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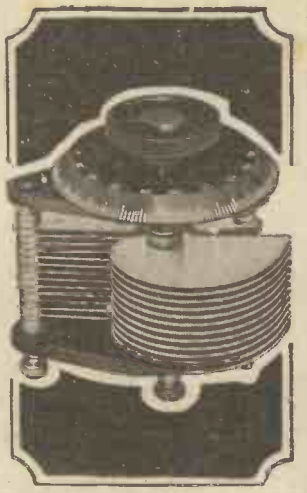

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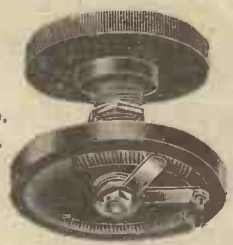

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This book contains lucid and explicit instructions for the building of a number of efficient receivers, including a simple set costing under 10/-, a Two-Circuit Crystal Receiver such as was recommended by Capt. P. P. Eckersley in a recent broadcast talk. Details are given for making One and Two-Valve Low-Frequency Amplifiers, which can be connected to *any* crystal set. There is also a very practical and informative article, "All About Crystals," which will prove invaluable to everyone possessing or about to make a crystal receiver.

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The contents of this book include details of how to make various receivers employing one or two valves, including a One-Valve Set on the famous "Unidyne" principle, which eliminates the need of H.T. Batteries. A reliable Two-Valve Loud-speaker Set, a One-Valve Reflex Receiver, and a Two-Valve Reflex Set. This latter set is a most efficient receiver, which will present no difficulty to the careful constructor. Stage by stage instructions and diagrams together with a

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Contacts marked on both sides. Earthing clip to valve cap. Low self capacity. Made in two types. For front of panel, 2/- each. For underside of panel, 1/9 each

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Supplied for 1, 2, or 3 valves. Compact, and fitted with an "off" position obviating the need for a special switch.

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THE results obtained with a home-made receiver depend chiefly upon the components used. Many experimenters who achieve distinction by receiving over immense distances use simple circuits. These successes, nine times out of ten, may be attributed to the use of good components. "Sparta" components are good—in the finest sense of the word. Good in design, good in workmanship and good in performance. Moreover, each one is guaranteed for 12 months. That is because we know they will perform their duties under all conditions.

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Completely enclosed mechanically and screened magnetically. The heavy iron case maintains even coil temperature and prevents breakage of wire due to expansion and contraction. Especially layer-wound, moisture-proof coils parchment spaced. "B" and "C" type coils are spaced turn for turn with silk thread to reduce self-capacity and make turns rigid. Magnetic circuit has two air-gaps in series-thus preventing noise due to eddy currents.

Amplification is high, consistent with minimum of distortion.

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The former is constructed from a fireproof material. Each turn is rigidly supported.

Each resistance is sufficiently small to go into the same space as a valve-holder, thus allowing each valve to have its resistance mounted underneath it.

"Sparta" Potentiometers are of similar design to the filament resistances. Resistance value 400 ohms.

¶ *Space only permits us to show four components here. Just send a card for list 316B, it fully describes the complete "Sparta" range.*

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Felix stops perambulating!
Why stands he thus, hand elevating?
—Pose emphatic, eyes ecstatic—
Is that master mind debating
Schemes for which the world is waiting?

Felix stops perambulating!
And the world, no longer waiting,
Shares the pleasure of a treasure.
See his hand an ear caressing,
And his whiskers crystal pressing!

Felix stops perambulating!
From waves ethereal emanating,
Sounds entrancing, joy enhancing,
A message clear proclaims with might
The wondrous power of Tungstalite.

W.W.

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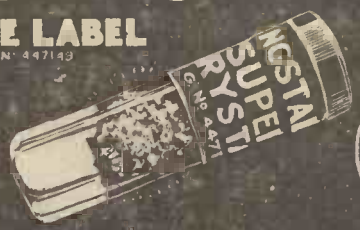


1/6

"The Finest Crystal in Existence!"

POPULAR WIRELESS

AND WIRELESS REVIEW.

January 17th, 1925.] THE RADIO WEEKLY WITH THE LARGEST CIRCULATION. [Every Thursday, Price 3d

Technical Editor: G. V. DOWDING, Grad.I.E.E. | Editor: NORMAN EDWARDS, M.Inst.R.E., F.R.G.S. | Scientific Adviser: Sir OLIVER LODGE, F.R.S.

RADIO NOTES AND NEWS OF THE WEEK.

The "Multidyne."

A SERIES of articles under this title are now in active course of preparation, and will shortly be published, week by week, in P.W. The "Multidyne" is an ideal set for the experimenter, enabling him to utilise an almost unlimited number of circuits by a simple plug-in arrangement which does not necessitate the dismantling of any component parts. The "Multidyne" does not claim to be a new invention: it is, however, a very meritorious improvement in experimental design, and as such it will be presented at an early date to P.W. readers.

* * *

"Best Way" Wireless Books.

DO not fail to secure your copies of the two "Best Way" Wireless books now on sale, price 6d. each. These magnificently produced guides for wireless constructors represent the best value ever offered to amateurs. The "Best Way" Book, No. 162, entitled "How to Make Valve Sets," contains five detailed constructional articles by well-known experts—and you can't go wrong.

* * *

A Free Blue Print.

THE "Best Way" book, No. 162, also contains a large Pictorial Blue Print; and No. 161, "How to Make Crystal Sets," will supply a long-felt want among crystal set enthusiasts. Both books can now be purchased at ANY bookstall or newsagents, price 6d. each.

* * *

Lifting the Ban.

THE removal of the ban on foreign apparatus, which became effective on January 1st, has not had time to affect the British market yet, but developments are being eagerly awaited. Whilst there is a natural disposition to support home industries, the average listener does not overlook the great discrepancy in price between some Continental and similar British products. There is a feeling that the coming competition will ginger-up the tendency to reduce prices which seems to have halted during the past few months.

The Government's Bill.

ANOTHER feature of the New Year which is being watched with interest is the Government's promised radio Bill to regulate the position of licence holders. The G.P.O. is commendably prompt in sending out requests for renewals, but threats of dire penalties are quite out of place in view of the P.M.G.'s failure to prosecute Mr. Ford, at his own request. What will the Government do with "pirates"?

* * *

Cold Filament Reception.

AN Edinburgh correspondent informs me of an experience he had recently whilst experimenting with a one-valve set, which should be of interest to all experimenters. The L.T. cells were run down and were disconnected, and the filament resistance arm was off the wire, but 50 to 60 volts H.T. were plugged in. Despite the cold filament, 2 E H could still be heard, as if the oscillations were building up and broke through, coming loud with a jerk and then dying into nothing. Have any other readers had a similar experience?

* * *

2 L O at Sea.

I HEAR through one of the wireless operators of the s.s. Leviathan that 2 L O is regularly received on board at distances up to 1,000 miles, and 5 X X up to 2,000 miles. The vessel carries eight wireless operators, and by means of specially-balanced aerials they are able to handle spark and continuous-wave transmissions simultaneously.

The main studio at W E A F, the well-known station belonging to the American Telephone and Telegraph Co., New York.

Another Super Station.

MR. WILLIAM WRIGLEY—the "chewing-gum king"—and other prominent American business men are planning to erect the largest building in the world at Chicago. It is to be a "temple of agriculture," and amongst the latest scientific equipment it will house a super broadcasting station, which it is expected will be heard in this country. A broadcasting tower, modelled on the Eiffel Tower and rivalling the great European erection, is included in the plans.

* * *

"Corking" the Aerial.

HAVE you "corked" your aerial? Serious damage is being done to pigeon-breeders through valuable birds flying into wireless aerials, and as pigeons as well as wireless rendered great service during the war, it is only fair and humane that the lives of the birds should be safeguarded by the simple precaution of fixing corks to the wires every three or four feet, so that the pigeon in flight can see the obstruction.

* * *

No Trouble, No Danger.

