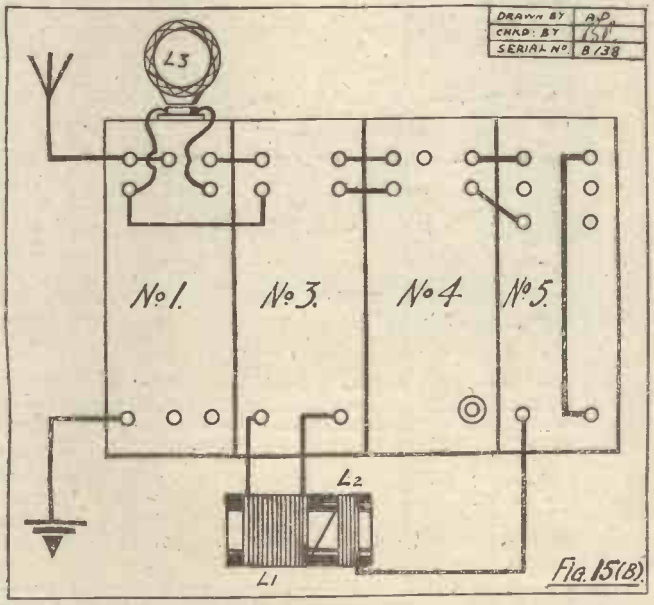


FIG. 15 (B)

Coils L_1 and L_2 can be mounted in a two-coil holder for convenience of coupling.

The three simple examples given above will, no doubt, be sufficient to give a general idea of how the system is used as a multi-circuit receiver. The rapidity and ease with which various circuits can be connected up should appeal to the man who likes to try out all the latest circuits and new forms of old ones. Trinadyne circuits, evolved on paper, were all tried out and worked into practical form on the original Interplex system.

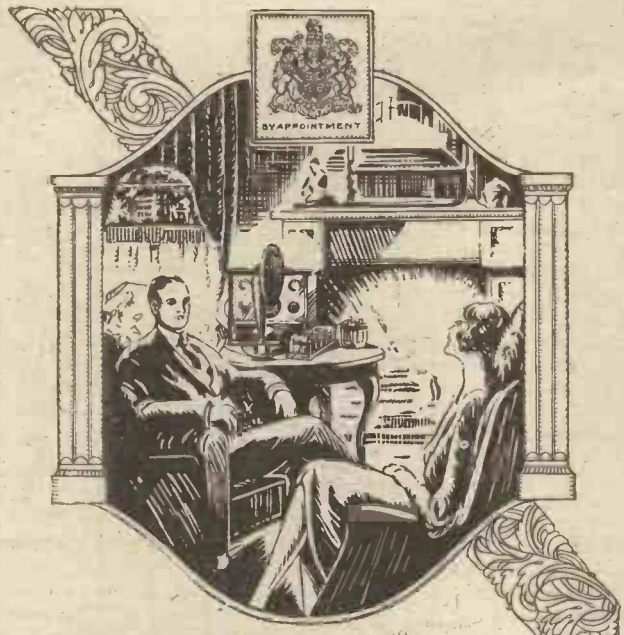
Anyone who designs and constructs much radio apparatus will find the system ideal for working out details of receivers, and it is possible to get a close approximation to the layout of the proposed instrument.

A Useful Device.

It will be noticed from the examples given above that Unit No. 1 is the foundation of all aerial tuning circuits, while Unit No. 3 forms the basis of other tuned circuits, such as tuned anode, grid, and coupled circuits.

An accessory that, in conjunction with

(Continued on page 770.)



Ideal Evenings with your Wireless Set

FOR real wireless enjoyment—purity of reproduction, freedom from distortion and ample volume of tone are, of course, essential.

Use "HART" BATTERIES with your set for both Low and High Tension supply and "wireless" will reveal new charms to you; their steady voltage, low resistance and exceptional reserve of power ensuring reception at its best.

Discard your dry batteries to-day and substitute the "HART" "RAY" type of High Tension Accumulator (20 volts 14/8, 30 volts 22/-, 60 volts 44/-). The marked improvement in reception will certainly surprise you.

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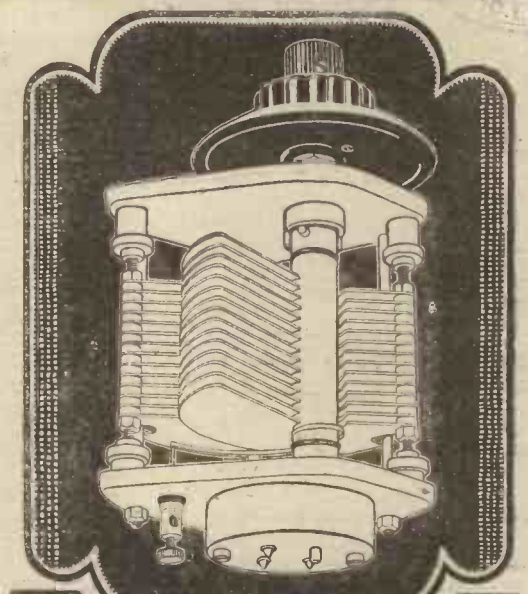
There are models of "HART" Batteries for all Low and High Tension Circuits. Write to Dept. "P.W.5" to-day for illustrated lists and full particulars.

HART ACCUMULATOR CO., LTD.
STRATFORD, LONDON, E.15

Goodall Ad.



BUILT LIKE A MICROSCOPE

HERE IS the last word in Variable Condensers. Geared movement combined with low-loss design—made by a famous firm of scientific and radio instrument makers, built with the precision and finesse that only makers of scientific instruments know how to impart.

A TYPICAL FEATURE is the unique smoothness of the 200-1 ratio geared vernier control that enables the minutest adjustment to be made. There is not the slightest trace of backlash. The condenser is solidly built of brass with porcelain insulation. A dust-proof case is provided for the gear mechanism, and the stout stamped endplates are entirely insulated from the rotor vanes by ebonite and from the fixed vanes by porcelain, making hand capacity negligible. Connection to the rotor vanes, which are of decrement shape, is made by a soldered pig-tail to the spindle. Definite stops are provided. Fixing is by the one-hole method.

