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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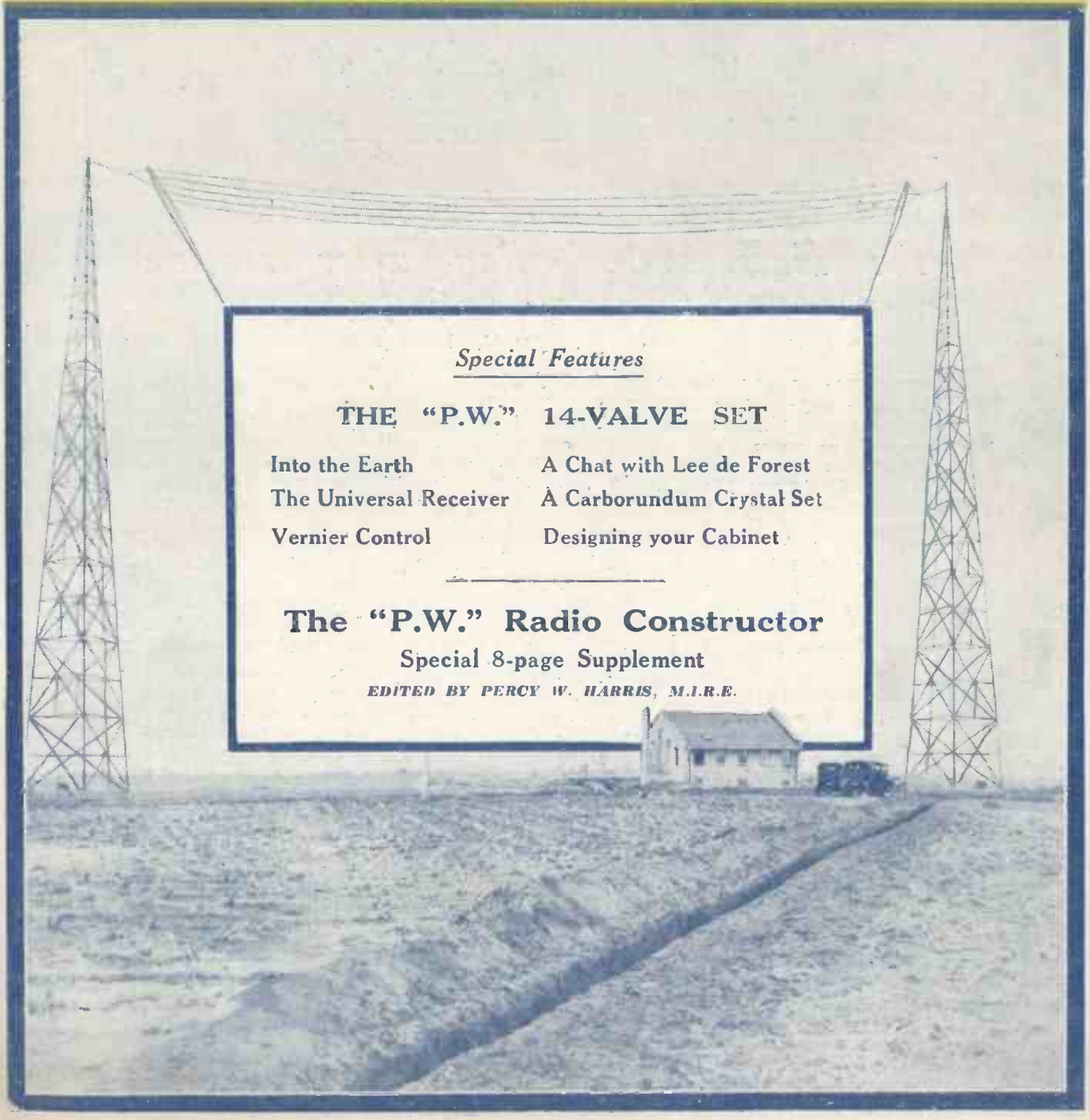


Special Features

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

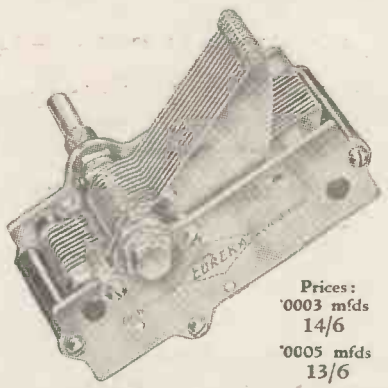
Special 8-page Supplement

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

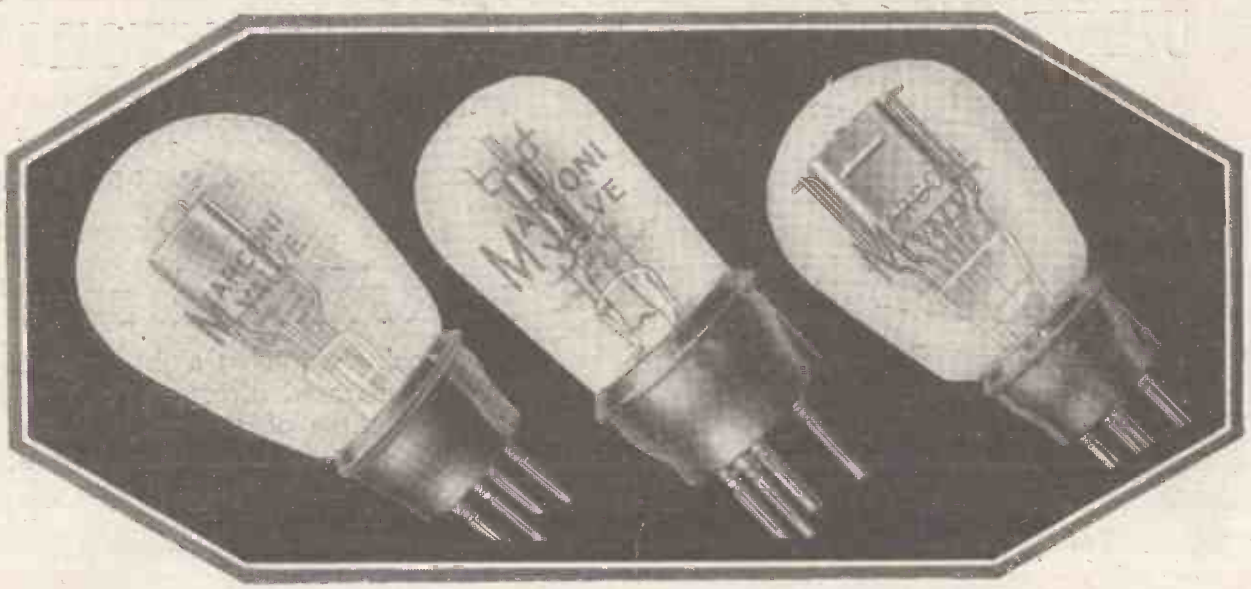
With its stout metal and plates—earthed rotor following latest low-loss practice—dual contacts, ball-bearing and self-centreing shaft, the new Eureka Ortho-cyclic is the most handsome Condenser on the market. It is a worthy "stable companion" of the famous Eureka Transformer and covered by the same generous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

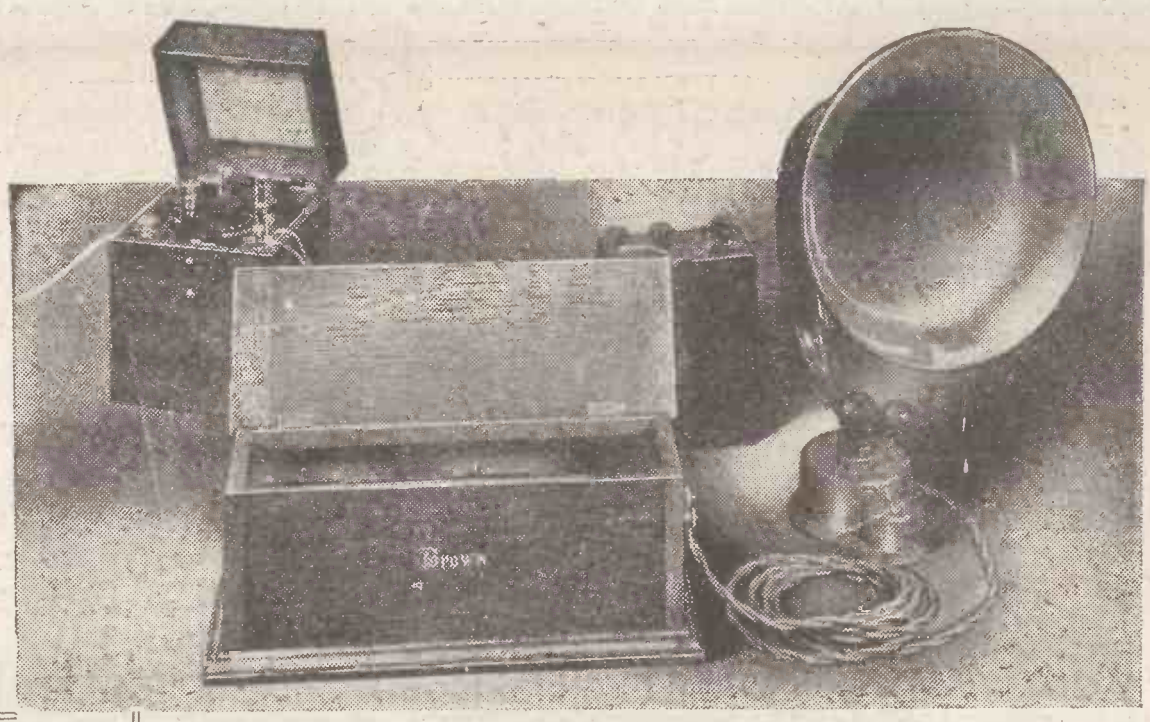
Recommended for L.F. amplification, when a steady negative grid bias of 6-7 volts is required, when using an anode voltage of 100. If a larger output is desired, a D.E.5 or D.E.5A may be used in the last stage of the amplifier. The D.E.8 L.F. may also be used as a general purpose valve. Fil. volts 5·6-6. 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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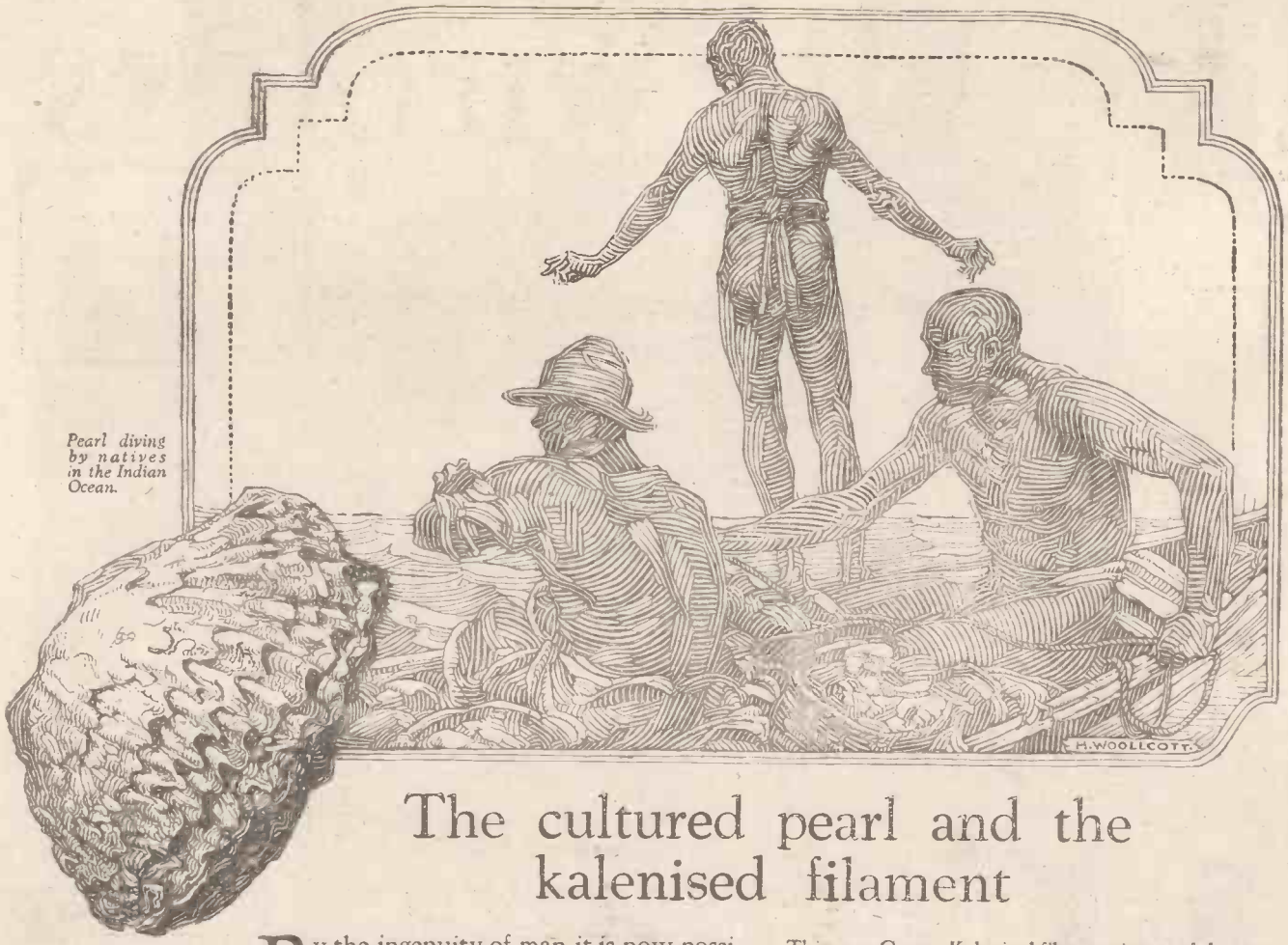


Pearl diving by natives in the Indian Ocean.