FOR the benefit of those who live near pigeon-breeding-grounds it may be as well to point out that the placing of corks along the aerial to make it more easily visible has no harmful effect whatever upon reception. Both the cost and trouble are negligible, and I am sure that once the danger to the pigeons or other birds has been pointed out, there is no amateur who will not try to make the air safe for them.

* * *

Guiding Pilots.

AS forecast in "P.W." some months ago, beam wireless has been adapted to guide aeroplanes during low visibility. The recent flying fatality near Croydon would probably not have been avoided by such a scheme, but there is no doubt that in the past an invisible ether line along which to fly in bad weather would have saved more than one fatality. During tests at Dayton-Ohio it was found possible for

(*Continued on page* 1178.)

NOTES AND NEWS.

(*Continued from page 1177.*)

a pilot to keep a perfectly straight course on a hazy day, unaided by landmarks, by listening in to a kind of radio beam.

* * *

W S A I's Claim.

THE Cincinnati station (W S A I), which has been coming over very well during the last month or so, claims to have the finest chime-concerts in the U.S.A., which it broadcasts from a nine-story bell tower. The station is owned by a playing-card manufacturer, and its programmes consist mainly of local musical talent, drawn from the city's glee-clubs, orchestras, and College of music.

* * *

Help Wanted.

A WILLESDEN GREEN reader asks if there is anyone in that district who would be willing to co-operate with him in practising the Morse code? Enthusiasts who favour the idea should write to Mr. E. W. Luff, 38, Strode Road, Willesden Green, London, N.W.10.

* * *

To-night's Concert.

TO-NIGHT and on subsequent Thursdays during 1925 the programme from the high-power station will not be provided by the B.B.C. artistes, but will come from some outside source such as a well-known hotel orchestra or famous concert. The popularity of the Hallé concerts has already been enhanced by broadcasting, and it is likely that they will be drawn upon frequently under the new scheme. Other provincial music which has been inadequately recognised outside its own locality should find a new lease of life through 5 X X.

* * *

1925 Prospects.

THE most eagerly awaited development of the New Year is the permanent establishment of the B.B.C.'s high-power super station in the Midlands (just outside Daventry). With this station sanctioned by the Government the scheme of dual entertainment can be pushed to its logical conclusion, and I think that 1925 will see the provision of alternative concerts to practically every section of the B.B.C.'s audience.

* * *

The Leeds Exhibition.

I HEAR that bookings for the Leeds Wireless Exhibition are very good, and that the organisers are anticipating that a thoroughly fine show will result. The "Leeds Mercury" is offering prizes to the value of £75, and some interesting competitions for constructors have been arranged. The Exhibition will be open from Tuesday, January 20th to Saturday, January 31st, at the Fenton Street Drill Hall, Leeds.

* * *

Radio for Surveyors.

SURVEYORS who are mapping the less-thickly populated surfaces of the globe are finding wireless time-signals of the utmost assistance in fixing longitudes. Mr. Blanchet, who is surveying the Great Slave Lake, in the Mackenzie River district, uses a portable receiver to listen to European and American time-signals. On one occasion the wire placed between two paddles on a 16 ft. canoe acted as aerial, and the midday time signal from Annapolis was caught as the canoe swept along the Great Slave Lake.

* * *

Hilversum Increases Power.

HILVERSUM, the Dutch station which is just starting broadcasting on high-power, is an old friend of the British listener. Formerly the tuning-in of the station on a single-valve circuit was not at all common, but with the power increased ten-fold, reception on the simplest circuits should now be an easy matter. The wave-length is 1,050 metres, and the call-sign H D O.

* * *

Concerts from Holland.

I HEAR that some first-class artistes have been engaged to appear at the Hilversum studio, and that in framing the programmes, the listener in this country has been borne in mind and well catered for. Two steel masts, two hundred feet high, have been erected to support the aerial; and the well-known Dutch valve-manufacturing firm who will operate the station inform me that they will relay the famous Mengleberg orchestra from Amsterdam every Tuesday evening.

Ultra-short Waves.

FOLLOWING similar tests in France, the Germans claim to have succeeded in producing ultra-short waves having a frequency of more than 300,000,000 per second, which corresponds with a wave-length of less than one metre. Although at present a laboratory experiment, it is quite likely that such results will greatly affect broadcasting, and the fact that American radio fans are already down upon the ultra-short waves reminds me that if any British amateurs are similarly engaged they are keeping very quiet about it!

* * *

Radio Travels.

SINCE the daily Press has given prominence to long-distance wireless "tours" a great deal of interest has been shown in these radio travels. Amongst the very interesting lists I have received in this connection is one from a Cleckheaton correspondent, who gives details of thirty-four different stations received between 7 p.m. and midnight, including broadcasting from Holland, France, Belgium, Germany, Sweden, Austria, Spain, and the United States.

* * *

"Mr. Dooley" may be Broadcast.

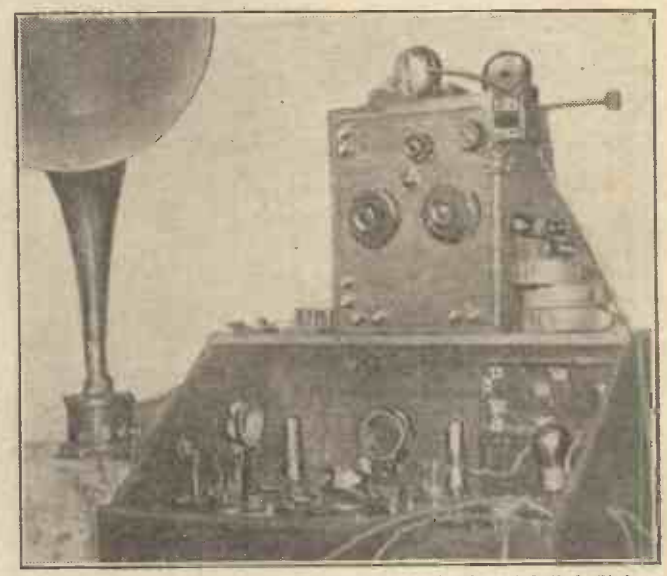
THERE is an interesting piece of gossip going round to the effect that we may hear "Mr. Dooley" through the microphone soon. The rich Irish-American humour of the stories about Mr. Dooley and his friends of the bar-room should be extremely effective "on the air," and although they are not as well-known over here as in America, they have plenty of British admirers, amongst them being Mr. J. R. Clynes. It is just possible that the B.B.C. will persuade Mr. Clynes to read them for the benefit of listeners—he is fond of doing so to a select party of his friends.

* * *

New Station for Norway.

NORWAY is contemplating the erection of a high-power broadcasting station, with an energy of 15 kilowatts. Such a station would be heard in this country easily. I hear that a company has already been formed for the project, and is being well-supported by the public as regards capital and subscriptions.

ARIEL



A Preston reader's 4-valve set (1-v. 2) and a super 1-valve set, both built from instructions given in "P.W."

SHORT WAVES.

"... wireless has this advantage over the schoolmaster: what it says never comes in at one ear and goes out at the other. Not when you use headphones."—"Daily Herald."

* * *

"... Solomon said there was nothing new under the sun, but he didn't say it by radio."—Mr. Thomas Jay, of "Punch," speaking at Bristol.

* * *

"... Broadcasting has come to stay, and, even allowing for a certain waning of nightly enthusiasm on the part of listeners when the first novelty has worn off, it is likely to become and remain part of the equipment of the majority of households. ... We shall get used to broadcasting as we get used to everything else; but the chances are that we shall have to listen when there is anything irresistible on the programme."—"The Times."

* * *

"If you are a pirate, wend your conscience-stricken way to the nearest post office and deposit 10s. and receive in return a little slip of paper which will go a long way towards making a respectable citizen of you."—"Manchester Evening News."

* * *

"... It is clear that wireless in coming days will touch the whole of life and compete more and more powerfully with other interests for the leisure time of the people."—"Sunday School Chronicle."