CAPACITIES. .0001 m f d. .0003 m f d. } £1 2s. 6d.
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Manufacturers of Scientific Instruments and Radio Apparatus

BRINGS RECEPTION PYE TO PERFECTION

THE INTERPLEX.

(Continued from page 768.)

Unit No. 3, constitutes the foundation of several forms of H.F. coupling is the device illustrated in Fig. 17. On a square of ebonite are mounted four valve pins, 1 in. apart, the four holes in the middle being drilled so that a plug-in type of transformer can be inserted. The pins of the transformer engage with spring clips behind, these contacts being connected to the valve pins shown in the figure, and contacts from H.T.C. valve holders are useful here.

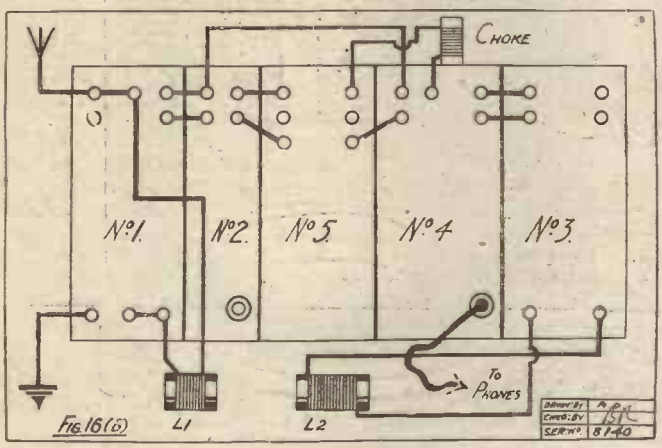


Fig. 16(6)

The H.F. Adapter.

If a Unit No. 3 is placed between two Units No. 4, this adapter can be connected to the terminals 22, 23, 13, 14, or 15, 16, 19, 21, giving respectively the circuits A and B of Fig. 18. When the second valve is a detector, terminals 19 and 20 are shorted.

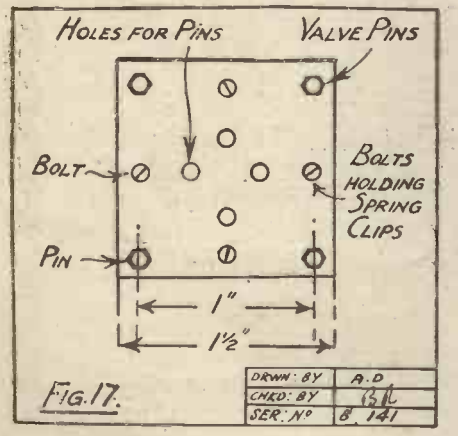


Fig. 17.

This adapter may be used to couple a crystal detector circuit to a radio-frequency valve, and if the primary or secondary windings of the transformer are tapped, then it is an easy matter to build up the couplings required for such circuits as the Neutrodyne, Rice, etc.

Apart from the pleasure and information that can be obtained from the use of the installation as an experimental receiver, it has other uses of great value to the experimenter interested in more serious work. For example, Unit No. 4 can be used for the determination of valve characteristics and other valuable data. Also, Units No. 3 and No. 4 can be used for the plotting of resonance curves, etc.

A Final Refinement.

A guide to the connections for using Unit No. 4 as a valve-testing panel is Fig. 19, which includes a potentiometer panel, another useful accessory used in my own installation.

Many uses can be found for the Universal Valve Unit, and there is no reason why a similar unit built on a larger scale should not be used for experimental transmission on low power.

In concluding, I hope that, even if the reader is not tempted to make up the entire system, he will have gleaned from this description of it some idea that will be useful in his own experimental set. On the other hand, I feel certain that anyone who builds an installation on the lines indicated above will be amply repaid for his trouble, and he will never go back to the untidy "hook-up."

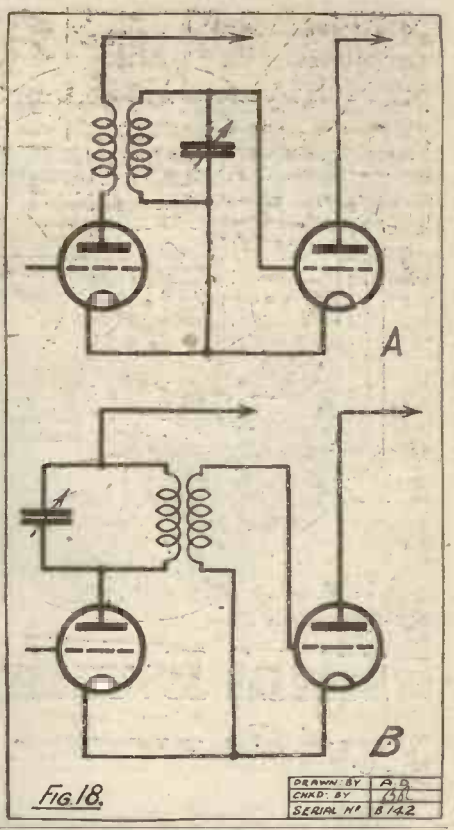


Fig. 18.

CHECKING YOUR WIRING.

By D. K.

IT is surprising, even after four years of broadcasting and the home-construction of wireless sets, how frequently one hears of cases where valves are burnt out owing to the H.T. getting across their filaments because wrong connections have been made in the receiver. It is, in the writer's opinion, far more excusable to make a wrong external battery connection than make an error in the *internal* wiring of a set. If the wiring is properly checked up before the set is tested there should be no chance of a mistake passing unnoticed.

That is the reason why point-to-point lists of connections are published with constructional articles, but even if such lists were not available it is a simple matter to check over even a complicated set.

The Checking List.

Assuming that the point-to-point list is not provided the constructor must fall back on either the practical wiring diagram or the the oretical circuit. The writer prefers to work from the latter, but it makes no odds which is used.