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

Scientific Adviser: Sir OLIVER LODGE, F.R.S.
Technical Editor: G. V. DOWDING, Grad.I.E.E.
Assistant Technical Editors: K. D. ROGERS, P. R. BIRD.

Editor: NORMAN EDWARDS, M.Inst.R.E., F.R.S.A., F.R.G.S.

Consultants: Dr. J. H. T. ROBERTS, F.Inst.P. J. F. CORRIGAN, M.Sc., A.I.C. C. E. FIELD, B.Sc. E. J. SIMMONDS, M.I.R.E., F.R.S.A.

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.

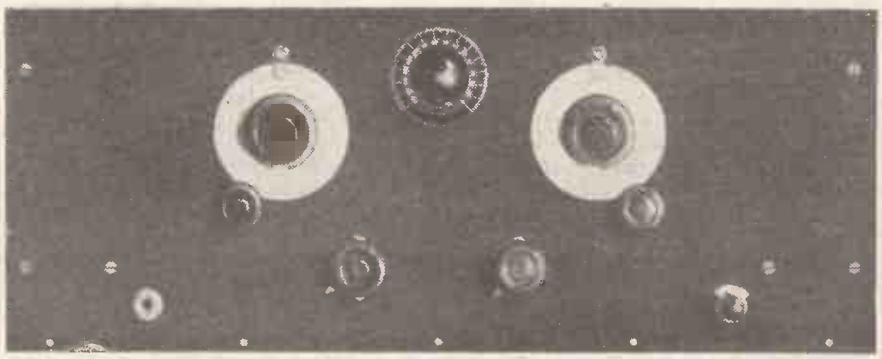
There is an exception to every rule, as is amply proved by the fact that the "Universal"—a receiver employing but a single stage of H.F. amplification—has met with the general approval of wireless "fans" in America. The "Universal" is a four-valve receiver with several novel features incorporated, and, 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.

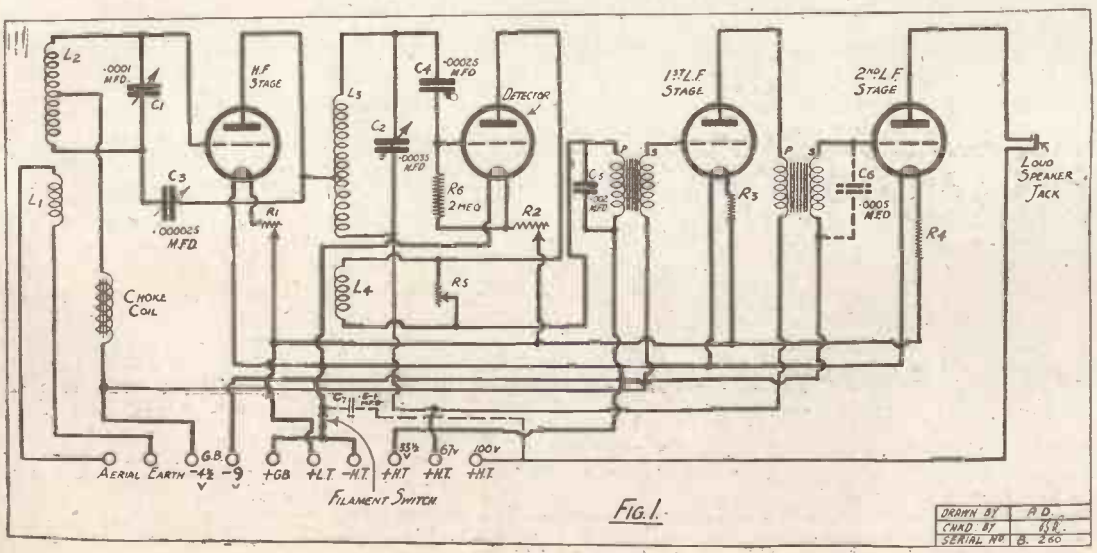


FIG. 1.

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.

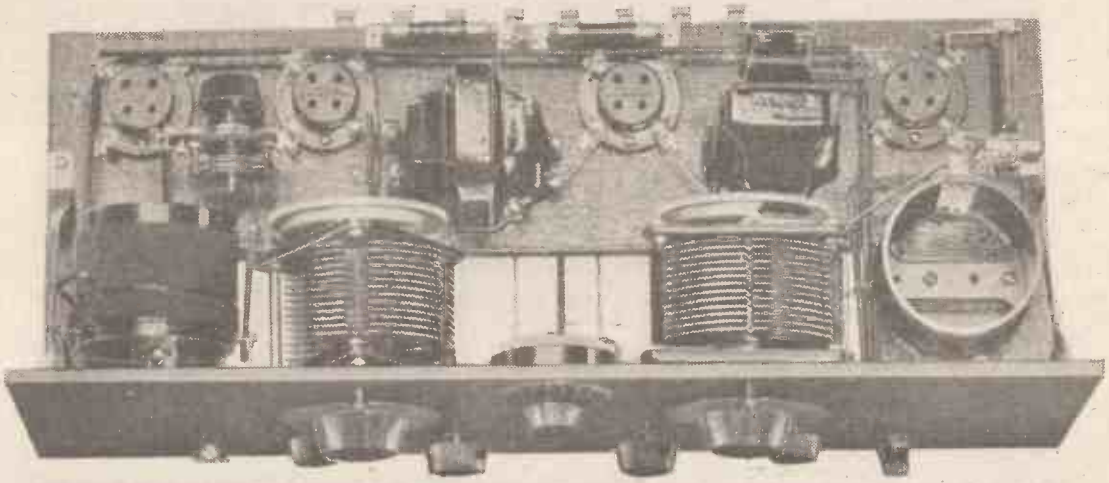
Both sets of coils are wound on cardboard or ebonite tubes of 2¾ in. diameter. In the first unit the secondary has 59 turns of No. 24 D.S.C. wire (this is the winding across which the variable condenser is connected). A centre tap in this coil connects to a choke coil and the other end of this latter 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.

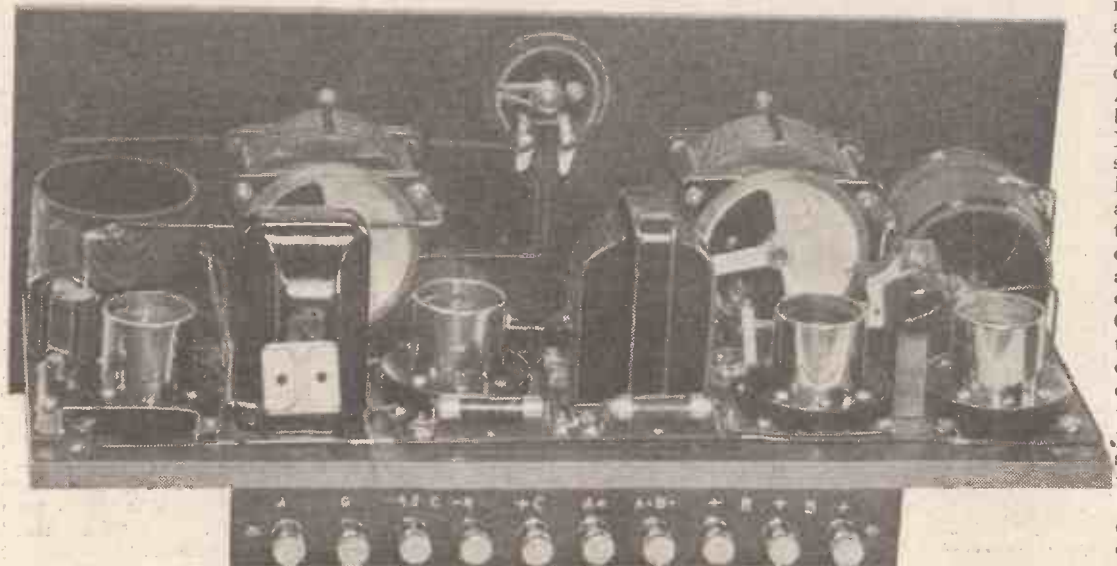
The Wiring Connections.

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.

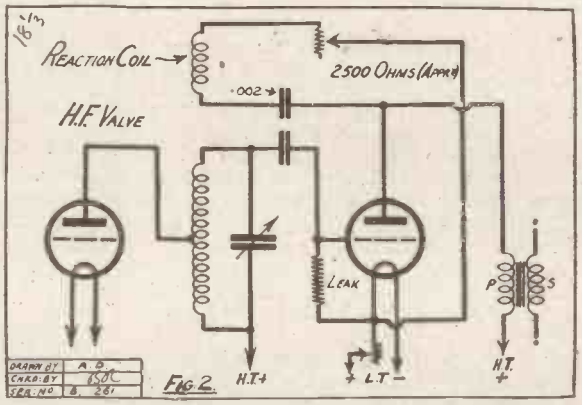


FIG. 2.

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.

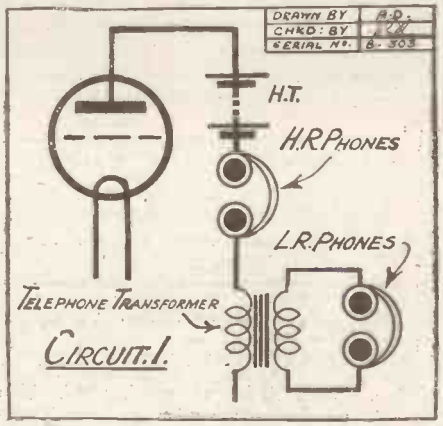
When the receiver is completed and apparently operating correctly, we set about the neutralisation process. Tune-in a station on about 300 metres whose signals are not too loud, with the detector oscillating. The condenser C2 should be tuned until the whistle is quite loud. Now the condenser C1 should 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.

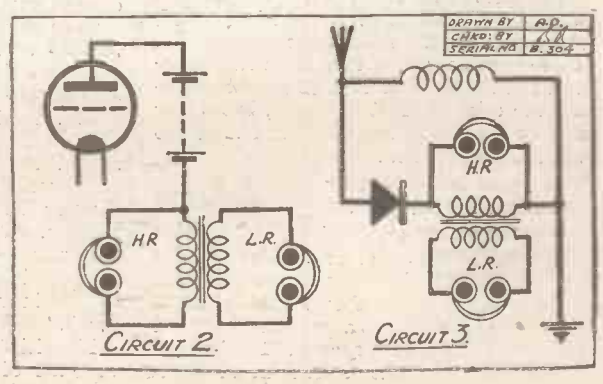
Circuit 1 is especially suitable for use in a valve set employing high impedance valves, whilst the alternative Circuit 2 is more especially of use for dealing with signals which are weak in intensity.

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.

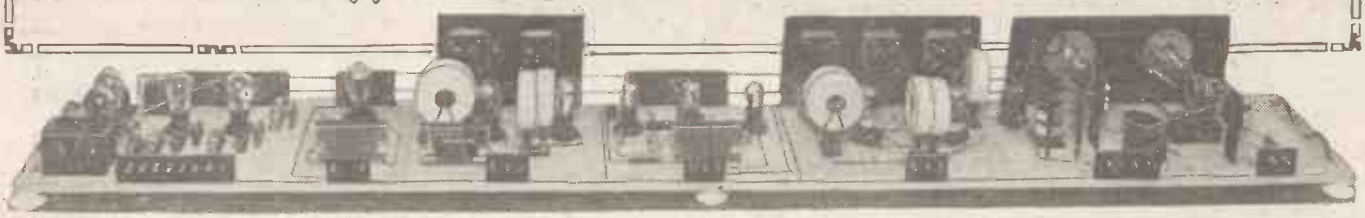
The second reason is uncertainty about the attitude of the new Board. The third reason is the consciousness that when the new system of distribution is introduced, the jobs of about two-thirds of the present staff will automatically vanish.

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.