* * *

"Broadcasting the image of a clock-face so as to show the exact time is now perfectly feasible, and the only reason why it is not being done is that most people are still satisfied with the audible time-signals we get every night."—Dr. Fournier d'Albé, in a message to the "Daily News."

* * *

"... Like several other men, I, myself, was once a small boy, and I can only say that an invention which has brought headphones into well-nigh every home, thereby rendering it less necessary than ever to wash behind the ears, is deserving of every encouragement."—Dudley Clark, in "The Passing Show."

TWILIGHT AND THE HEAVISIDE LAYER.

"WIRELESS SUNSET TIME."

By Lieut.-Commander H. W. SHOVE, D.S.O., R.N.

Why do wireless waves "carry" best after sunset? Why cannot "D X" amateurs achieve sensational results in the daytime? A well-known contributor to "P.W." explains these interesting problems in the following article.

THE reflecting effect of a conductor is, of course, the principle used by Senatore Marconi in his "Beam" system of directional transmission. But,

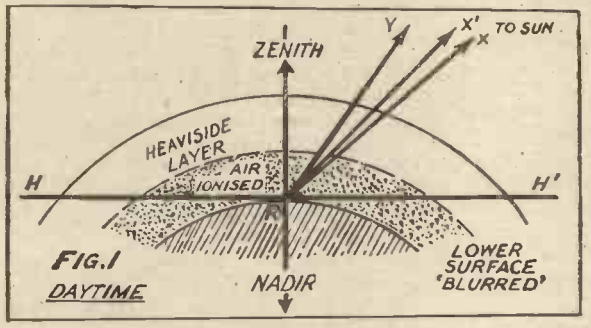


FIG. 1
DAYTIME

whereas he is forced, by practical considerations of the size of his apparatus, if for no other reason, to make use of very short waves, in order to be able to concentrate them by the use of any system of conductors of reasonable proportions, the "Heaviside Layer," as it is called, being of unlimited extent, reflects all rays of whatever length.

Thus the path of wireless waves is more or less confined to the space of about 50 miles between the Heaviside Layer and the earth's surface, and the effect of the reflection is to concentrate and throw down waves which would otherwise be dissipated into space, so that they can affect receiving apparatus in addition to those travelling directly along the surface from the transmitting to the receiving station.

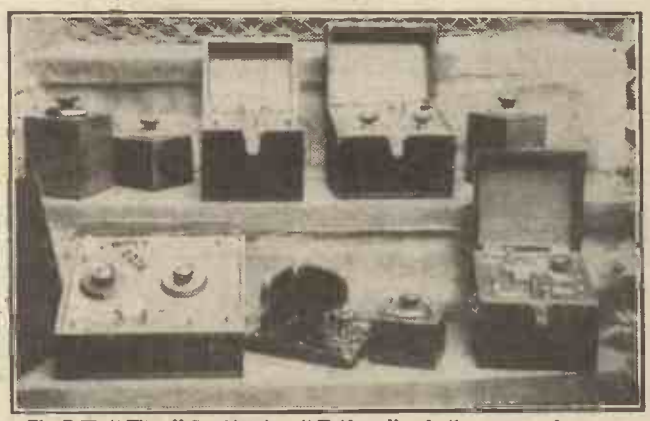
When Light Bends.

The air, from the earth's surface to the Heaviside Layer has, normally, practically no conductivity. But the influence of light upon this air is to cause more or less "ionisation." It is outside the scope of the present article to discuss what "ionisation" actually is, but it may be stated at once that its effect is to make the air more or less conductive.

The conductivity never, at any point near ground level, amounts to very much, but it is sufficient to "blur" the under surface of the Heaviside Layer, causing the line of demarcation between the conductive and the non-conductive strata to become less well defined, and in bright sunlight, which at that height means throughout the day—for it is far above the highest clouds—to prevent the reflection at that surface. This is the probable reason for the very marked difference in the "carrying" powers of wireless waves through lighted and unlighted areas. *And, owing to the height of the Heaviside Layer the effect persists long after sunset.*

Fig. 1 represents (not to scale) the daytime conditions over a portion of the earth's surface and in the superincumbent atmosphere. For simplicity we will only consider the immediate vicinity of the receiving station; but it must be understood that the conditions may vary at different parts of the wave-track, according to the local time at each spot, and that therefore the final result will be a mean of the different conditions. In Fig. 1, RX is the true direction of the sun, RX' the path of a ray of sunlight falling upon the observer at R, RY, a tangent to RX', the direction in which the observer sees the sun, the "apparent" direction.

The curve in the path RX' is due to the effect of the atmosphere in bending a ray of light passing through the strata of different density of which it consists. This phenomenon is known as "refraction." The bending will be greatest when the sun's rays have to traverse the greatest thickness of air to reach the observer—i.e. when the sun is on the horizon at sunrise and sunset. When, as at noon on certain days in the tropics, the sun passes through the zenith, the refraction vanishes and RX' becomes a straight vertical line.



The P.W. "Ultra" Combination, "Unidyne," and other sets, made by one of our readers who forgot to send his name and address!

Explaining "Twi-Light."

The refraction always bends the ray towards the earth, so that its effect is always to make the sun appear higher in the heavens than he really is. Thus, at apparent sunset (see Fig. 2) the sun is already really below the true horizon of the observer at R (the line RH). So refraction tends to prolong the day. But after sunset another phenomenon occurs.

It is a matter of everyday knowledge that it does not suddenly become dark at sunset. The reason for this is that all the lower part of the atmosphere is full of small particles of matter in suspension, "the motes that people the sunbeam." These particles all reflect light, and it is the light from them that causes what we know as "twilight," which is really exactly analogous to moonlight; but in twilight we have an infinite number of tiny moons, too small for our eyes to distinguish individually and all comparatively close to us, instead of the one great, distant, silver disc which is the obvious and visible source of moonlight.

The "Fall" of Darkness.

It will be readily understood that, as the air becomes more and more rarefied, so it becomes less and less able to support the "motes" that give us our twilight, and that the higher up we go the lighter and consequently the fewer must be the floating particles.

As the sun sinks below the horizon and the earth's shadow eclipses first the lower, heavier, and more numerous "motes" in the lower atmosphere, and then the lighter and rarer ones higher up, twilight gradually deepens into night, the shadows falling faster at first, since more of our tiny moons are being eclipsed each instant, and more slowly later on, as the last glimmers of twilight fade into the complete darkness of true night.

But, even then, as we gaze upwards to the dark sky, we are actually looking through the sunbeams which are passing far above our heads between us and the twinkling stars. Only we cannot see the sunbeams, for there are no more tiny "moons" to reflect them to us.

This condition of things supervenes when the sun has reached a depression of 18 degrees below our horizon, as shown in Fig. 3.

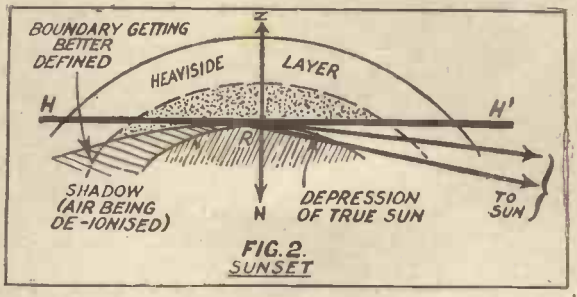


FIG. 2.
SUNSET

Along with the gradual extinction of sun-

(*Continued on page* 1180.)

TWILIGHT AND THE HEAVISIDE LAYER.

(*Continued from page* 1179.)

light has gone on a process of "de-ionisation" of the air, and the absorption of wireless waves has been gradually getting less and less, higher and higher up in the atmosphere. When the line of the earth's shadow reaches the Heaviside Layer above us all ionisation due to direct sunlight ceases.

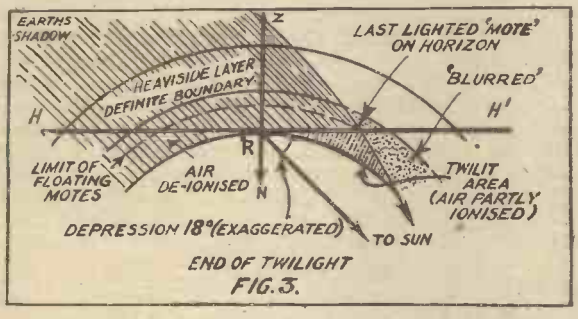


FIG. 3.