When the wiring has been completed, the constructor should carefully clean up the set and then set to work on the checking process—which must be done methodically. In the first place, he should take either the theoretical or practical diagram and make a list of the main points of his receiver—LT+, L.T.−, H.T.−, H.T.+ terminals, A and E, and so on, and then he should write against them *all* the points with which they make connection, marking the lines off on the diagram as he goes on. When he has finished, any lines not marked off should be noted and he is ready for the actual checking on the receiver.

Many points will, of course, overlap, but that will only emphasise the checking. For instance, the earth lead will be found in most cases to go to L.T.+ or L.T.− and to one set of valve filament sockets. This will be duplicated when the L.T. leads are dealt with, but it is advisable not to omit the L.T. terminals from the list even if some of the points *are* duplicated.

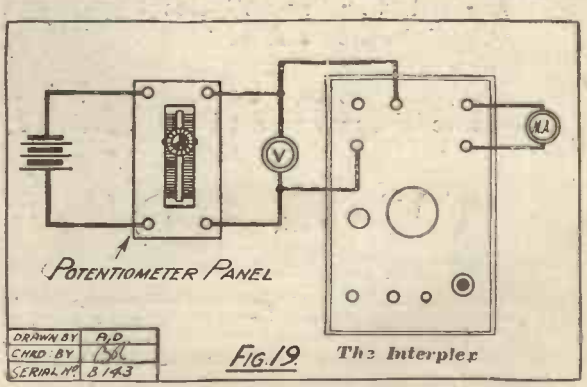


Fig. 19. The Interplex

The list should be taken as written, and the points and their connecting wires noted on the set, each joint being tested for strength and cleanliness as the constructor goes on. After this, which does not take so very long, he can rest assured that the set is wired as described in the diagram, and he can go ahead with the practical test, feeling sure things are all right "down under."

Apparatus Tested

Traders and manufacturers are invited to submit wireless sets and components to the "P.W." Technical Dept. for test. All tests are carried out with strict impartiality in the "P.W." Test room under the supervision of the Technical Editor, and the general reader is asked to note that this weekly article is also intended to provide a reliable and unbiased guide as to what to buy and what to avoid.—EDITOR.

SUPERIAL SIMPLE-STRIP.

ALTHOUGH soldering is quite a simple task the fact remains that many constructors hesitate to tackle it; indeed, if it were not possible to assemble a wireless set without soldering, it is probable that there would be a much smaller number of home-made sets in use. Quite an efficient alternative to soldering, however, is the use of "Simple-Strip," a product of the New London Electron Works, Ltd. It is ¼-in. strip copper heavily tinned, in which oval holes are stamped. These holes are very close together, but the material is tough and pliable and retains sufficient strength to stand against very rough handling.

"Simple-Strip" can be cut quite easily and bent with the fingers into any desired shape. Owing to the holes being oval no difficulty is experienced in getting the material to lie snugly under terminal nuts, even if slight miscalculations in length of lead are made. Of course, "Simple-Strip" can be soldered, if desired, and, as a matter of fact, it takes solder as well as does tinned copper wire.

In view of its large surface area it forms a very efficient conductor, and a receiver connected up with it offers a very attractive appearance.

Superial "Simple-Strip," as it is called, is sold in packets containing 12 ft. at 2/- per packet.

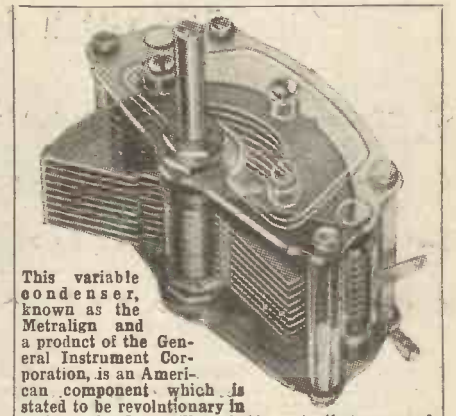
THOSE MARCONI VALVE BOOKLETS.

The Marconiphone Co., Ltd., recently published two very interesting booklets—"The Story of the Marconi Valve" and "The Marconi Valve Booklet." These publications will interest all valve enthusiasts, and we expect that many copies of the November 20th issue of "P.W." are now minus the coupon which appeared on page 657. This coupon entitles any reader of "P.W." to obtain either one of the booklets gratis and post free. Unfortunately a printer's error occurs in it, and the following asterisked statement should have appeared at the bottom of the coupon: * "Strike out what is not required." In some copies this appears partially corrected, and in others it is omitted altogether. Readers are welcome to a copy of either booklet, by writing to the company at 210, Tottenham Court Road, W.1.

A PRICE CORRECTION.

Will readers please note that the price of the Eureka Orthocylic Variable Condenser is 15s. 6d., with a capacity of ·0005 mfd., and not 13s. 6d., as was stated in the advertisement columns of our issue for November 6th. With a ·0003 mfd. capacity the price is 14s. 6d.

(*Continued on page* 774.)



This variable condenser, known as the Metralign and a product of the General Instrument Corporation, is an American component which is stated to be revolutionary in design. Readers will probably note that one end plate at least is transparent.

APPARATUS TESTED.

(Continued from page 772.)

THE BROWN CRYSTAL AMPLIFIER.

We have recently had a "Brown" Crystal Amplifier under observation, and at the conclusion of a series of tests carried out in varying localities, we are able to form a definite opinion as to its capabilities.

It is contained in a polished case provided with a lid, and on to which are mounted six terminals. To two of these must be connected a small 4½-volt dry battery—the only source of local power required. The other four include two terminals for the loud speaker and two for connecting up to a crystal set by its telephone terminals.

Beneath the lid are two levers for adjusting the instrument. These levers are not finicking little things, but each moves over a distance of two or three inches, and neither is at all a critical control. Even so, very precise instructions are provided, showing exactly how these levers should be handled to get best results, instructions that anyone who can read could understand.

Now, whenever crystal signals are comfortably strong in telephone receivers, this Brown amplifier will bring them up to good loud-speaker strength. Good in both volume and purity too. We have never heard such pure, mellow, microphonic amplification before as that given by this instrument. And volume is excellent, notwithstanding the fact that only the one tiny battery is used.