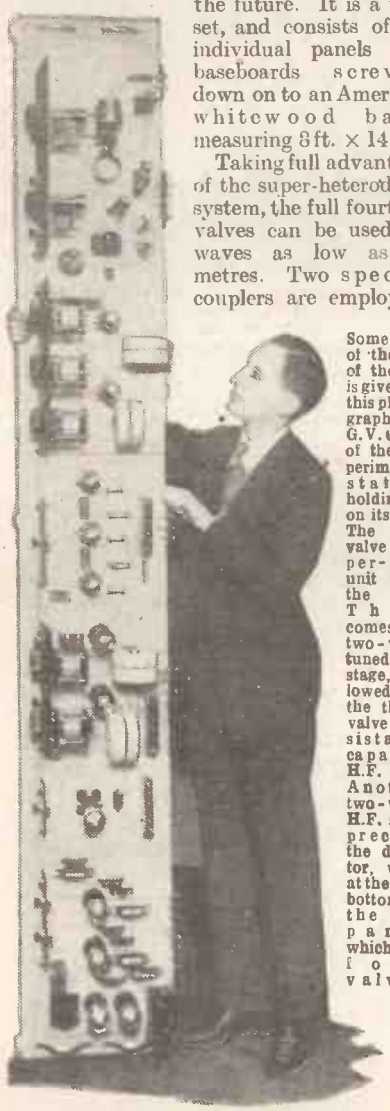
Further particulars are now available of the probable constitution of a Labour Board for Broadcasting in the event of a Labour Government succeeding to office before the end of the tenure of the first Board of the British Broadcasting Corporation. Mr. George Lansbury is to succeed Lord Clarendon, Mr. 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.

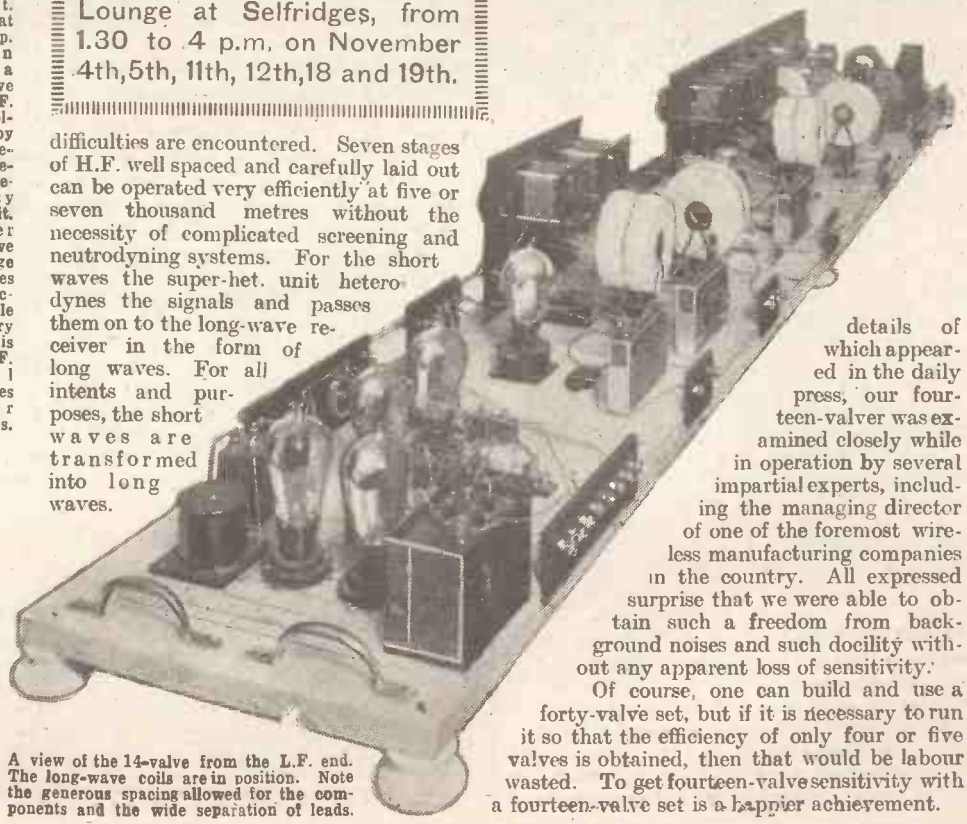
one for short waves and the other for the "broadcast band" (300 to 600 metres). Thus the whole set operates efficiently on the low waves with the super-het. unit in circuit, and, with this removed, the receiver is a long-wave twelve-valver, capable of handling wave-lengths between the hundreds and the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

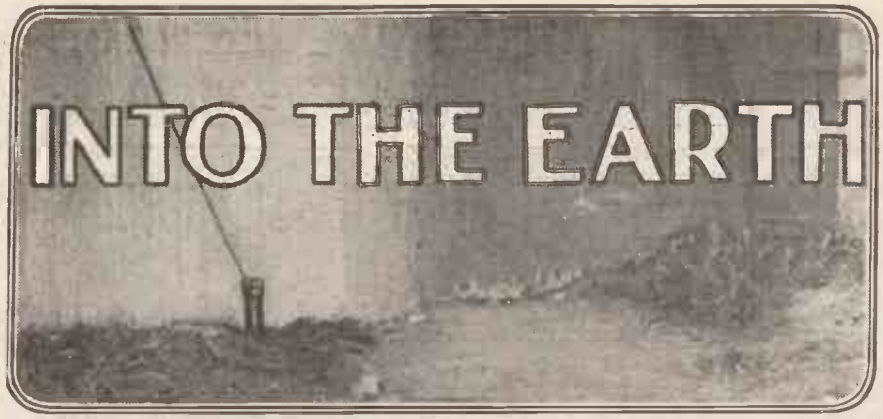
Easy to Handle.

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.

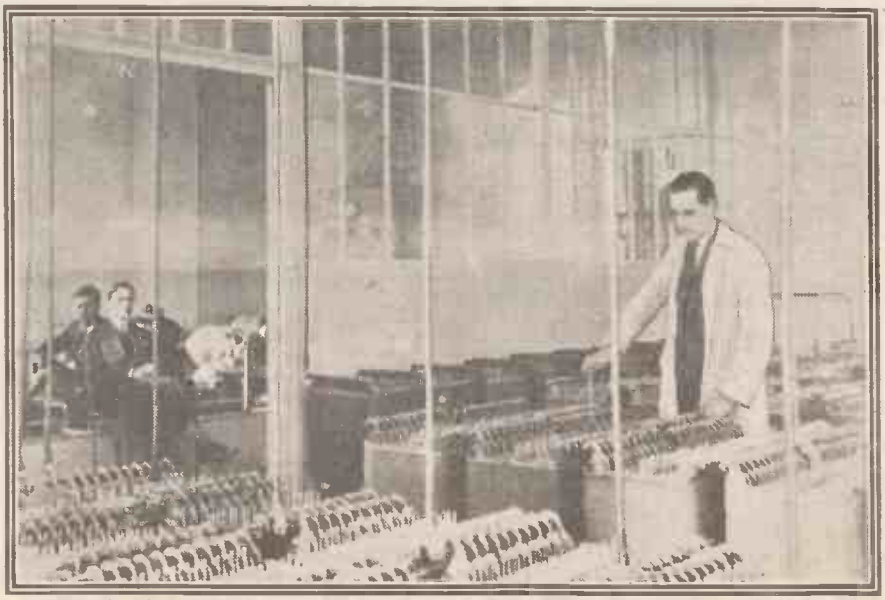
No doubt most of my readers realise that the earth merely acts as one plate of the condenser formed between the elevated aerial wires and the earth; consequently, without going into any theories of voltage distribution, it should be appreciated that if we have a long earth lead there will be a comparatively 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.

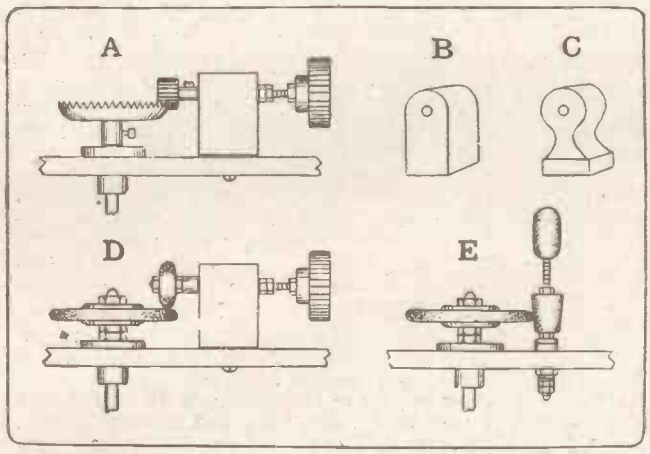


Fig. 1. Some simple methods of obtaining Vernier control.

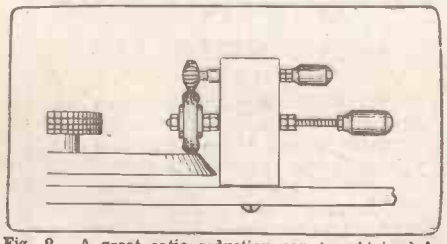


Fig. 2. A great ratio reduction can be obtained by the above.

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

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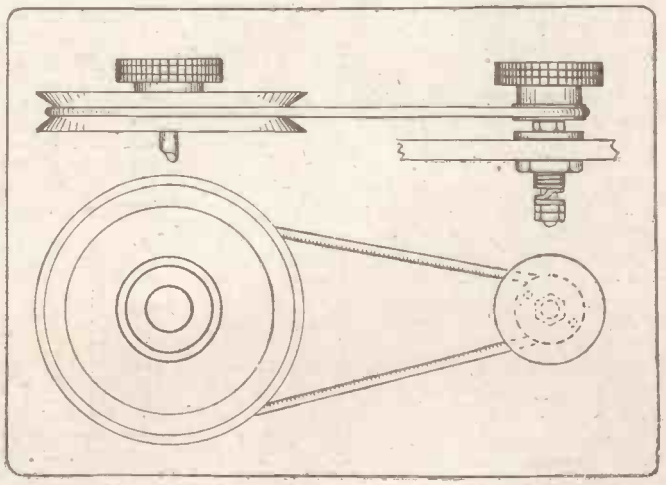


Fig. 3. Another form of control that is very satisfactory.

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.

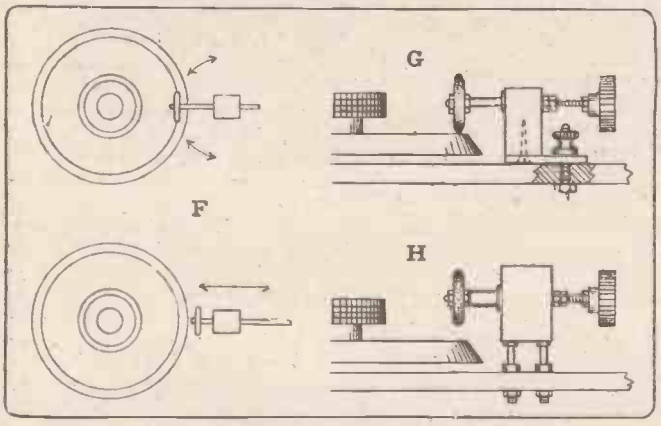


Fig. 4. A system of removable vernier controls.

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.

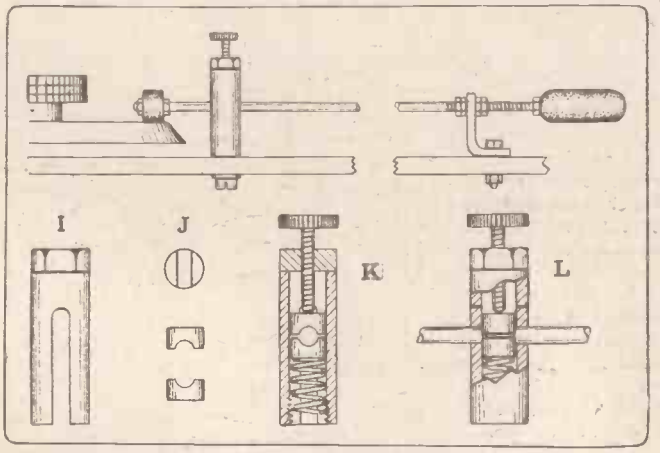


Fig. 5. A simple arrangement that is an improvement on Fig. 4.

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.**

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 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.