It will be seen at once that this time is considerably after sunset at the observer's position on the surface. Of course, the fading light and consequent de-ionisation does operate (in the lower layers) immediately after sunset to begin to improve reception. But it is not till the shadow reaches the Heaviside Layer that we are free from the effects of direct sunlight. We may call this time "Wireless Sunset" (see Fig. 4).

The "Wireless Sunset."

The calculation of the exact time of this occurrence is complicated by the difficulty of making an accurate allowance for the refraction in the upper atmosphere and also by the fact that the height of the Heaviside Layer is not certainly known. But, assuming the latter to be 50 miles up, "Wireless Sunset" will take place when the sun is *about* 10 degrees below the horizon. Thus it is intermediate in time between the observer's sunset and the end of twilight. But "Wireless Sunset" does not mean the end of all sunlight effects.

Marked Seasonal Variations.

The reflected twilight will still continue to have its ionising effect until, as previously stated, the sun is 18 degrees below the horizon. Since, at that time, the earth's shadow extends at least 150 miles above the observer's head the under surface of the Heaviside Layer is now evidently free from any interference which could cause the "blurring" referred to early in this article. From "Wireless Sunset" onwards the improvement in signal strength should be rapid, but it is not until the end of twilight that "True Wireless Night" sets in and we get the full benefit of the Heaviside Layer in aiding the carrying power of the waves.

As twilight lasts all night long in England at midsummer and it is only between July 22nd and May 23rd that there is any period of absolute darkness in London, it is not to be wondered at that seasonal variations in the case of distant reception should be so marked.

A Useful Table.

For the benefit of those who may be sufficiently interested in the subject to make a few experiments in this fascinating branch of wireless study the approximate time of "Wireless Sunset" in London in the winter months is given in the table, assuming the lower boundary of the Heaviside Layer is 50 miles up and making a rough allowance for refraction. If it is found that a marked improvement in signal strength of the local station takes place *earlier* than the times given, it would seem to indicate that the Layer is *lower* than we have assumed, and if later, of course, the opposite. The writer would be glad to hear from anyone who cares to experiment in this direction.

The microphone at the Brussels Broadcasting Station.

TABLE

showing (in G.M.T.) the approximate times of "Wireless Sunset" for each month of the year between September and April. Calculated for the latitude of London (51° 30′ N.) and on the assumptions made in the text.

September	15th ..	6.55 p.m.
October	15th ..	6.13 p.m.
November	15th ..	5.7 p.m.
December	15th ..	4.43 p.m.
January	15th ..	5.16 p.m.
February	15th ..	6.19 p.m.
March	15th ..	6.23 p.m.
April	15th ..	7.18 p.m.

"ONE-HOLE FIXING" TRANSFORMERS.

By O. J. R.

AN ordinary terminal, even if quite useless for electrical purposes, is certainly more pleasing to the eye than four screw-heads countersunk into the face of a panel; but when this terminal can be used both mechanically and electrically, then surely the idea is worth consideration. Here, then, is the idea, and it is hoped that it may prove to be yet another definite step towards improvement in receiver design.

A small brass plate is bent and drilled as shown in the sketch, and bolted to the four legs of the L.F. transformer. The bending will not be necessary if countersunk screws are used, or if the enthusiast should feel energetic enough to solder same to the transformer legs. The next step is obvious, an ordinary terminal being used as a bolt for securing the transformer to the under-side of the panel. The terminal, being in contact with the frame and core, may conveniently be used to earth the core, if desired, and should a metal shield be used, this can be easily attached to the four corners of the plate by means of a little solder.

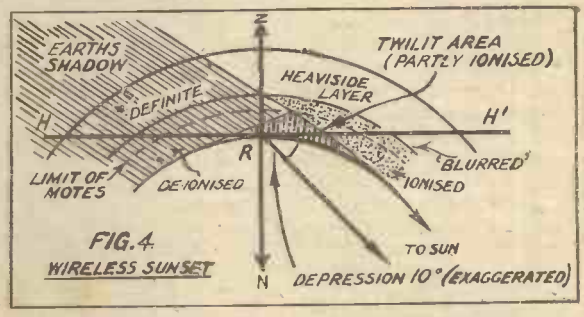
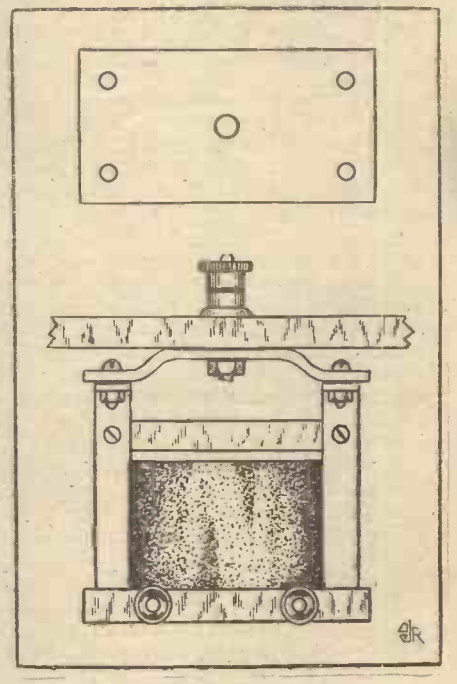


FIG. 4.
WIRELESS SUNSET



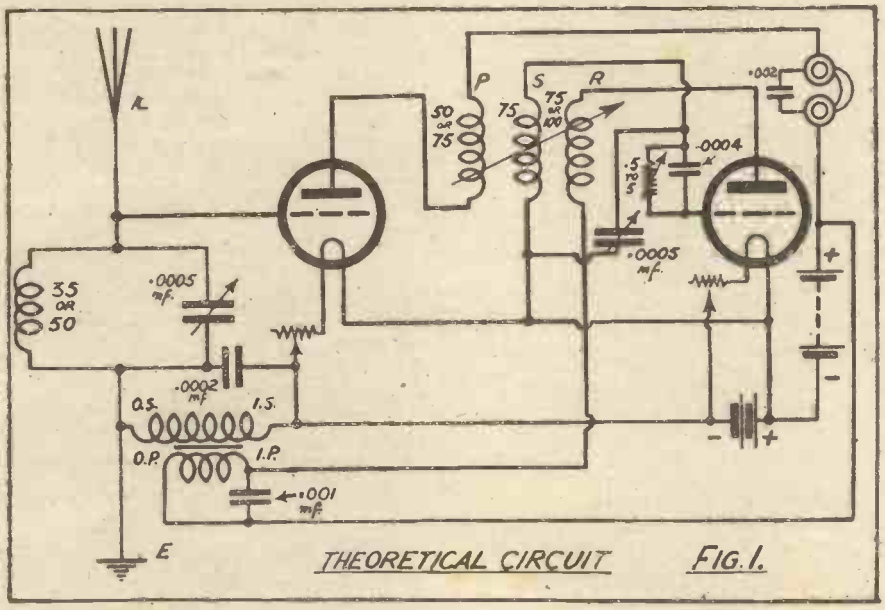
HOW TO CONSTRUCT A "FOUR-CIRCUIT" TWO-VALVE SET.

By M. C. PICKARD.

Here is a set which should interest every wireless experimenter. Reliable and efficient, it offers many opportunities to the amateur not merely content with "listening-in."

THE following article describes the construction of a two-valve receiver which should prove extremely popular, both on account of its simplicity and its extreme efficiency.

First, the method of H.F. coupling employed is by far the most efficient yet brought out for a reflex circuit, consisting of a loose coupled transformer with a semi-aperiodic primary, and tuned secondary loose coils in a two-coil holder are used, so that by plugging in suitable coils any wave-length can be received.