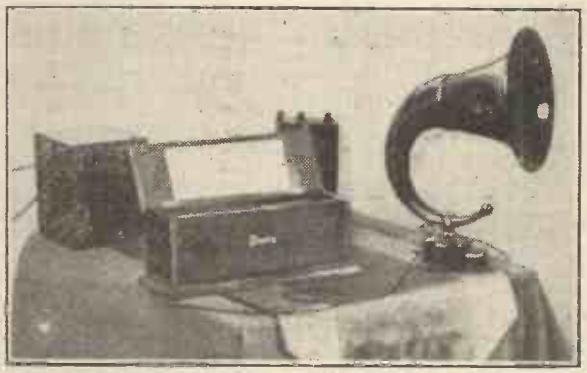
In view of the fact that such results are obtainable, it is surprising that Messrs. Brown have managed to keep their new amplifier within such practical bounds of stability and robustness; indeed, it is rather wonderful and once again testifies to the supremacy of the S.G.B. people in this particular branch of radio. In our opinion, the Brown Crystal Amplifier is far and away above everything else of the kind, and, moreover, it is a precision instrument fitted with "man-in-the-street" controls. Eliminating, as it does, both valves and accumulators, at £4 4s., it is a proposition that requires serious consideration.

THE "ELECTONE" AUTOMATIC CONTROL.

One of the cutest little gadgets we have seen is the "Electone," an automatic switching device due to Messrs. Frederick J. Gordon & Co., Ltd., 92, Charlotte Street, London, W.1. It consists of a small clock around the face of which are situated 24 plug sockets. Six plugs are provided and at whatever point a plug is inserted the clock movement closes a switch inside for a period of half an hour. The "Electone" is placed in series with one of the L.T. battery leads, and this switches the L.T. on and off in accordance with the plug positions.

If a plug is inserted in the socket opposite eight o'clock the set is switched on a few minutes before eight, and switched off again a few minutes after eight-thirty. If another plug was inserted at the eight-thirty point, the set would carry on till nine o'clock.

The device is quite small and neat in appearance, and as it is essentially a clock, does not look out of place by or on top of a receiver. The clock movement is not a Benson one, of course, but it is robust and keeps excellent time. Certainly the "Electone," combining as it does a clock with an automatic switching device, is one of the most useful radio accessories we have seen. With one of these little instruments the amateur can leave his set in the morning, and have music turned on and off for the benefit of the household without any but his own hands touching a single switch, even a dial. We have had an "Electone" in use for several weeks now, and not once has it failed to do its duty. There is a slight noise when it switches off or on, but otherwise it is perfectly silent. In our opinion, it forms one of the best solutions to the problem of distant control so far placed before the radio public, and should command a very ready sale at 27/6.



The Brown Crystal Amplifier, which is described on this page.

RADIOTORIAL

All Editorial Communications to be addressed to The Editor, POPULAR WIRELESS, The Fleetway House, Farringdon Street, London, E.C.4.

The Editor will be pleased to consider articles and photographs dealing with all subjects appertaining to wireless work. The Editor cannot accept responsibility for manuscripts and photos. Every care will be taken to return MSS. not accepted for publication. A stamped and addressed envelope must be sent with every article. All inquiries concerning advertising rates, etc., to be addressed to the Sole Agents, Messrs. John H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4.

As much of the information given in the columns of this paper concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and the trader would be well advised to obtain permission of the patentees to use the patents before doing so.

Readers' letters dealing with patent questions, if sent to the Editor, will be forwarded to our own patent advisers, where every facility and help will be afforded to readers. The envelope should be clearly marked "Patent Advice."

TECHNICAL QUERIES.

Letters should be addressed to: Technical Query Dept., "Popular Wireless," The Fleetway House, Farringdon Street, London, E.C.4.

They should be written on one side of the paper only, and MUST be accompanied by a stamped addressed envelope.

Queries should be asked in the form of the numbered questions: (1), (2), (3), etc., but may be accompanied by a short letter giving any necessary additional particulars as briefly as possible.

For every question asked a fee of 6d. should be enclosed. A copy of the numbered questions should be kept, so that the replies may be given under the numbers. (It is not possible to reproduce the question in the answer.)

BLUE PRINTS. A series of 20 Blue Prints can be obtained from the Query Dept., price 6d. per Blue Print.

Only a limited number of circuits are covered in this series and full details of the circuit arrangements available in Blue-Print form are published fortnightly in the advertisement columns of this journal.

All other back-of-panel diagrams are specially drawn up to suit the requirements of individual readers at the following rates: Crystal Sets, 6d.; One-Valve Sets, 6d.; One-Valve and Crystal (Reflex), 1s.; Two-Valve and Crystal (Reflex), 1s.; Two-Valve Sets, 1s.; Three-Valve Sets, 1s.; Three-Valve and Crystal (Reflex), 1s. 6d.; Four-Valve Sets, 1s. 6d.; Multi-Valve Sets (straight circuit), 1s. 6d. Except SUPER-HETERODYNE DIAGRAMS, all of which, irrespective of number of Valves used, are 2s. 6d.

If a panel lay-out or list of point-to-point connections is required an additional fee of 1s. must be enclosed.

Wiring diagrams of commercial apparatus, such as sets of any particular manufacture, etc., cannot be supplied. (Such particulars can only be obtained from the makers.)

Readers may submit their own diagrams, etc., for correction or for criticism. The fee is 1s. per diagram, and these should be large, and as clear as possible.

No questions can be answered by 'phone.

Remittances should be in the form of Postal Orders.

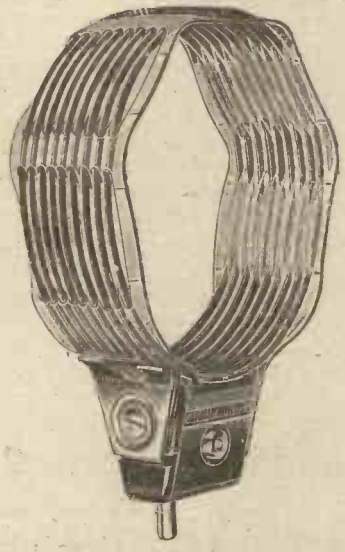
Questions and Answers

A 2-valve Amplifier.