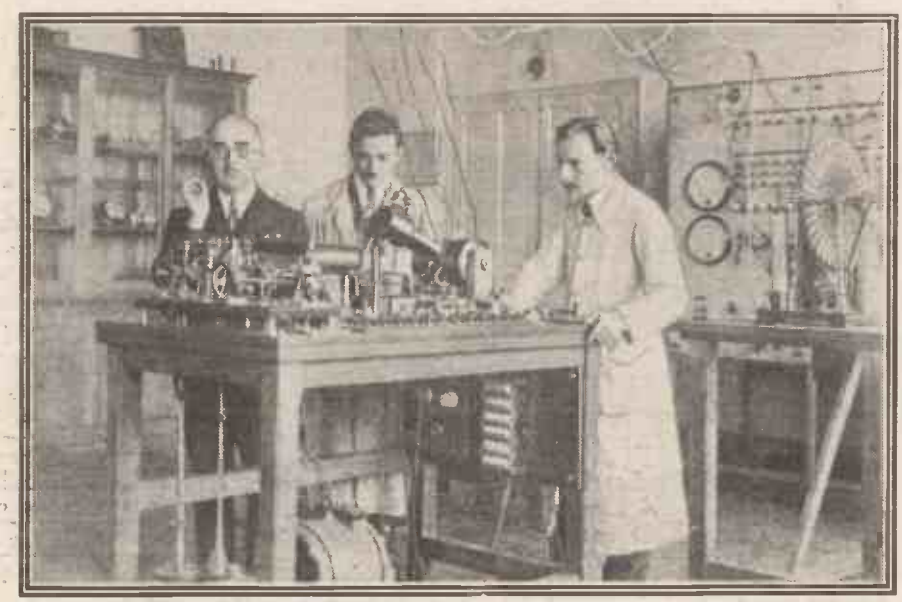
Petroleum Jelly.

"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

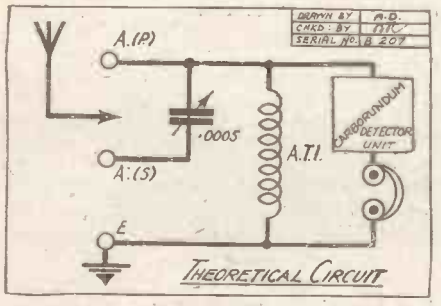
(*Continued on page 584.*)

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.

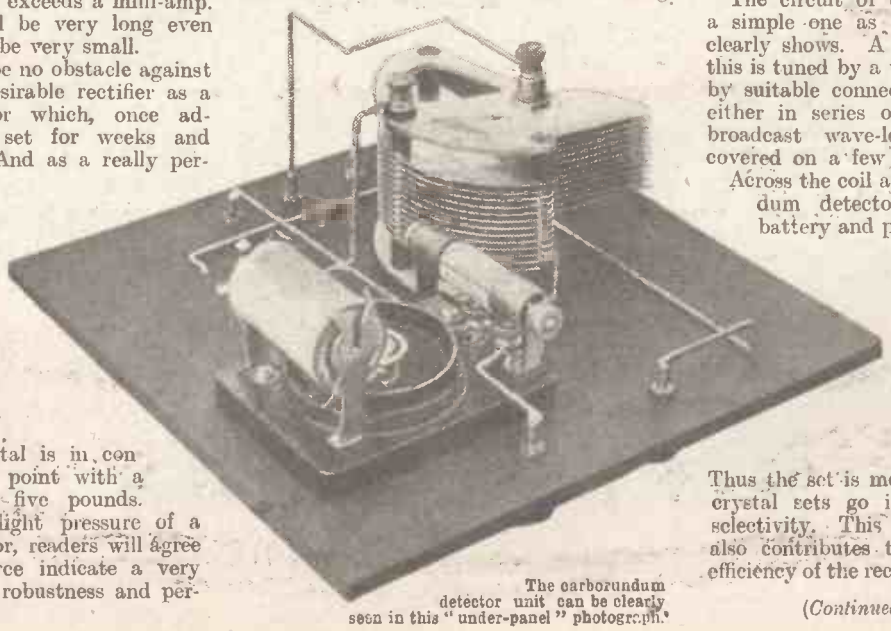
The Set Designed and Described by
G. V. DOWDING, Grad.I.E.E.
(Technical Editor).
Constructional Work by
G. V. COLLE
(Technical Staff).

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.

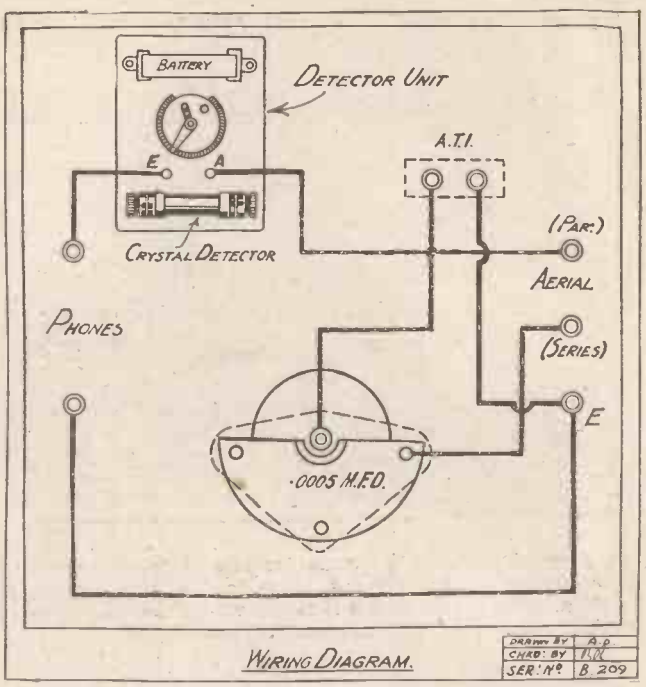
A list of the necessary parts and components is given, and from this it will be seen that no great initial outlay confronts the intending constructor. The little dry battery will last for months without replacement.

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.

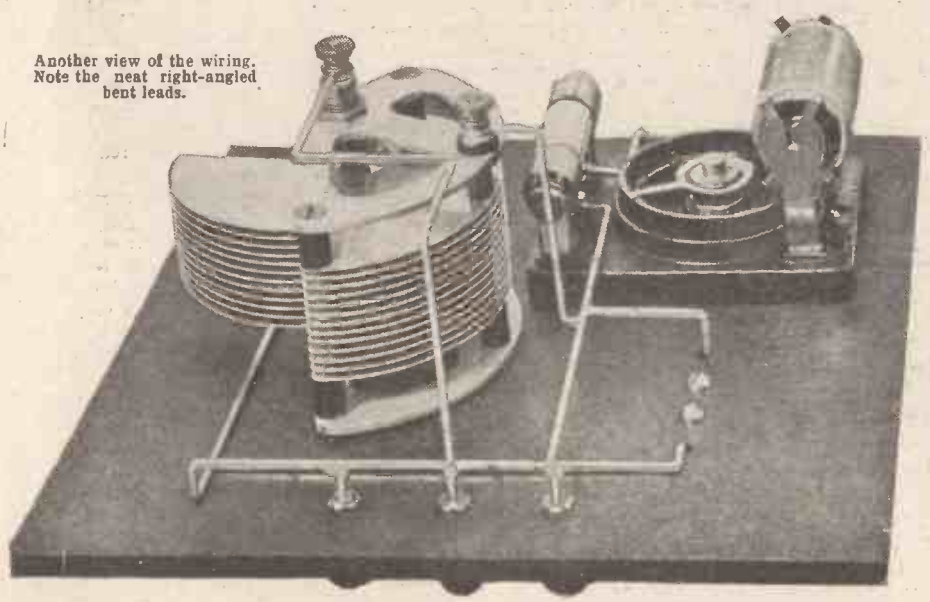
Square section tinned copper wire should be used, and each lead should be carefully cut and bent into its final exact shape before even one end is soldered. It takes a trifle longer to get all the wiring paralleled and with right-angle bends, but the extra trouble is well worth while. Leads should also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

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MODEL H.T.4 ... 30 VOLTS ... 30/-
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Have you considered the advantages of C.A.V. H.T. Accumulators as compared with dry batteries for your H.T. Supply?

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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.

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BIRMINGHAM.—Great Hampton Street.
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GLASGOW.—227-229, St. George's Road.
LEEDS.—117, Park Lane.
LONDON.—224, Shaftesbury Avenue, W.C.2.
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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.

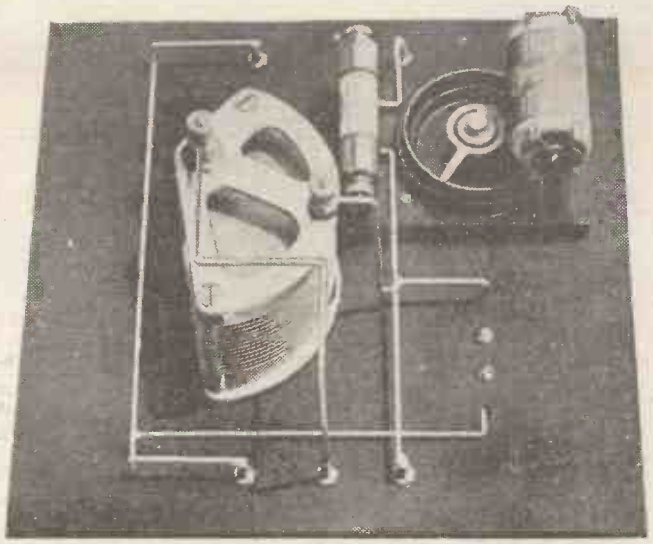
Earth terminal to plug of coil holder and to bottom 'phone terminal.

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.

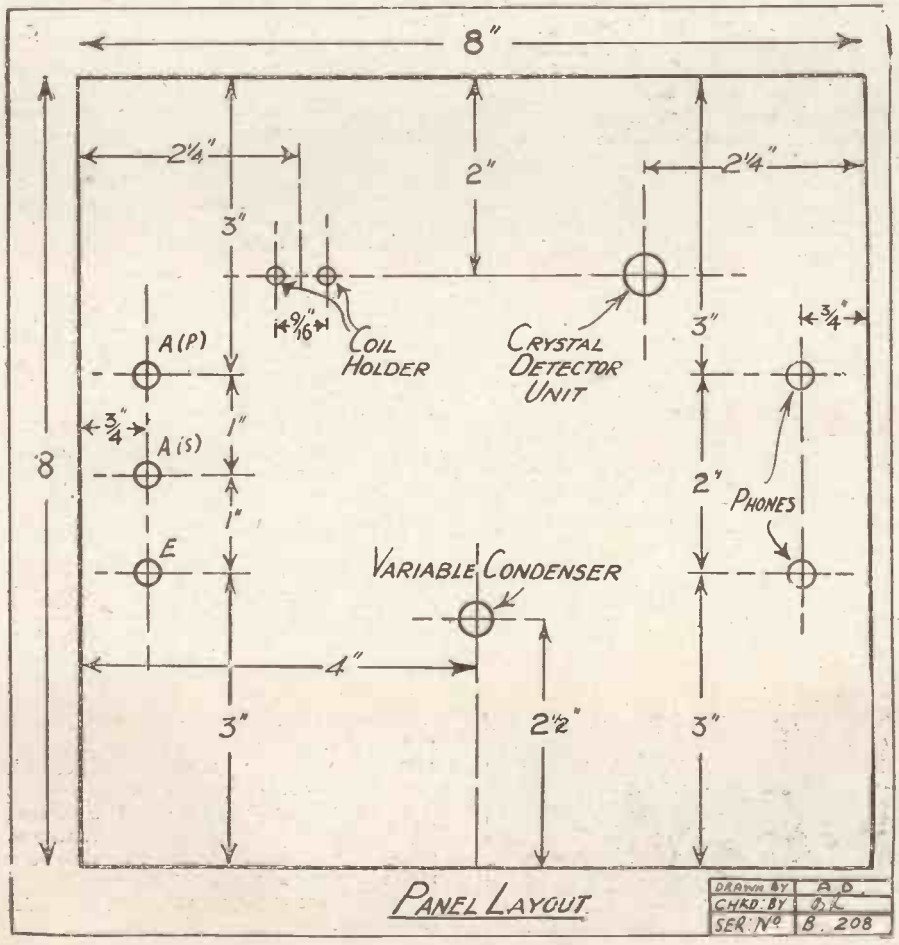
Adjusting the carborundum detector calls for just a little care if best results are to be obtained. First of all, the little battery must be inserted the right way round in its holder. Then the potentiometer knob must be slowly rotated first one way and then the other until the loudest signals result. 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.

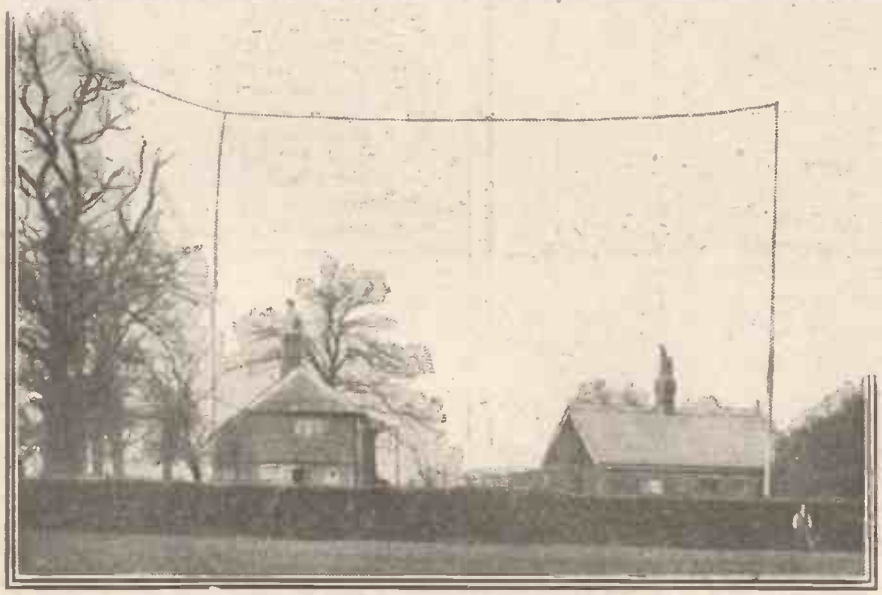
It is, however, about time they forgot all about the publicity value of broadcasting. Undoubtedly there is a great publicity value in connection with broadcasting, but it is hardly policy these days to keep on dragging it up as an excuse for not paying certain artists adequate fees for their services.