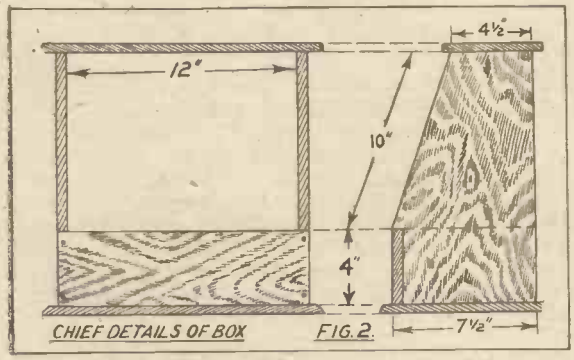
THEORETICAL CIRCUIT FIG. 1.

The switching arrangements have been chosen with great care, so that no loss of efficiency shall occur through them, and so that they shall perform their duty in the best possible manner.

They consist of one D.P.D.T. switch and one S.P.D.T. switch of the knife variety, and enable any of the following combinations to be used at will:

1. Detector with reaction.
2. Ditto with note magnifier.
3. H.F. and detector.
4. H.F. detector and L.F. (dual).

The first three combinations require no comment, but perhaps a short account of the chief virtues of Combination 4 would be of value here.



CHIEF DETAILS OF BOX FIG. 2.

Extension Handles Advisable.

The primary, for the most stable results, should be one size smaller than the secondary, and should be fairly tightly coupled.

This transformer coupling eliminates practically all the troubles usually laid at the door of reflex sets, and the set is quite as stable as an ordinary straight two-valve set.

To prove this the theoretical reflex circuit (Fig. 1) was wired up roughly on an experimental panel, no care being taken as to spacing of wiring, etc., and the results were even then extremely good.

The components required to make up this set are as follows:

	s.	d.
1 Sloping front cabinet to take panel 12 in. by 10 in. (see Fig. 2)	8	6
1 Ebonite panel 12 in. by 10 in. ..	5	0
2 Igranic filament resistances.. ..	9	0
1 Watmel variable grid leak	2	6
2 Valve holders (loose sockets) ..	0	8
1 Three-coil holder (with extension handles)	7	6
1 Coil plug	0	9
2 ·0005 mfd. variable condensers (Raymond)	10	0
2 Dials (Raymond)	2	0
2 Extension handles for above (Raymond)	2	0
14 Terminals	2	4
1 Medium-sized D.P.D.T. switch ..	2	6
1 Medium-sized S.P.D.T. switch ..	2	0
4 Edison Bell fixed condensers ·0002 mfd., ·0004 mfd., ·001 mfd., and ·0002 mfd.	5	0
1 Ferranti transformer	17	6
Sundries, screws, etc...	5	0
Total—	£4	2 3

The above prices are approximate only, except where the actual make is stated, and here the reader should purchase only these makes as they have been found best in practice; especially does this apply to the transformer and variable condensers.

The two switches should be as large as convenient, those on small bases being used remounted on the panel, as the type usually sold for panel mounting are too small.

The extension handles are a really useful investment, as they eliminate hand capacity troubles when tuning for long distance stations.

The type employed and the method of fixing them in place of the knob is shown in Fig. 3.

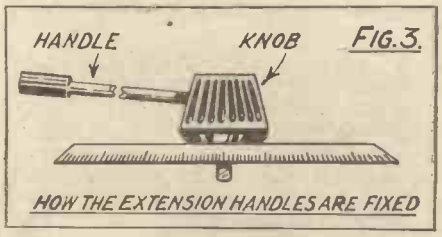


FIG. 3.

HOW THE EXTENSION HANDLES ARE FIXED

The cabinet need not, of course, be made absolutely in accordance with Fig. 2, and a bought one can be used provided it has the right panel size.

Drilling the Panel.

On no account should the set be modified to build it into an existing cabinet, as any change in the lay-out may result in a loss of efficiency.

It is obviously impossible to give all measurements for drilling here, but a good idea of the lay-out and spacing of the components can be gathered from Fig. 4.

The panel is first squared and trimmed up with a file, then with a scriber or other sharp instrument mark the panel out into compartments, as shown in Fig. 4, allotting a suitably sized space to each component.

When this has been done, the holes to be drilled for the components are marked on

(Continued on page 1182.)

HOW TO CONSTRUCT A "FOUR-CIRCUIT" TWO-VALVE SET.

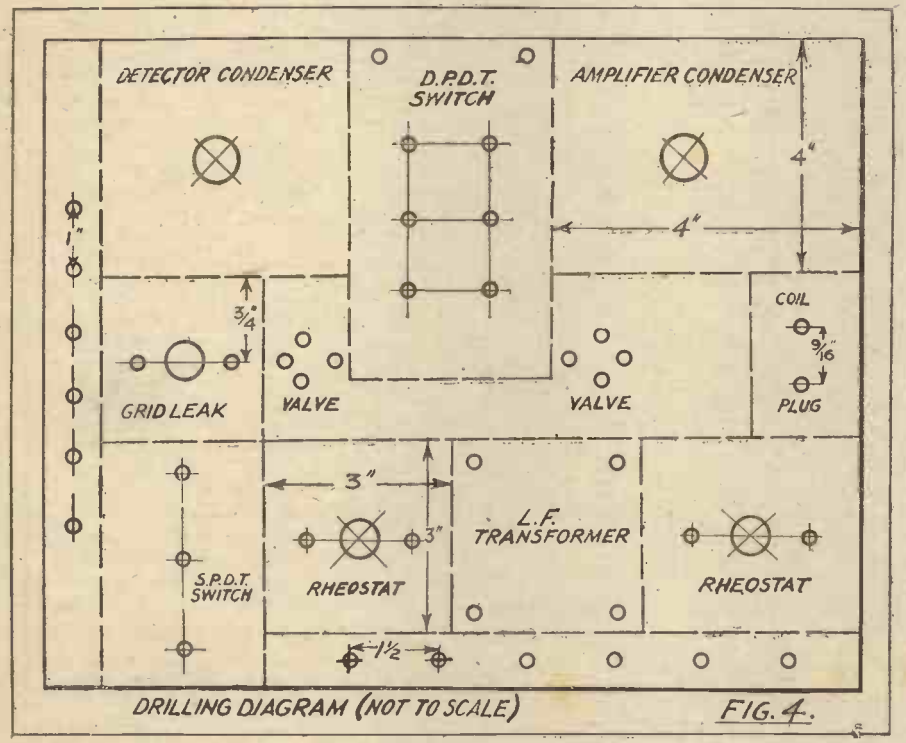
(Continued from page 1181.)

from actual measurements of the components themselves, or in the case of the rheostats, by means of the templates given with the instruments.

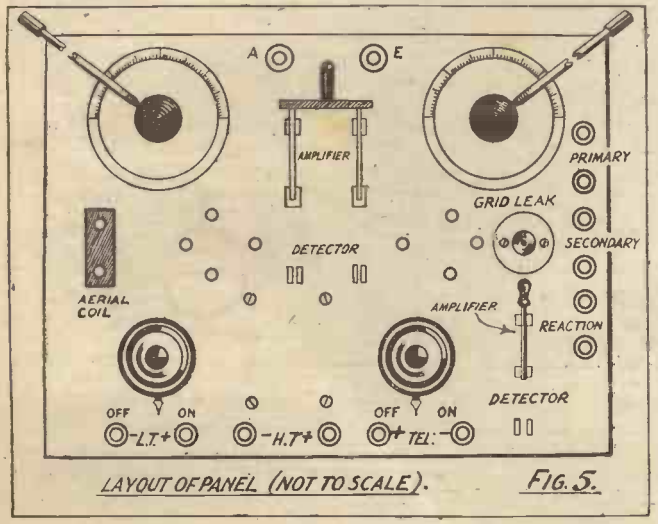
When this has been done, mark the centres for drills with a centre punch, or a sharp nail, and carefully drill out all the holes, drilling a small hole first if the hole required is above ¼ in. in diameter.