E. A. B. (Tatsfield, Surrey).—"I have a good one-valve set in use, which has given such excellent results that now I intend using a loud speaker. I wish to retain the one-valve set as the first part of the new receiver. To get really good results I shall need three-valves in all, so could you recommend me a 2-valve amplifying circuit?

(*Continued on page* 778.)

ALL WAVELENGTHS



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A user of Igranic Coils has written to tell us that he has built a receiver with which he can receive ALL wavelengths from 10 to 100 METRES when using IGRANIC PLUG-IN COILS. With other makes of coils he could not receive the short waves.

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or 10/-, set of four.

For wavelengths above 100 metres, use IGRANIC "XLLOS" COILS or IGRANIC TRIPLE HONEYCOMB COILS. PRICES from 2/9 each.

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2-volt 0·2 *amps*		*2-volt* 0·2 *amps*

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RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 776.)

I am thinking of using a 25/- L.F. transformer and I am uncertain whether to follow this with another transformer-coupled stage, or whether to use the last stage resistance-coupled. I understand that very great purity is obtainable in this way, and I shall be glad if you can tell me whether the volume would be such that the loud speaker would be working at full strength, or whether for this purpose I should need to use two transformers?

As your present receiver is already giving excellent results, you should be able to work a loud speaker comfortably with two additional valves. In view of the fact that your transformer is a good one, we recommend you to follow it with one stage of resistance-capacity, which would give great clarity of reproduction, and, provided you are using an ordinary good aerial, the signal strength will leave nothing to be desired.

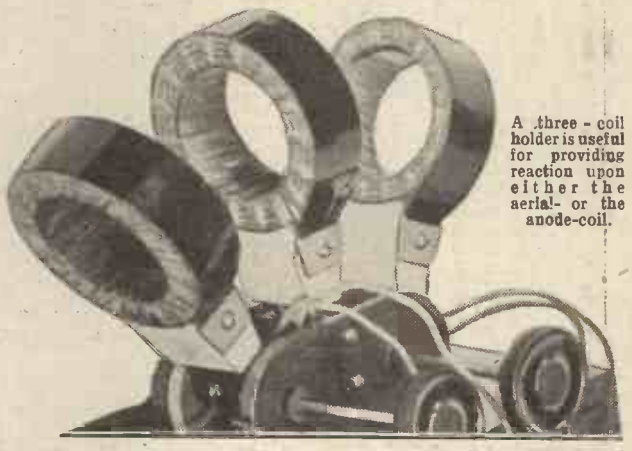
You will find that the "P.W." blue print, No. 15, shows a circuit of exactly the kind you require. The back of panel diagram in this instance is that of a flat panel type, but as the blue print shows the circuit in theoretical form, and also the connections in pictorial form, you should have no difficulty in making any slight modifications that may be necessary to fit the proposed cabinet.

AERIAL OR ANODE REACTION.

"ALTERNATIVE REACTION" (Streatley-on-Thames).—I have a straight three-valve receiver in which the first valve is employed as H.F. amplifier, working upon a tuned anode principle. The other valves are detector and L.F. amplifier respectively, and the reaction coil is connected between the primary of the L.F. transformer and the plate of the detector valve. I am told that by using a 3-coil holder (instead of the 2-coil holder at present employed) I could have the reaction coil coupled to either the aerial coil, or the anode coil, at will. (At present it is coupled only to the aerial coil in a two-way coil holder.) How should the coils be arranged in order to give this form of alternative reaction?

The method of using a three-coil holder (see accompanying photograph) is only effective where the set in question allows plenty of room for the two outer coils to open right out, at an angle of 90 degrees from the centre coil. (Both the outer coils must be capable of movement, although the centre coil is fixed upright.)

(Continued on page 780.)



A three-coil holder is useful for providing reaction upon either the aerial- or the anode-coil.

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RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

respectively were 35 and 150, now we have to use 100 and 300. I might mention the aerial and earth are all that is to be desired, as we have examined same.

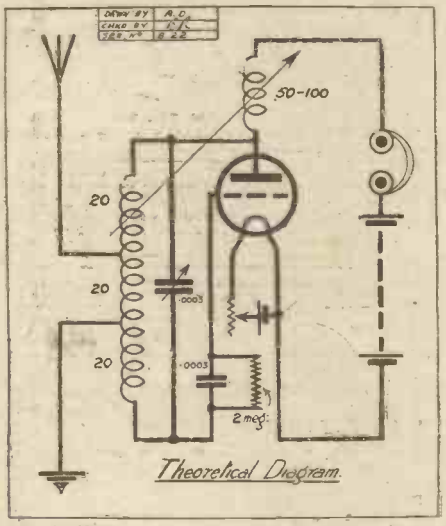
The fault complained of is a very unusual one, and appears to be due to a break in the circuit of the aerial tuning condenser. From your description we think that one of your condensers leads or joints has broken, leaving this condenser disconnected.

The wires and terminals should, therefore, be examined carefully, and when the break is remedied it should be possible to work again with the 35 and 150 coils, for the local and 5 X X stations respectively.

THE ULTRA COIL.

P.S. (Pendleton, Manchester).—Having been very successful with the "P.W." Ultra Crystal Set, I should like to try an Ultra coil in a one-valve receiver. What are the connections?

The connections for Ultra coil tuning of a 1-valve set are shown in the accompanying diagram. The



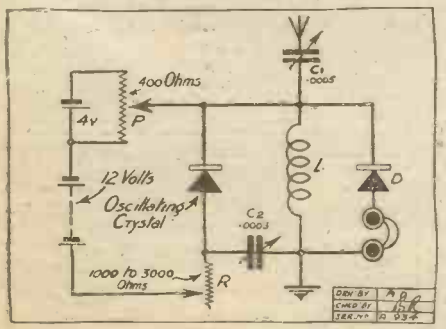
construction of a set of this kind was fully described in "P.W." No. 222 (September 4th, 1926, issue).