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.

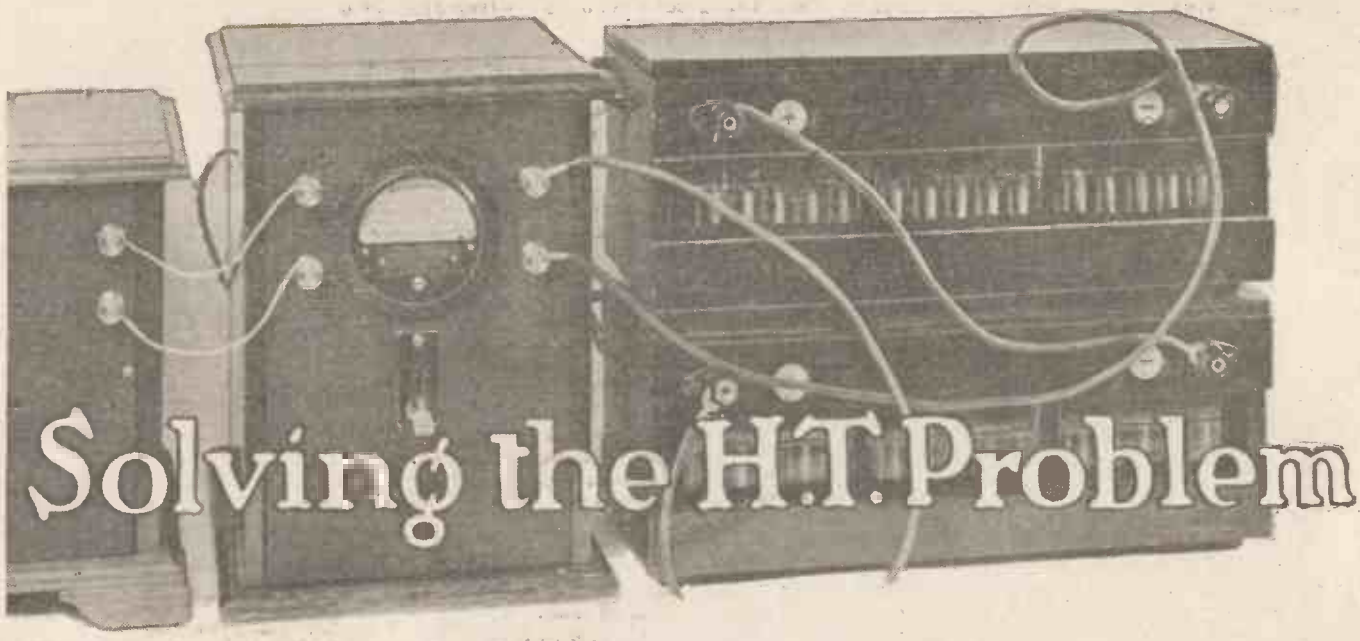
When Mr. Hale, the inventor of the circuit, visited my laboratory the other day and tried the single valve set described last week, we left the loud speaker operating on the lunch hour programme from 2 L O, and could still distinctly hear the music after we had left the room, gone downstairs and passed 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:

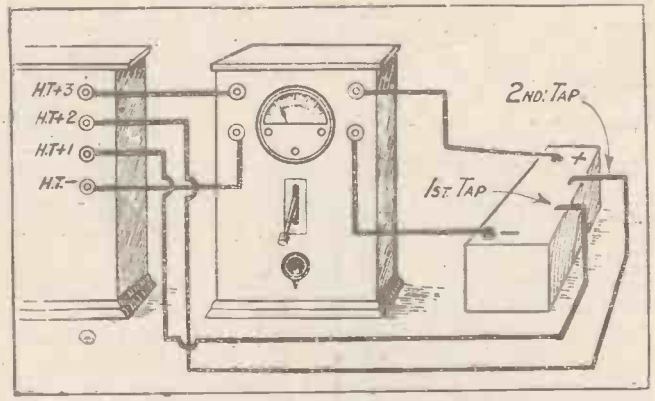


Fig. 1. The H.T. accumulator charging unit described stands permanently by your set. Charging is effected by throwing over a switch.

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.

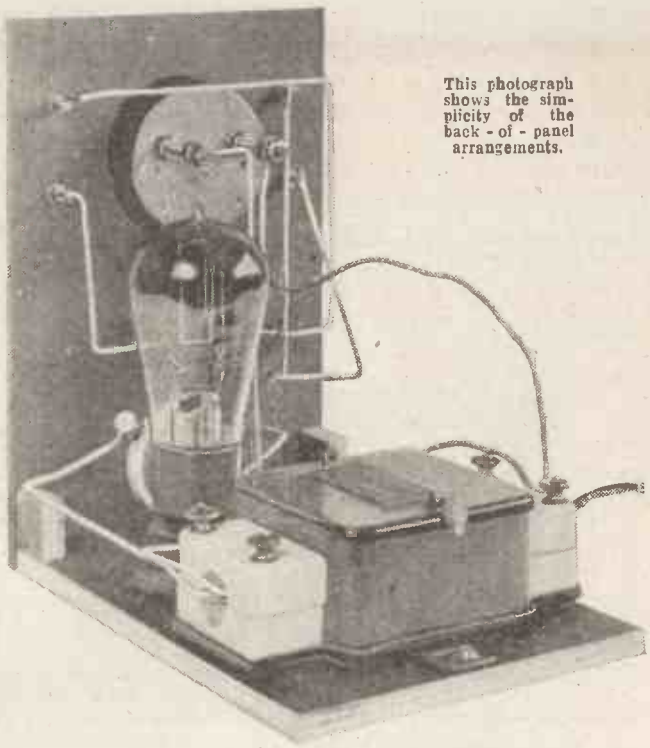
Change-over Arrangements.

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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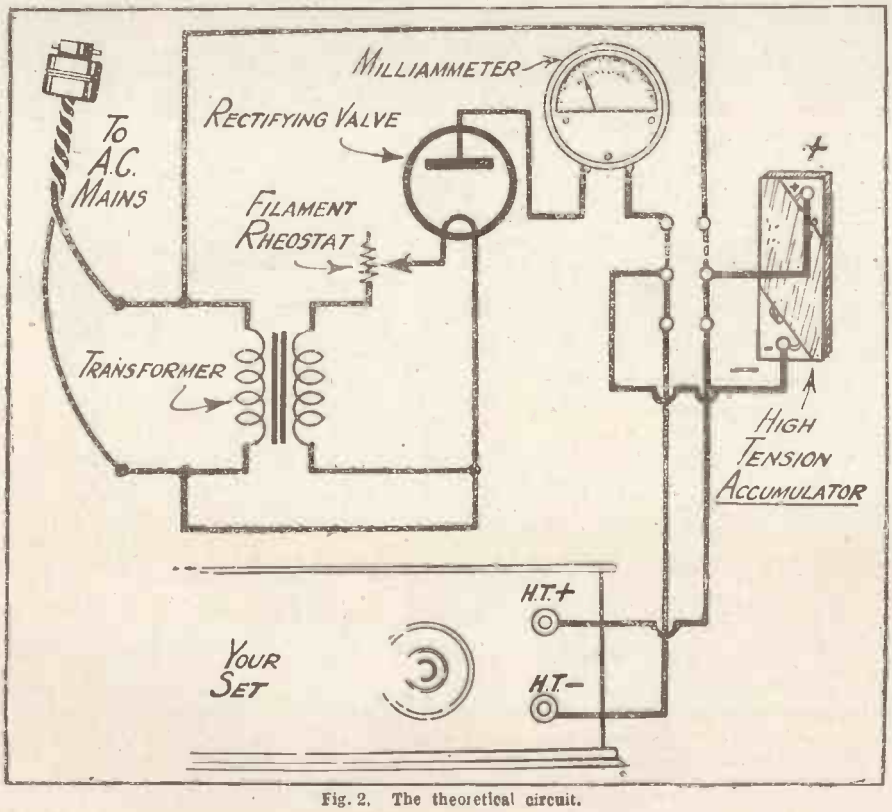


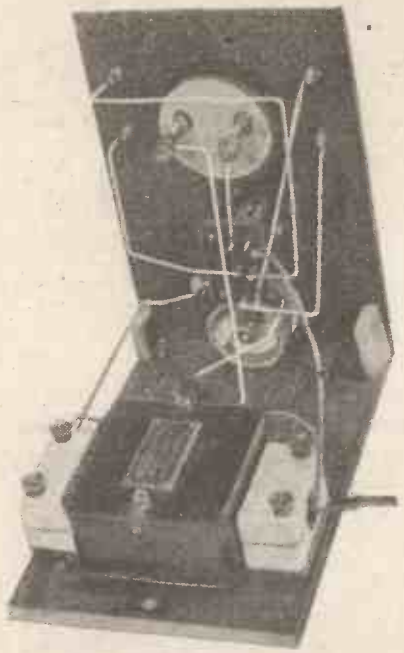
Fig. 2. The theoretical circuit.

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.

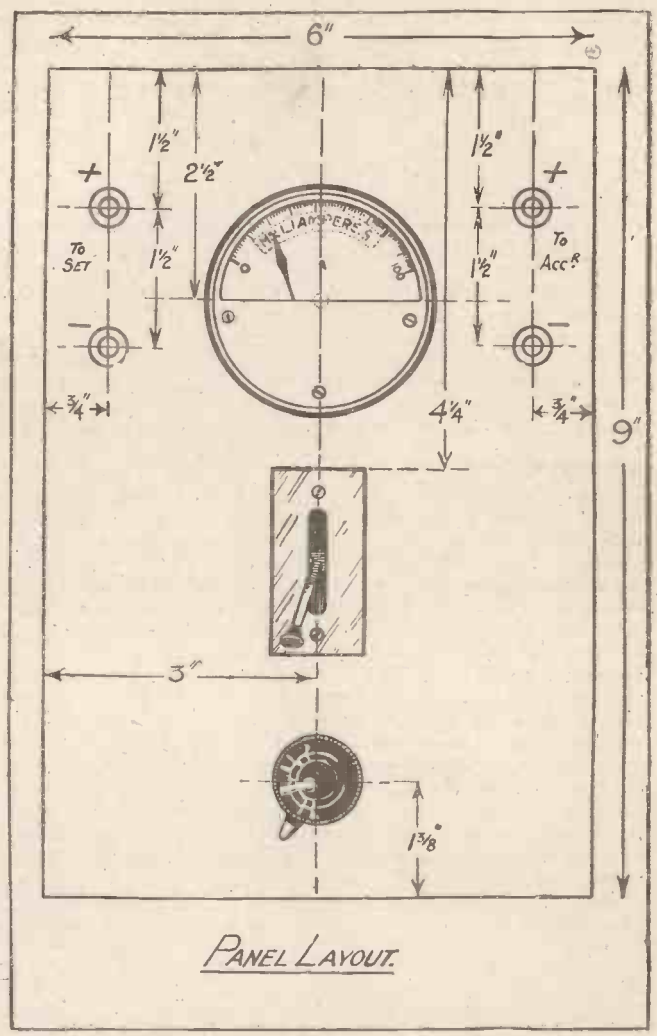
If you should happen to use the particular type of bell-ringing transformer that I have adopted, you will find three terminals on the low voltage side. These are designed to give a choice of voltages. Use those I have shown.

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.