The polish on ebonite is a source of leakage, therefore, unless the ebonite is of a guaranteed brand all polish must be removed with emery paper.

The space allotted to the different components can be readily seen from Figs. 4 and 5, the latter being a top-of-panel view of the finished set.



DRILLING DIAGRAM (NOT TO SCALE) FIG. 4.



LAYOUT OF PANEL (NOT TO SCALE). FIG. 5.

Great care must be taken to see that all screws are tight, the terminals, etc., are secured in place by one nut, and another is then threaded on to secure the wire.

The fixed condensers are held in position by gauge 18 wire, which also connects them into the circuit in their respective positions; this is ample support for a condenser.

Wiring Up.

The constructor will find very little difficulty in wiring up by following carefully Figs. 6 and 7. The latter gives the directions taken by all wires, as well as the terminal to terminal connections of the receiver.

The connections for the fixed condensers are as follows:

·0002 mfd. across IS and OS on the transformer.

·001 mfd. across IP and OP on the transformer.

·002 mfd., across the telephone terminals.

·0004 mfd. grid condenser across the Watmel grid leak.

All connections made with No. 18 S.W.G. bare-tinned copper wire are best soldered, but if you are not really proficient in the art of soldering, do not attempt to do so, but make use of the binding screws, as there is no more common fault in a wireless set than a badly soldered joint.

The connections to the three-coil holder, which is mounted on the end of the cabinet are made by flexible leads taken from the terminals on the end of the panel marked P, S and R in Fig. 5. The order of the coils in the sockets is the same as the order of the terminals, namely, primary at one end, secondary in the middle, and reaction at the other end.

When wired, the panel must be fitted into the cabinet and secured by four screws.

Referring to Fig. 5, the switching for the different combinations is as follows:

Circuit.

1. Detector with reaction.
2. Detector with L.F. amplifier.
3. H.F. amplifier and detector.
4. H.F. detector and L.F. (dual).

D.P.D.T. Switch.

1. "Detector."
2. "Detector."
3. "Amplifier."
4. "Amplifier."

S.P.D.T. Switch.

1. "Detector."
2. "Amplifier."
3. "Detector."
4. "Amplifier."

The operation of the set is by no means difficult, but if it is your first-valve set it requires care and patience until you have got into the way of it.

The Set in Operation.

To receive your local station, place both switches into the "detector" position and plug a 35 coil into the secondary socket of the coil holder, or if the wave-length of the station is above 380 metres, use a No. 50 coil. In the reaction coil socket plug a 50 or 75 turn coil.

Now, leaving the coils well apart, and screwing the grid leak about three turns from the minimum position, turn on the detector valve alone, and rotate the handle of the condenser, which tunes the secondary, until something is picked up. Tune the signal to its loudest and bring the reaction coil nearer; if signals grow fainter instead of louder, reverse the connections to the reaction terminals, and repeat the process. When you have brought the signals to their greatest intensity without making the set howl, retune slightly. Now by lighting up the second valve and switching the S.P.D.T. switch into the amplifier position; on slightly retuning and readjusting the reaction coil, signals should be some five to seven times louder.

Now try replacing the secondary coil by a No. 75 and placing a 50 in the primary socket. The former aerial coil must be placed in the aerial socket on the panel.

Some Results Obtained.

Place the D.P.D.T. switch into the amplifier position and retune with both condensers, loosening the reaction coupling considerably. The signals will not be very much louder than before on a near station, but long distance stations should be comparatively easy to receive.

No constructional article is complete without an account of the actual results obtained with the receiver described.

This set is very stable on all wave-lengths, and will tune down to 100 metres with care, and if a variable condenser is inserted in the earth lead.

On a good aerial in Sheffield the set brings in the Sheffield Relay Station (200 watts only) loud on the loud speaker, using the set as a "dual" or as detector and L.F. amplifier.

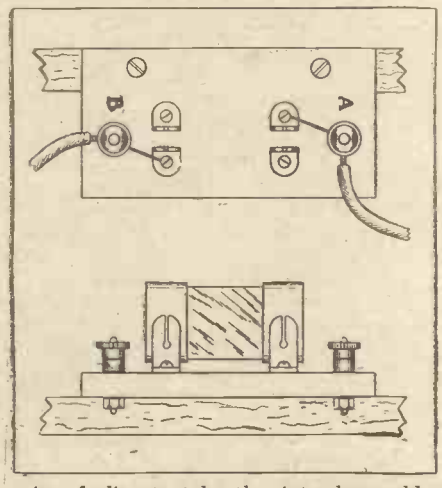
Manchester is quite loud on the loud speaker, as is Birmingham after dark, and

(Continued on page 1183.)

THREE USEFUL HINTS.

A Fixed Condenser.

A SMALL fixed condenser, the capacity of which is usually found by trial, will invariably add to the general efficiency of a crystal receiver when connected in series with the aerial lead-in, and where it is not convenient to mount the condenser on the panel or baseboard of the set, a separate fitting may be attached to the window-frame, or operator's table, in the manner shown in the sketch. This consists of a piece of matted ebonite, about 3 by 2 by ¼ in. in thickness, which is fitted with two

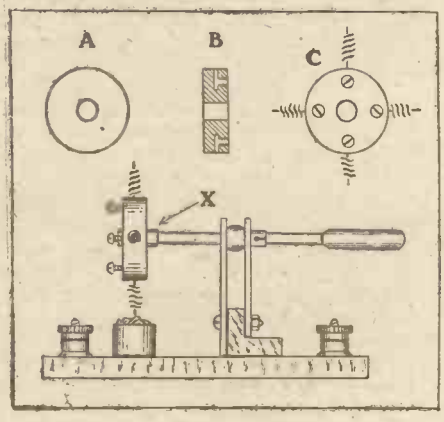


pairs of clips to take the interchangeable type of condenser. Two terminals, A and B, are connected to the clips as shown, one being joined to the aerial lead-in and the other to the aerial terminal on the receiver.

With such an arrangement a short circuiting or continuation link is, of course, desirable. This can be easily made up from a piece of thin board to which is attached a strip of sheet brass so arranged to make good contact with the slips when replacing a condenser. Alternatively, a simple "on and off" bell switch may be fitted between the clips. * * *

Multiple Contact Holder.

A simple holder, accommodating four different kinds of tentacles or "whiskers," and which can be easily made and fitted to any existing crystal detector of the type shown in the sketch, consists of an ordinary brass bush, A, as used for variable



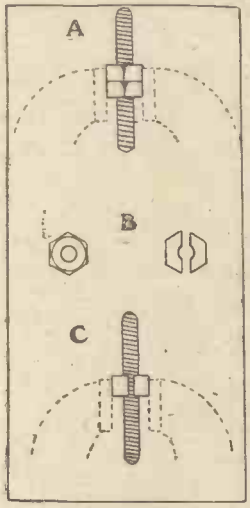
condensers, etc., which is drilled and tapped in the manner shown at B, and provided with four small clamping screws as shown at C.

The periphery of the bush is first marked off into four equal parts, four very small holes then being drilled down towards the centre of the bush to a depth of about ¼ in. The four holes on the side of the bush are then drilled to meet the smaller holes, these being carefully threaded by means of a plug tap, which, of course, should correspond in size with the screws to be used.

Usually, the hole through the centre of the bush is rather too large to fit tightly over the end of the detector spindle, and in most cases it will be necessary to provide a small brass sleeve, X, which should be soldered to the end of the spindle and then tapered off towards the end, so that it fits very tightly in the bush.

A Clamping Device.

It often becomes necessary to place a length of B.A. screwed brass rod in the vice for cutting, filing, or re-threading, and to prevent the threads from becoming damaged some sort of clamp must be provided.



The most usual method is indicated in diagram A where two lock nuts are tightened up on the rod and gripped in the vice. For the larger size rods this is usually quite satisfactory, but the threads of small rods are invariably strained when the nuts are tightened up, and to avoid this it is best to split a nut by means of a hacksaw and use this as a clamp as shown at B and C.