Note.—Back numbers of POPULAR WIRELESS are obtainable from The Amalgamated Press (1922). Ltd., Back Number Dept., Bear Alley, Farringdon Street, E.C.4. Price 4d. each, post free.

REACTION WITH A CRYSTAL SET.

"CRYSTAL CRAZY" (Slough, Bucks).—Is it really possible to oscillate and obtain reaction with a crystal set? If so, how is it done?

It is quite possible to obtain reaction and oscillation effects, using for that purpose a crystal instead of a valve. A specially chosen "Oscillating Crystal" has to be used, in an additional circuit that includes



resistances and batteries. Such an arrangement can be added to an ordinary crystal set which has the tuning condenser in series, as shown by the accompanying diagram.

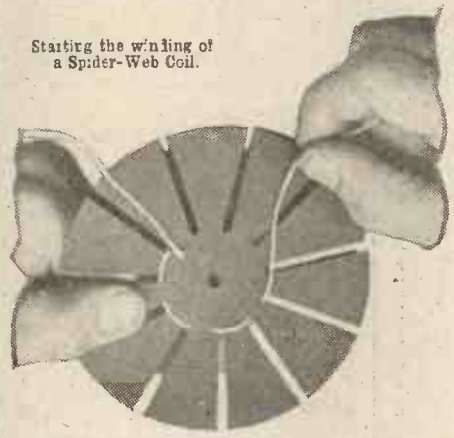
(Continued on next page.)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from previous page.)

STARTING A SPIDER-WEB COIL.

S E. J. (Billericay, Essex).—I have a spider-web former and some 26 D.C.C. wire to make a 50-turn coil for a crystal set. I know the way to wind the coil, but how is the wire held in place at the beginning of the winding?



Starting the winding of a Spider-Web Coil.

All that is necessary is to make one or two holes in the former and thread the beginning of the wire through these, to make it fast.

RESTORING DULL-EMITTER VALVES.

J. F. M. (Ireland).—How can I restore dull-emitter valves which have lost their sensitiveness?

This depends upon the type of valve, and fortunately many '06 amp., and similar types, are curable after this sort of mishap. In any case, the procedure is to burn the valve at the correct voltage for about half an hour or more *without any H.T.* on the plate. This will bring some of the special chemicals to the surface of the filament, and normal electron emission will result.

Another way is known as "flashing," but it is decidedly risky. It consists in connecting one filament leg of the valve to one side of the H.T. battery, and just brushing the other H.T. connection on the other filament leg. This should have the same effect as the above.

If the "brushing" is not done quickly, and the filament is connected too long to the H.T., it will burn out. One method of ensuring that too much current does not pass when "flashing" a valve in this way is to do the flashing from a fixed condenser.

All that is necessary is to connect a very large fixed condenser (say, 1 mfd. or more) across a high-tension battery of 100 volts or so. Disconnect the H.T. battery, and then connect the filament legs across the fixed condenser.

This latter will, of course, discharge itself via the filament, and as the current is limited by the capacity of the condenser there is no danger of applying the current for too long a period.

CORRESPONDENCE.

Letters from readers discussing interesting and topical wireless events, or recording unusual experiences, are always welcomed; but it must be clearly understood that the publication of such does in no way indicate that we associate ourselves with the views expressed by our correspondents, and we cannot accept any responsibility for information given.—Editor.

The Simmonds Short Wave Set.

The Editor, POPULAR WIRELESS.

Dear Sir,—On September 20th I finished a short-wave set similar in design to that shown by Mr. Simonds in "P.W." No. 230 (October 30th). Results are certainly excellent, all parts are British, and all connections thoroughly soldered. So far I have heard K D K A four times (I enclose confirmation [copy of] from K D K A) and W G Y twice. Also 3 T N and 3 A L, Australia, on C.W. Morse.

On telephony I have got—British: 2 B W Z, 2 W N, 2 N M, 2 U G, 2 B M, 2 I T, 5 T Z, 5 D A, 5 W K, 5 W W, 5 D T, 5 T Z, 5 D C, 5 A Z, 5 Z G, 5 U S, 5 H J, 6 U Z, 6 I A, 6 Q O, 6 M U, 6 M O, 6 T X, 6 K K, 6 O H, 6 T R, 6 U T, 6 K S, 6 U P.

North Ireland: 6 Q O, 6 M U.
France: 1 A E, 8 A R T.
Italy: 8 A U.
U.S.A.: K D K A, 2 X A F (W G Y).
Germany: Koenigswusterhausen.
Australia: 3 T N, 3 A L (Morse).
All between 30 and 70 metres.

I am, yours,
London, E.C.3. G. M. MITCHINER.

The "Hale" Receiver.

The Editor, POPULAR WIRELESS.

Dear Sir,—I notice in your editorial of the Radio Constructor this week that you ask readers to write and give you their experiences with the "Hale" receiver described last week.

On Thursday evening of last week, as soon as I reached home, I wired up the circuit roughly and with an old Phillips D.E. Power valve and 120 v. H.T. and 1½ v. bias 2 L O was tuned in with a strength on the L.S. that can only be likened to a 3-valve set (v. 2) and with crystal quality. Members of my household begged me to make up the set in a proper cabinet and scrap my two-valve Reflex set ("P.W." Combination and L.F. amplifier), which I have had in use now for about two years. This I have done, and on Sunday morning I was able to get Hilversum for an hour on the L.S., and after it had closed down Koenigswusterhausen came in also on the L.S. even more strongly, then Radio-Paris. Several evenings this week I have had an evening's hunt and so many stations come tumbling in that I hesitate to write them down in case I should be thought guilty of prevaricating. One thing I should like to do, and that is, make the set more selective. If this can be done perhaps you will tell us in the near future.

Two of my neighbours have decided to scrap their existing sets and build the "Hale."