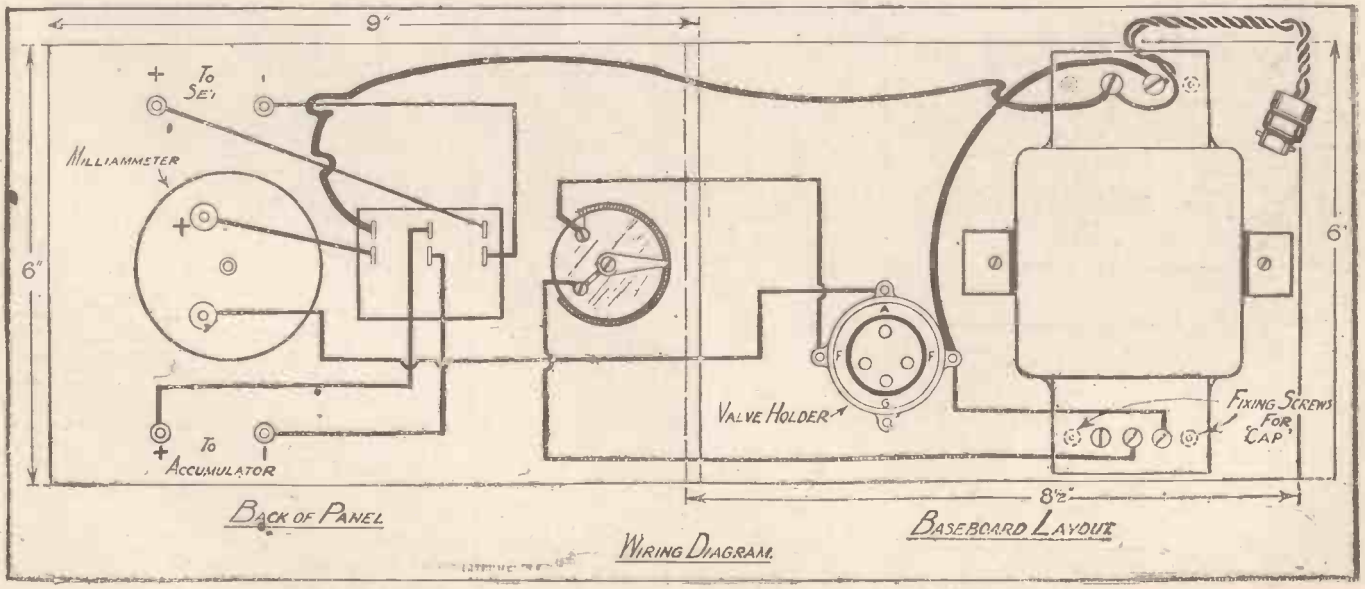
Most of the leading valve makers now make special rectifying valves capable of passing current of 50 milliamps. or more, and this set was made up and first used with the Burndept rectifying valve called the U. 695, the price of which is 20s. It operates with 4½ to 6 volts on the filament,

(*Continued on next page.*)



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.

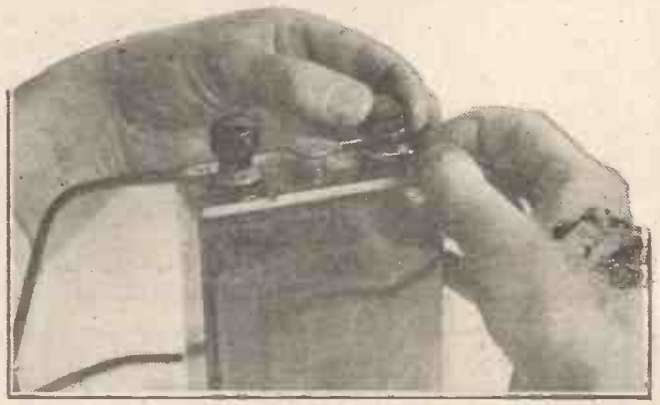
If several of the components on the set are nickeled (on-and-off switches, jacks, and many other components are now generally sold in a nickel finish) it may possibly be that the terminals will be the only other metal work showing. In such a case you will enhance the appearance of your set by purchasing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

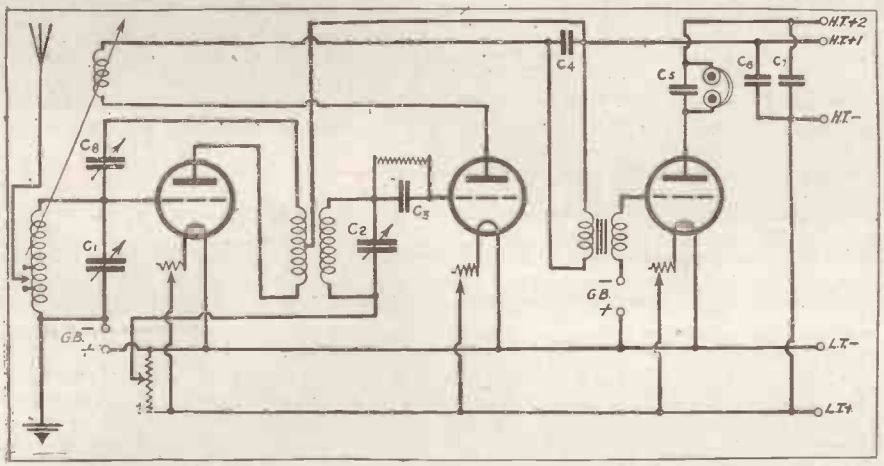
BRING YOUR OLD SET UP TO DATE.

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.

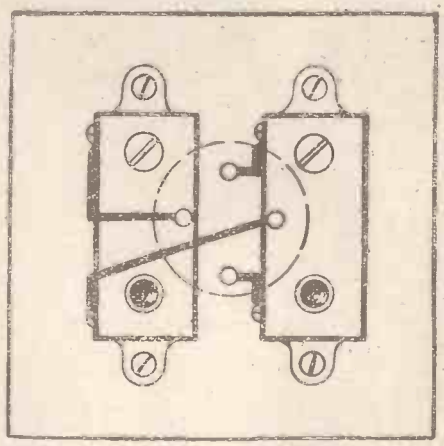
You will notice that provision is made for grid bias where perhaps it had not been before. If you have no previous experience in the adjustment of grid bias, do not imagine it is a complicated matter. All you have to do is to connect the positive wander plug of your grid bias battery to the positive 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.

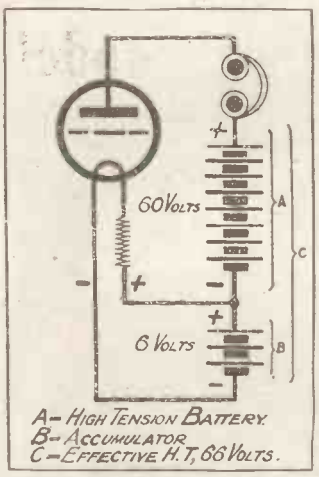


How to connect a pair of fixed coil sockets in place of the valve sockets.

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.

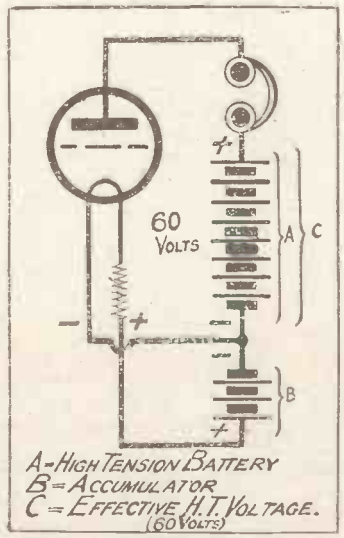


Illustrating the query on H.T. voltage.

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.



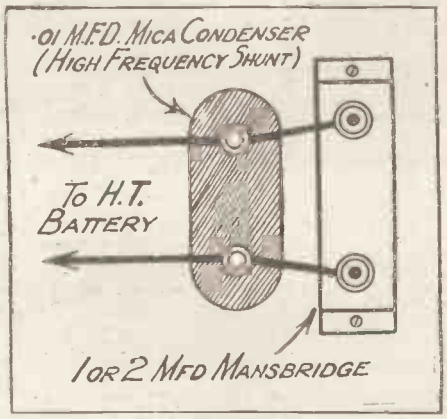
This arrangement gives a lower effective H.T. voltage.

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.

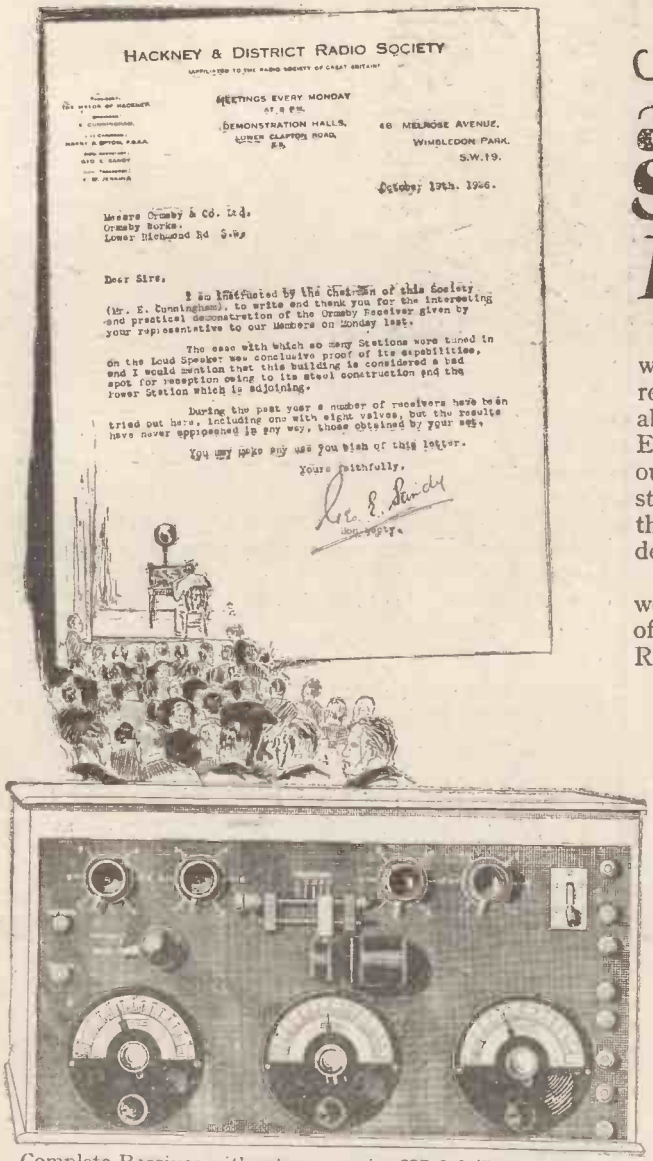
For this reason, in a circuit where radio frequency amplification is important, it is well to experiment with shunting the large Mansbridge condenser with a good, high quality mica condenser of, say, ·01 mfd. size, so that the H.F. current has a very low resistance H.F. path, while the L.F. currents 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!



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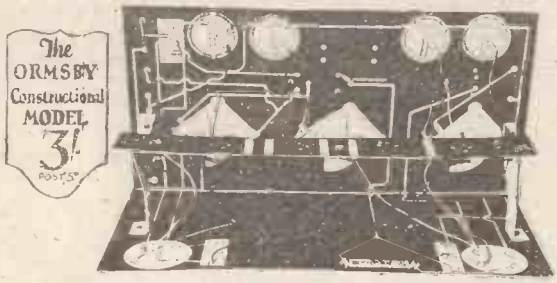

A circuit that amazed a Radio Society — Read this Letter!

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.

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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.

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¶ 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.*

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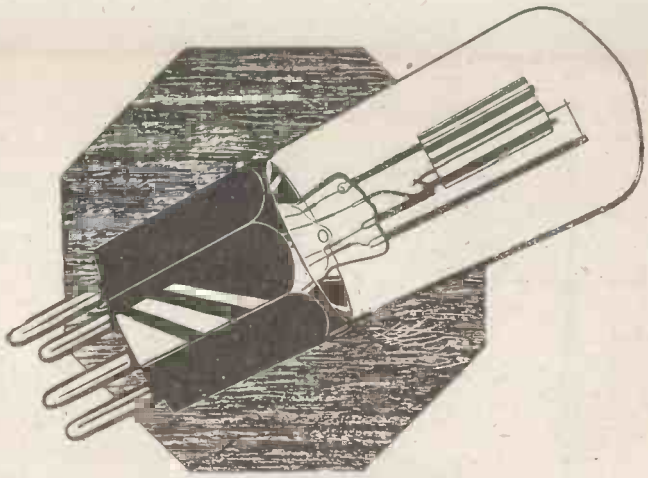

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The Filament of the Octron—the heart of the valve—has been selected with the greatest care and is specially tested under the strictest supervision by filament experts. Its mounting has been so arranged as to hold it firmly without either a tendency 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.

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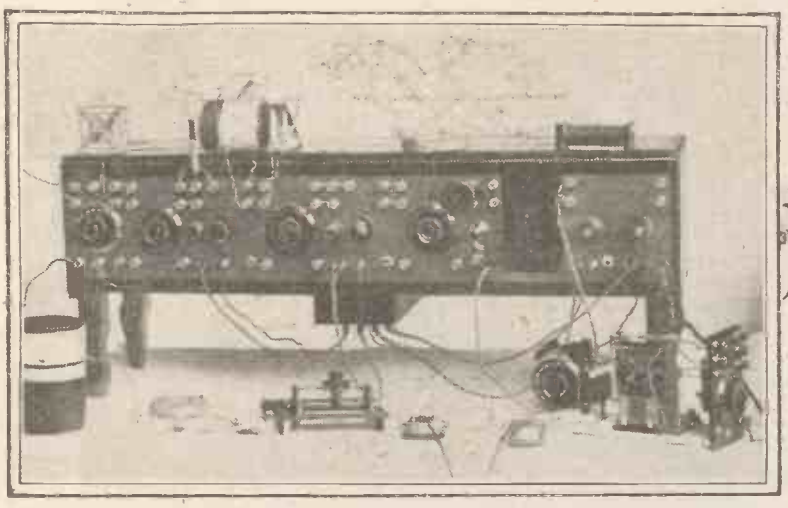


The INTERPLEX

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.