HOW TO CONSTRUCT A "FOUR-CIRCUIT" TWO-VALVE SET

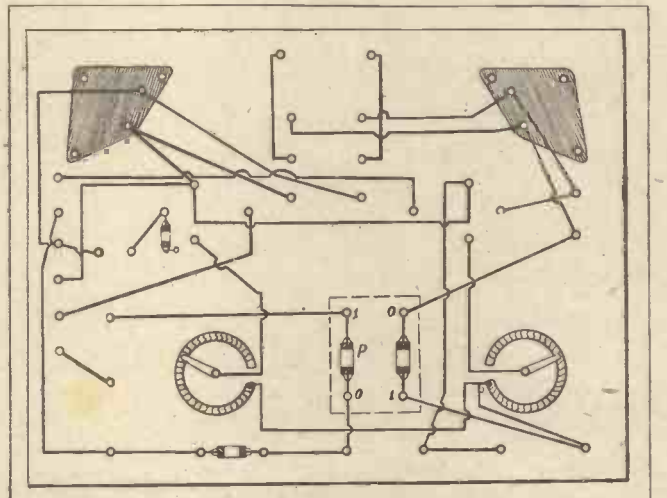
(*Continued from page* 1182.)

Chelmsford in all atmospherical conditions.

After dark all the B.B.C. stations can be received well in the 'phones and occasionally well on the loud speaker.

Radio - Paris and Brussels (265 m.) are always very good in the 'phones after dark and many of the German stations can be easily picked up, results varying, of course, with different conditions of the ether.

As a general guide, however, any station that can be heard on a crystal set will give good loud speaker reproduction on this set from the same aerial.



BACK OF PANEL WIRING DIAGRAM (NOT TO SCALE) FIG. 7.

In conclusion, a word of warning as to modifications of design and so-called improvements. As Captain Eckersley says about oscillation, "Don't do it," that's all.

You cannot hope to get the best results unless the original design, which has received every attention possible, is strictly adhered to.

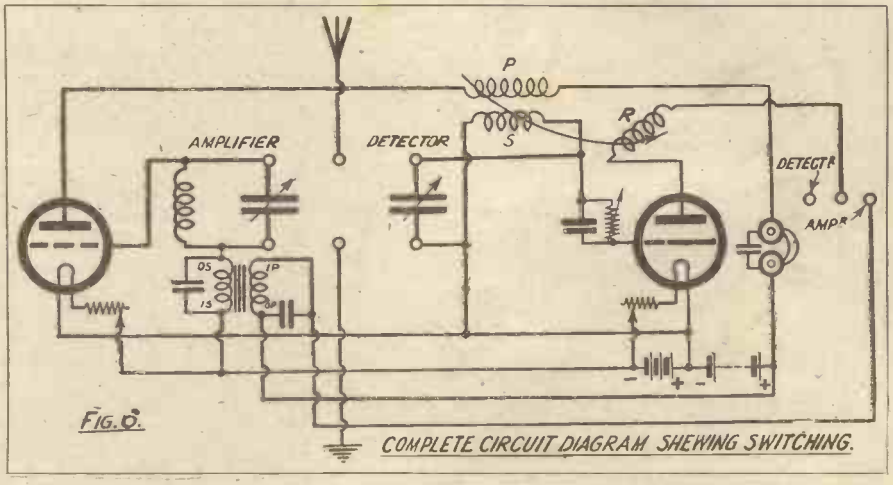


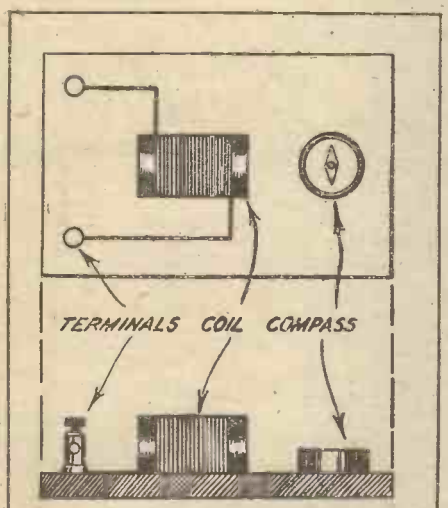
FIG. 8. COMPLETE CIRCUIT DIAGRAM SHEWING SWITCHING.

Constructional Notes

Conducted by Dr. J. H. T. ROBERTS, F.Inst.P.

Polarity Indicator.

THE experimenter continually finds the need for some simple and ready device for determining the polarity of current supply terminals. There are many such devices, some of them depending upon electrolysis, but perhaps the simplest, and certainly one which, when once made is of permanent use, is the one shown in the drawing. It will be seen that this consists in effect of a rudimentary galvanometer, a solenoid being secured to a small wooden baseboard and an ordinary compass-needle being placed in such a position that it is affected by the magnetic field from the solenoid when current passes through the latter. The solenoid can be secured to the baseboard by means of a strip of wood or cardboard, and the compass by means of a little Seccotine. An accumulator is connected momentarily to the terminals of this device, with such polarity that the north pole of the needle turns towards the solenoid, and the positive and negative terminals of the device are then permanently marked accordingly. For subsequent use, any leads whose polarity is to be determined may be momentarily connected to the terminals



POLARITY INDICATOR

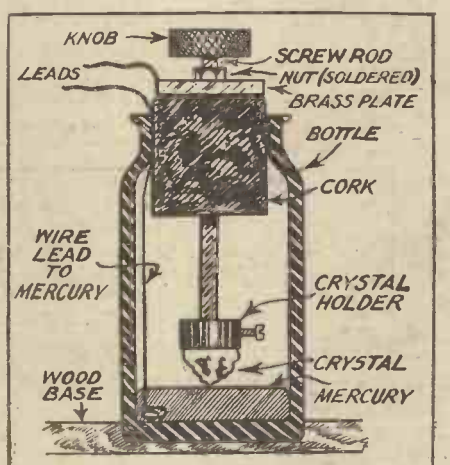
of the device, when the direction taken up by the needle will at once indicate the polarity. If desired, the solenoid may be made of fairly fine resistance wire, say any gauge between 30 and 40, or a resistance may be included in series with it, so that the current passing through the instrument shall not be large enough to cause damage to small dry batteries, for example.

* * *

Novel Crystal Detector.

Here is a crystal detector which is quite a departure from those generally in use. The principal feature of this detector is that it makes use of mercury for the contact to the crystal, in place of any form of wire or strip cat's-whisker. This in itself is equivalent to a large number of cat's-whiskers in parallel, since the mercury touches the crystal at a large number of points, in fact over a considerable area.

For the actual design of the device the details are not important, but the arrangement shown in figure is convenient. By

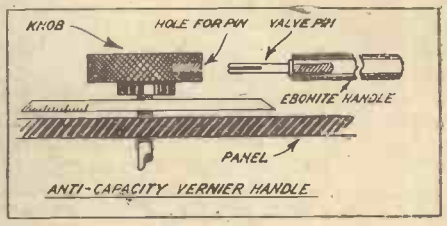


NOVEL CRYSTAL DETECTOR

using a small bottle for the container, there is no danger of the mercury being upset or lost, and if any shaking occurs, as it is bound to do, the mercury automatically runs back into its proper place again. Only a very small quantity of mercury is required—a globule about the size of a shilling. A wire lead will be needed to pass alongside the cork, to make contact with the mercury. The crystal should be secured in the crystal holder preferably by means of a screw, as if Wood's metal or other such alloy is used the mercury will almost certainly attack and dissolve it in time. A small metal plate is shown at the upper part of the cork, with nut for making contact with the crystal control shaft, but actually this is not necessary. For the adjustment of the crystal, the motion of the screwed rod through the cork will be found to be sufficient. When completed, the device may be secured to its baseboard by means of a small piece of wood, in which a hole is cut, large enough for the base of the bottle to make a tight fit. The rest of the work may be completed by means of a little Seccotine judiciously applied.

Anti-Capacity Vernier Handle.