Many thanks for introducing such a fine circuit to "P.W." readers, and may I express a Coue-ism, that Every Day, etc. Yours faithfully,
Gwynne Road, S.W.11. J. A.

More than "Astounding!"

The Editor, POPULAR WIRELESS.

Dear Sir,—I beg to write in appreciation of your wonderful circuit in "P.W." October 30th. I refer to the "Hale" receiver. I wired this up on Sunday and added one stage of L.F. in the ordinary way, and I am absolutely astounded at the volume and purity. I am always "playing" with my set, but know very little about wireless except how to wire up from a diagram. Your circuit gives greater volume and purity than the four-valve (1–v–2) which I pulled down in order to try it, and in fact is miles better than any circuit I have ever tried.

You hesitate in your article to use the word "astounding." The circuit, in my humble opinion, is poorly described by the adjective, and I thank you for giving us the chance to try it, and I look forward to a further article on it. I am able to get many other stations, but have great difficulty in bringing them in clearly, as the least touch on the reaction sends the set into violent oscillation, but directly I loosen the reaction a shade I lose the station. My only other trouble is continuous crackling between each item, and I cannot trace this to H.T., transformers, loose contacts, or anything like that. Is this a peculiarity of the circuit?

For the sake of curiosity I am at some time going to try a further stage of transformer-coupled L.F.; and by what the present two-valves are doing, while I write, I should imagine the addition of a further L.F. will about blow the horn off the loud speaker. I am using 2 Cossor valves and a Red Diamond permanent crystal (2s.) which I haven't touched since Sunday, and two quite cheap transformers. Well, I must close, or I'll bore you stiff; but, by Jove, you've found a wonderful circuit. Thank you very much.

Yours sincerely,
D. MACKENZIE.
34, Church Street, Croydon, Surrey.

BRINGING THE SUPER-HET UP-TO-DATE.

From a Correspondent.

ALTHOUGH it is a comparatively short time ago since the super-het became popular with British amateurs, the earlier types are already becoming out-of-date.

Nowadays it is generally recognised that a series of untuned intermediate transformers must necessarily lead to inefficiency. It is almost impossible for the maker to match a set of transformers and filter so exactly that no discrepancy creeps in. Consequently owners of super-hets with untuned intermediate stages must carry out a few alterations.

Tuned Intermediates.

There is no need to scrap the untuned transformers and fit the tuned type. This would be most expensive, and a lengthy business to change all the multitudinous connections of a super-heterodyne receiver. Instead the reader should buy some good vernier condensers to fit to his transformers.

These condensers should be as small as possible in order to save space. Take care that they come from manufacturers of good repute and are of the low-loss pattern. They should be connected across the primaries of the transformers.

Increased Purity

When everything has been finished switch on the valves and turn the vernier condensers to zero. Tune in some distant station which is noted for its clear and pure transmissions, such as San Sebastian. Then adjust the first transformer vernier until signals reach their maximum strength. Repeat this operation in turn to each of the other verniers. Return to the first vernier and make the final adjustment. After this there will be no further need to touch the transformer condensers again. The reader will be surprised at the great increase in clarity and tone.

Long Wave Reception.

The older super-hets were only arranged to deal with the broadcasting wave-lengths. To bring the set up to date and to receive stations on the higher wave-lengths, like Daventry and Hilversum, a different type of oscillator coupler must be installed; the best way to do this is to use the plug-in coupler so that the high or the low wave-band may be received at will by the simple operation of changing the coupler. The reader is advised to obtain one of these couplers, which are marketed by many wireless manufacturers.

In conclusion, the reader should take advantage of the new valves of superior efficiency now on the market and to bring his super-heterodyne up to scratch in this respect. Particularly, he is recommended to use a really good power valve in the L.F. stage. This has a great effect on the purity of reception, and is well worth the extra few shillings expended.

"DRY JOINTS."

Their Cause and Prevention.

By G. V. C.

THE art of soldering must necessarily be one of the accomplishments of every amateur who tackles the construction of a set. He may wire the major portion of his set by means of nuts and screws (and wire) and make a good job of it, but there is doubtless some component that is not so provided, and therefore the soldering iron, solder, and flux are essential acquisitions.

It is quite probable that a former acquaintance with these tools has made him adept at making seemingly good soldered joints, which, even from a close inspection, would make one pronounce "O. K."

However that may be, there is no getting away from the fact that the wiring of many sets after a period of, say, six months, literally "falls to pieces."

From a careful examination of the wiring so deteriorated, it is evident that the breaks are not due to someone pulling on the wires or that the set has been dropped, but rather to the solder crumbling.

Too Much Bismuth.

It is a fact, however startling, that much of the solder sold to-day by wireless dealers for wireless work has far too high a percentage of bismuth mixed with it.

Unfortunately, most amateurs are not sufficiently expert to judge good solder from bad, and the fact that the wireless dealer says it's solder, and they see it has the appearance of that metal, is sufficient for most of them without inquiring further.

A careful amateur or one who "knows" will examine the stick of metal (it is nearly always sold in the form of "blowpipe" solder), and if it has a fairly bright surface, appears to have been cleanly "cast," and offers a fair resistance to bending, will judge it good.

On the other hand, if it lacks a certain amount of lustre, has "cast" lumpy with a rough surface, and is fairly soft to bend, then he will refuse it, for he knows it will cause bad joints and will amalgamate unsatisfactorily with the wires.

Now, the reader may ask "How can I protect myself against the possibility of buying this solder?"

Tinman's Solder.

This can be done in two ways. The first and most obvious is to purchase the solder from a reliable firm, or from an ironmonger who supplies the local builders with solder for zinc roofing, etc.

The second and least known way is to obtain tinman's solder, which is cast in sticks about the thickness of one's forefinger. It is very unusual to get this latter type in a poor quality, so that one can have the satisfaction of knowing that this solder is as good as the best sold as "blow-pipe."

Its only disadvantage is that it takes longer to melt than its thinner brethren, but this is more than offset by the fact that it will give a joint that will at least stand the hand of time.

(*Continued on next page*).

"DRY JOINTS."