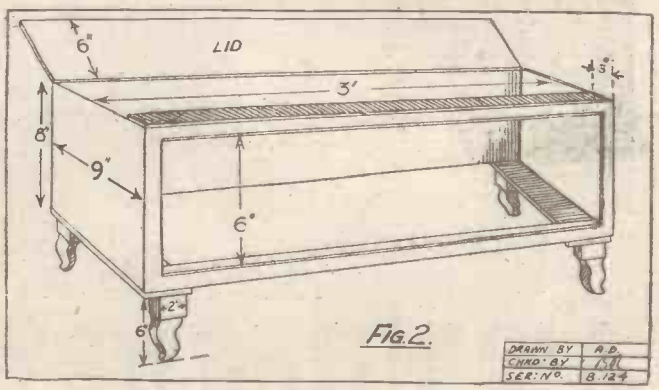


FIG. 2.

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.

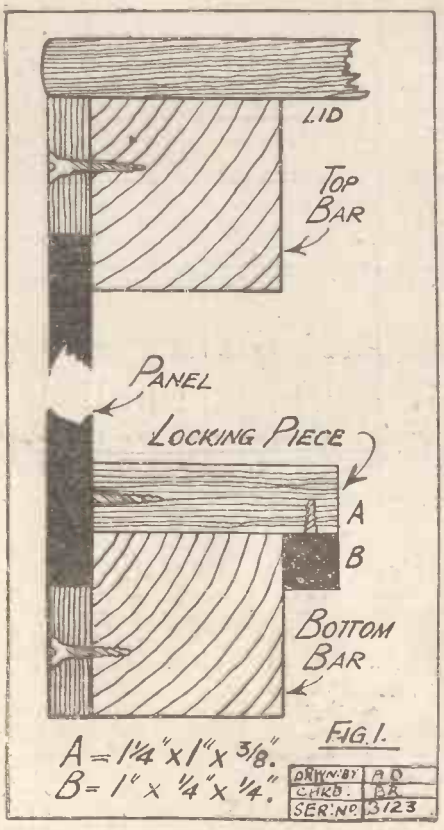
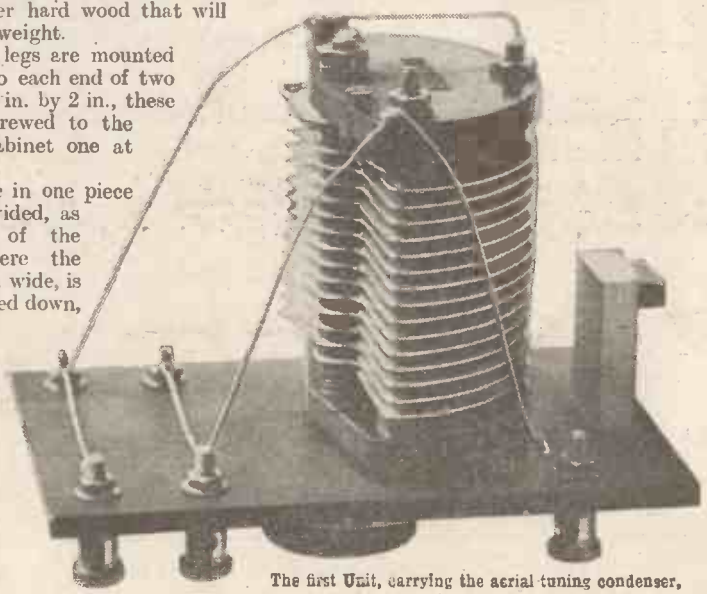


FIG. 1.

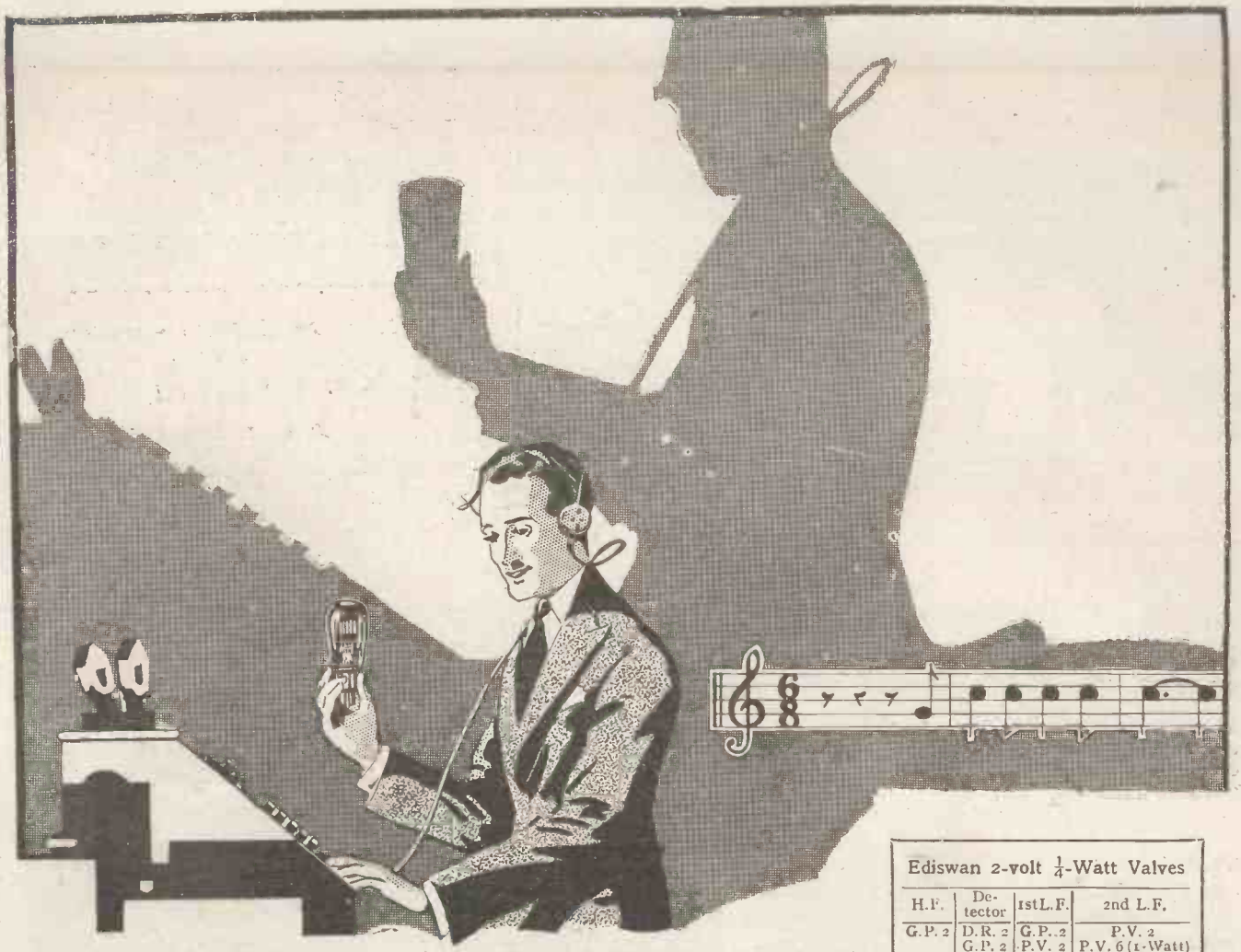
Constructing the Units.

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
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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.

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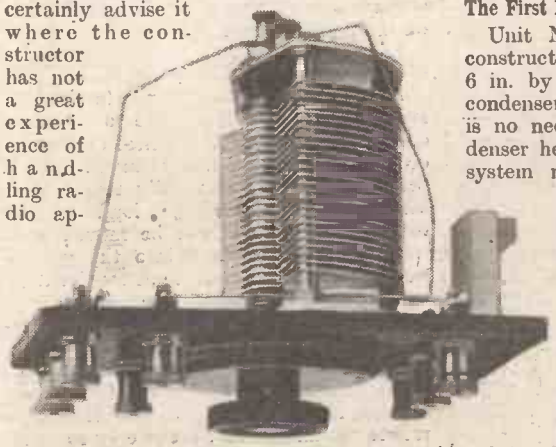
V S

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.

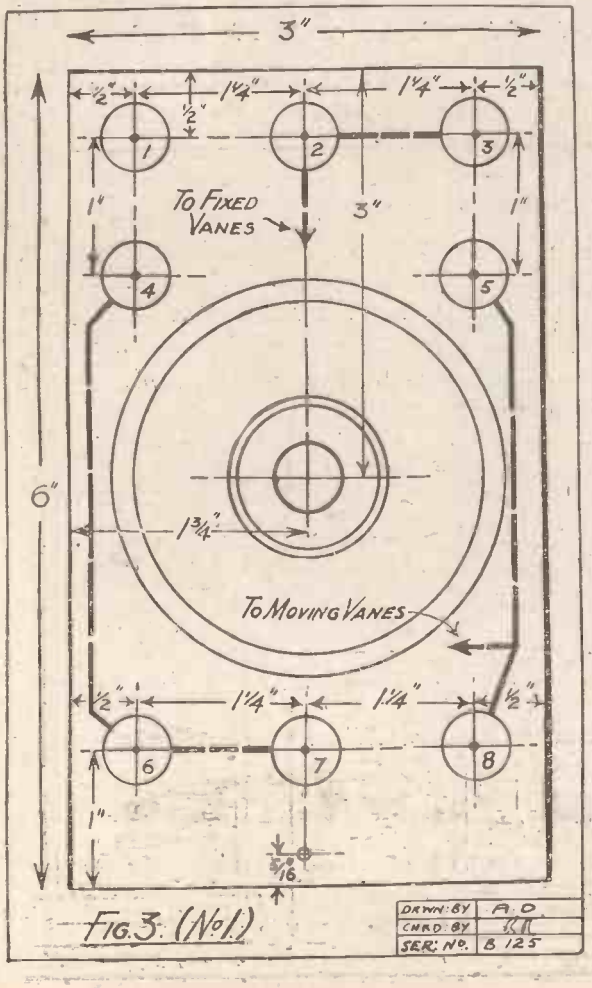


FIG. 3. (No. 1)

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.

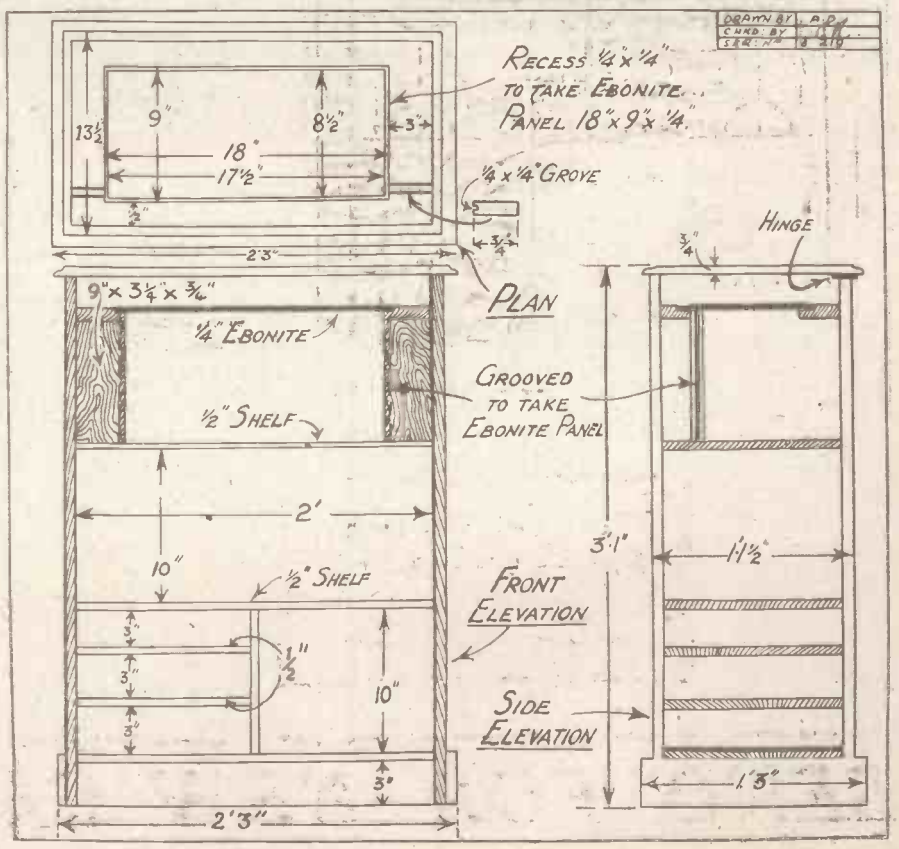
Loud Speaker Incorporated.

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.

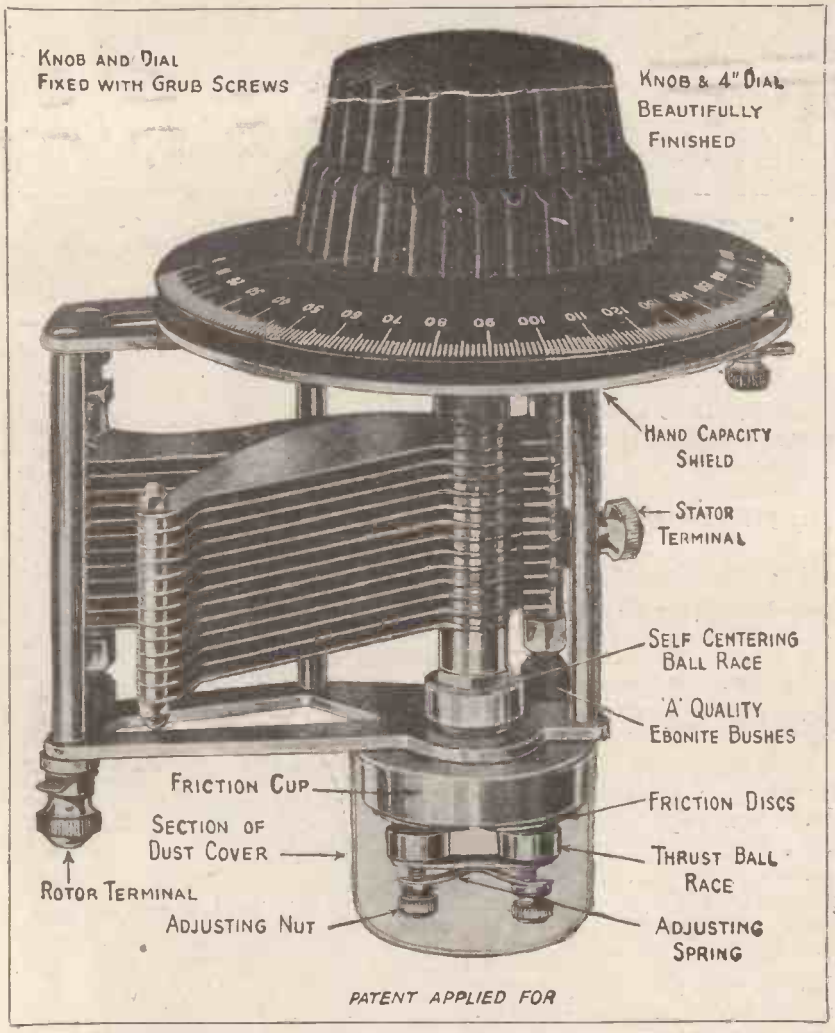
Constructors desiring a really neat and efficient wireless installation will be well advised to build a cabinet somewhat on the lines of the one described, when the set itself will be well protected and the whole outfit will present a neat appearance.



ORMOND S.L.F. CONDENSERS

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

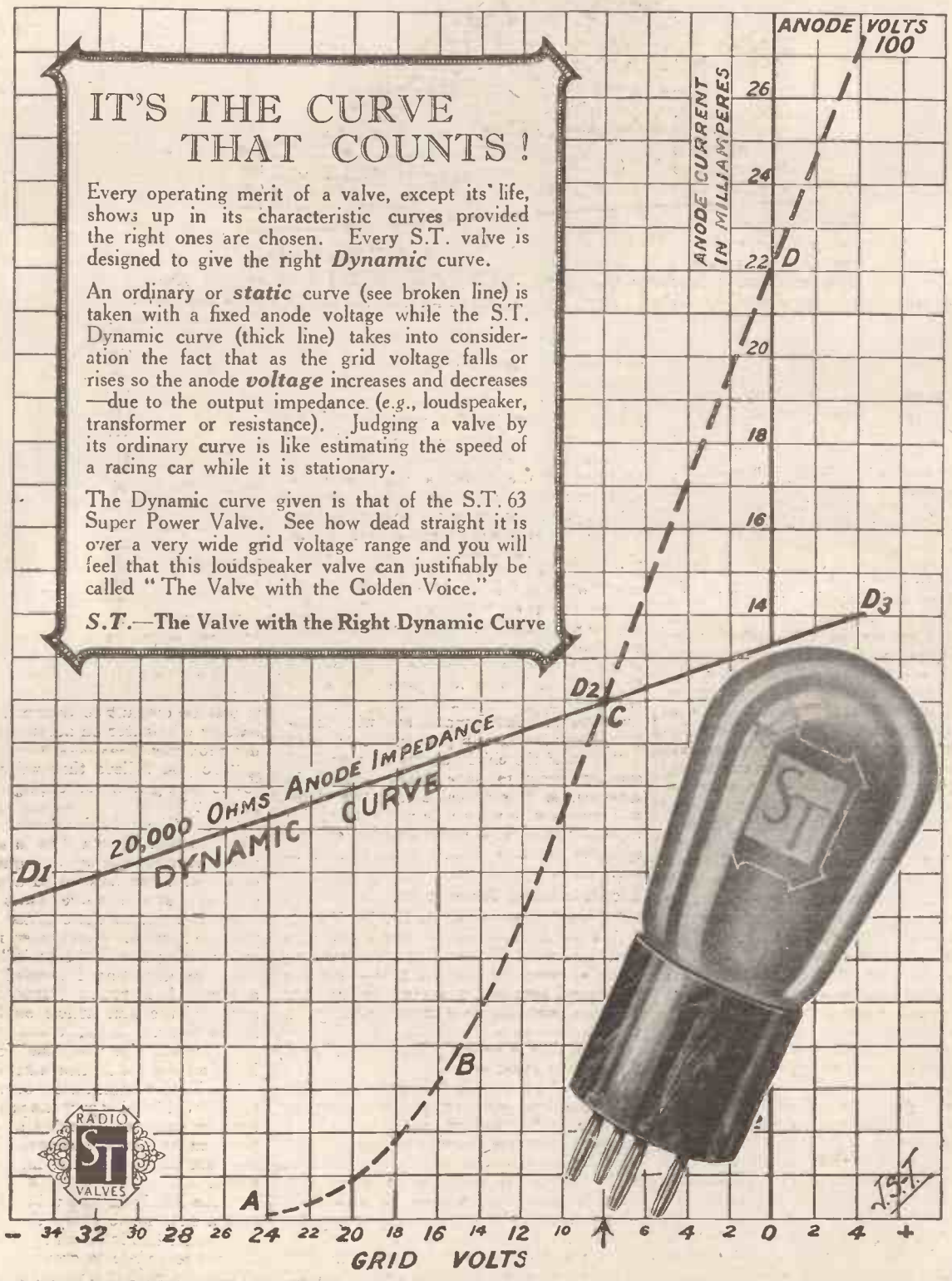
IT'S THE CURVE THAT COUNTS!

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.

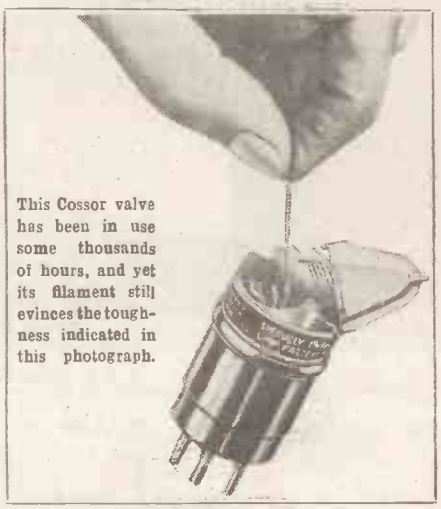
The loud speaker used with a multi-valve set forms a part of the anode circuit of the last valve, so that it is obvious that best results obtain when these two items are carefully chosen to work together. In these circumstances it is probable Messrs. A. Graham & Co., in producing the type AML 2/30 Amplion 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.

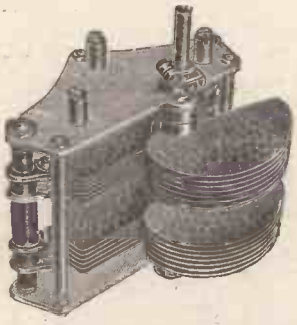
"HART" BATTERIES.

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

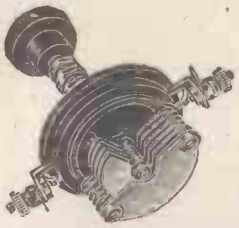


IGRANIC DUAL VARIABLE CONDENSERS (Square Law Type)

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.

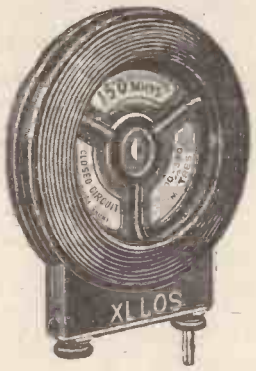
The NATIONAL WIRELESS WEEK
NOV. 7th.-13th.
'Let your Friends Listen'

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.

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Technical Editor:
G. V. DOWDING, Grad.I.E.E.

Assistant Technical Editors:
K. D. ROGERS. P. R. BIRD.

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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?

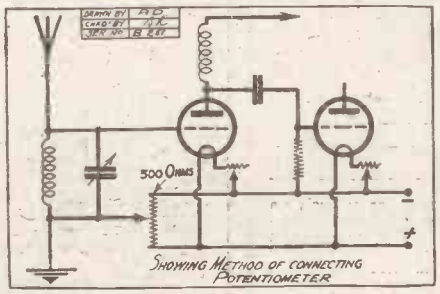
(*Continued on page 580.*)

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.

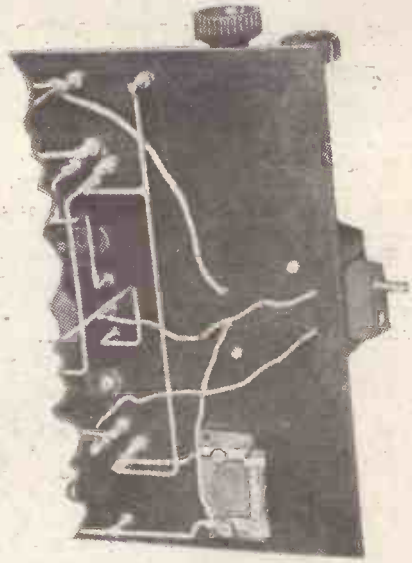
This tuning range is merely a band of wavelengths which the instrument will cover, and has nothing to do with the range of reception which is what you wish to increase.

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

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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
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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.

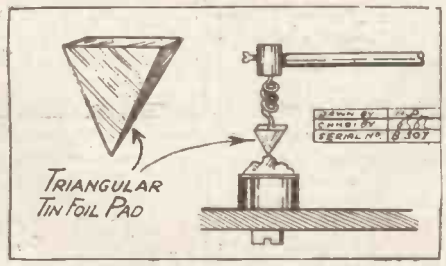
AMATEURS who are weary of re-adjusting refractory crystal detectors by means of the usual cat's-whisker method may be interested in the following method of obtaining rectification.

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.

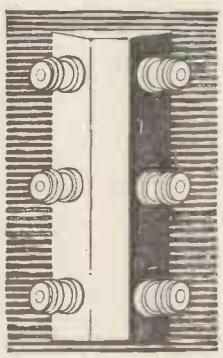
Next, you should get a large card of some sort that you can hang up near the receiver. Rule it into five vertical columns, and mark the first "coils," the second "coupling," the third "condensers," the fourth "station," and the fifth "wave."

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—

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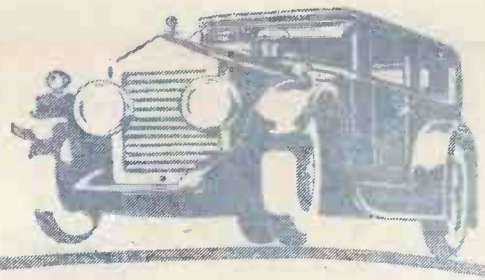
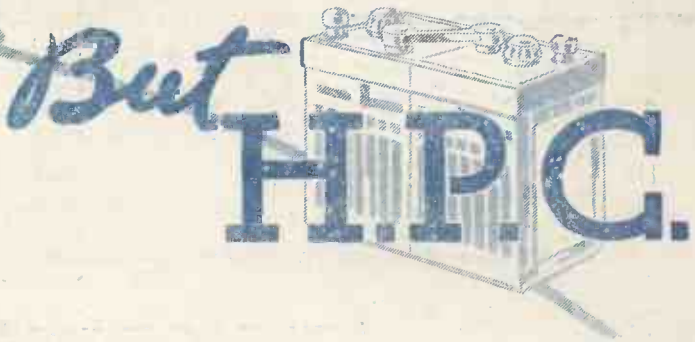
The mark of Better Radio



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

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R/R