(Continued from previous page.)

Another cause of dry joints is a certain class of soldering "tag," and for that matter of terminal too.

Both are often nickelled.

The former are sold as "tinned soldering lugs," and the latter—well, as "attractive" terminals.

Both will take solder well—until you happen to pull on the wire, then the plating comes away with wire attached, and you see a greyish powder left on the surface.

It is considered these facts speak for themselves, and as a precaution the reader is either advised to see that he leaves well alone and buys reliable terminals and tags, or else scrapes every vestige of nickel from those so plated, before tinning them and attaching the wires.

Flux is another thing that books could be written on, and while it is not possible to criticise any particular make, it is assumed the reader is not so ignorant as to use "killed spirits of salts."

Soldering Fluxes.

The forms soldering fluxes take are many and varied, and while many amateurs stick to one popular brand, "Fluxite," there are a few who use nothing else but "Baker's Fluid" or else pure resin.

There is something to be said for all brands, but there is little doubt that "Fluxite," having been in the running for a great number of years, will continue doing so, as it has proved its worth.

Resin is the only flux recommended where two fine wires have to be joined, especially as far as fine instrument work is concerned, because, owing to the small corrosive action of even the best patent brands of flux, the wires (some few thousandths of an inch in diameter) may get eaten through.

THE INEVITABLE EBONITE.

By R. H. BLACKMORE.

EBONITE is, or, rather, should be, composed only of sulphur and rubber.

The raw rubber, which will be familiar to most as the substance used for soling crêpe-soled tennis shoes, is passed between two smooth steel rollers which are revolving in a horizontal position.

Here it is so crushed and heated that it takes on the appearance of a yellow-tinted semi-transparent jelly; this is known as mastication. When this process has been carried far enough, the worker in charge of the machine adds the requisite amount of sulphur to the rubber, which has now layered itself around one of the rollers.

The sulphur is, so to speak, ground into the rubber, and the mixing process is continued till all the sulphur is absorbed and a homogeneous mixture produced.

The plastic mass is skilfully cut from the revolving rollers and passed to the calendering department. It may be noted here that the best class of ebonite has a sulphur content of between 30 and 35 per cent., the rest being pure rubber.

(Continued on page 788.)

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of TESTED CIRCUITS

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8. 1-VALVE REFLEX AND CRYSTAL DETECTOR (Employing H.F. Transformer, without Reaction).
9. H.F. AND DETECTOR (Tuned Anode Coupling, with Reaction on Anode).
10. H.F. AND DETECTOR. (Transformer Coupled, with Reaction).
11. DETECTOR AND L.F. (With Switch to Cut Out L.F. Valve).
12. DETECTOR AND L.F. UNIDYNE (With Switch to Cut Out L.F. Valve).
13. 2-VALVE REFLEX (Employing Valve Detector).
14. 2-VALVE L.F. AMPLIFIER (Transformer Coupled with Switch to Cut Out Last Valve).
15. 2-VALVE L.F. AMPLIFIER (Transformer-Resistance Coupled with Switch for Cutting Out Last Valve).
16. H.F. (Tuned Anode), CRYSTAL DETECTOR AND L.F. (with Switch for Last Valve).
17. CRYSTAL DETECTOR WITH TWO L.F. AMPLIFIERS (with Switching)
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19. H.F. DETECTOR AND L.F. (with Switch to Cut Out the Last Valve).
20. DETECTOR AND 2 L.F. AMPLIFIERS (with Switches for 1, 2, or 3 Valves).

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THE INEVITABLE EBONITE.

(Continued from page 786.)

In the calendering room the ebonite mixing is passed between huge steel rollers in order to obtain sheets of a given thickness. The sheets are then cut to size and conveyed to the vulcanising department. It is at this point of the process that the advent of radio has changed works practice in the manufacture of sheet ebonite. In pre-broadcasting days the next step was to roll tinfoil upon both sides of the unvulcanised sheet. The tin-protected sheets were layered one above the other inside a small tank of water, and the whole box of tricks placed in a large strong iron pan fitted with a screw-down lid. Steam was admitted to the pan at a pressure of about forty pounds to the square inch, and the whole allowed to stand at this pressure for a given time. Sometimes twenty-four hours was necessary for complete vulcanisation.

Leaky Surface.

When the "cure," as vulcanisation is technically termed, was complete, steam was turned off and the pan opened. The tinfoil was stripped from the surface of the sheets, which now resembled the ebonite of commerce. The beautiful polished surface produced by tinfoil proved to be a snare and a delusion, for it was found that the H.F. currents of wireless leaked left and right over the fairly conductive layer of tin sulphide with which the surface of the ebonite was coated.

This was the main reason that the unfortunate amateur was once so urgently advised to scrape the surface of his panel with a safety razor blade or some similar lethal weapon. The advent of matt-finished ebonite led to a cessation of this temper-destroying recreation.

The pleasing appearance of the old type of polished material still lingered in the minds of home constructors, and it was not long before ebonite manufacturers began to produce an ebonite with a polish quite equal to the old, but having a truly non-conductive surface.

One of the principal methods of achieving this object consists of taking the calendered sheets of "uncured" ebonite and placing them inside steel moulds, which are then placed within the shelves of a hydraulic press, the shelves of which can be steam-heated.

Matt Ebonite.

Pressure is then applied, probably over a ton to the square inch, and steam is turned on. The press is left till the ebonite contents are semi-vulcanised—that is, till they are very similar to the rubber of a motor tyre in appearance and feel. The moulds and ebonite are then removed and the ebonite is placed inside a vulcanising pan and there given a long enough cure to finally convert it into hard ebonite.

In order to obtain a non-conductive polish, the matt sheets are sent to the polishers, who, either by hand or machine, scour the sheets with fine emery. The conclusion of the process is the obtaining of the glassy finish by polishing the sheets on rapidly revolving cloth discs of different fineness of cloths.

The sheets are then sawn up into the appropriate panel sizes and passed out into the world of radio, there to fulfil their destiny.

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Operates at 180° below the pyrometer scale so that its life is vastly increased? YES

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