The annoying effect of hand-capacity with a variable condenser is well-known, and for this reason an anti-capacity insulating extension handle is often very useful. Furthermore, if the tuning is critical, the anti-capacity handle may also be arranged as a vernier adjuster. It is also useful if the extension handle can be readily attached and removed. For this purpose, the valve pin, which can be applied to a surprisingly large number of useful pur-



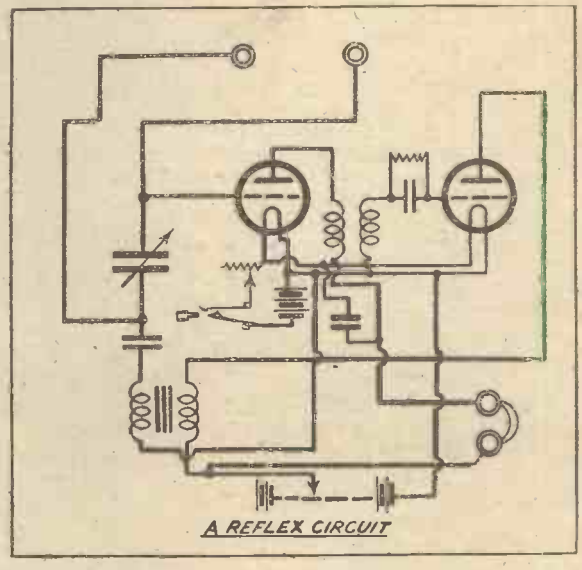
ANTI-CAPACITY VERNIER HANDLE

poses, comes in very handy. As will be seen from the illustration, a valve pin is screwed into a hole drilled in the end of an ebonite rod, the latter being, say, 6 in. in length, and $\frac{3}{8}$ in. in diameter. A hole of appropriate size is drilled in the side of the control knob of the condenser. The extension and vernier handle can then be inserted or removed as desired. In case this extension handle fouls any of the other controls on the panel, it is useful to drill three or four holes, at equal distances around the condenser knob, the extension handle being inserted into whichever hole is most convenient.

* * *

A Reflex Circuit.

The theoretical circuit shown in the accompanying diagram, which is taken from patent 18,937/23 (Sharman), illustrates an interesting system of dual-amplification. The principal feature of the circuit is the small blocking condenser in the grid-filament circuit, which insulates the grid from the grid-coil, and adjusts it automatically to the correct negative potential. This system can be applied to any number of valves, even where common high-tension and low-tension batteries are used, and it is claimed that there is no tendency to howl.


A REFLEX CIRCUIT

Brandes

The name to know in Radio

All Brandes products carry our official money-back guarantee, enabling you to return them within 10 days if dissatisfied. This really constitutes a free trial. Brit. Manuf. (B.B.C. Stamp).

–for Young Bill

The fever of the experimenter has fired young Bill's ambition. In the picturesque vernacular of our American friends he's "cottoned on to the hull bunch"—vacuum tubes, hook-ups, new wave bands, right down to the last binding post. He tunes in the distant stations now with his *Matched Tone* Headphones, and is content. They bring in the faintest signals, their delicate supersensitivity making them unexcelled for long range telephony.

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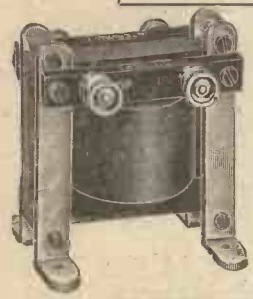

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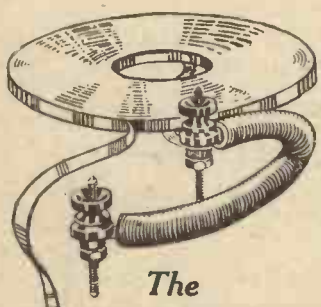

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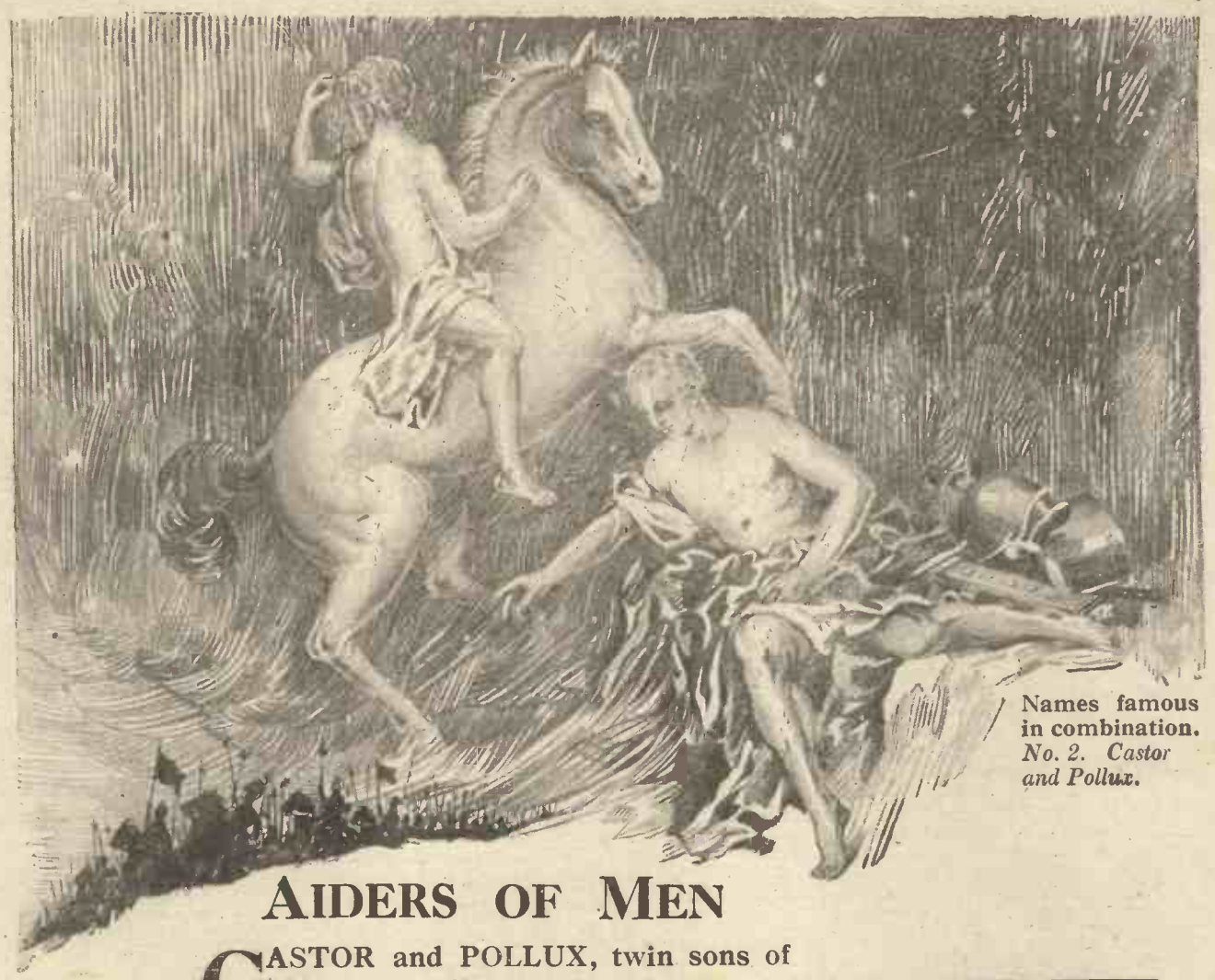

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PRACTICAL IDEAS FOR EXPERIMENTERS.

An "Overload Release" for H.T. Batteries—Controlling Reaction—Accumulator Fault Hunting—Engraving Metal Parts.

By B. F. SHORTT.

NEARLY every experimenter boasts a fuse in the H.T. circuit of his valve set in order to prevent mishap to his valves.

In a great many cases this takes the form of a small flash lamp bulb which at the best of times is inconvenient. Generally the fuse is the last thing one thinks of inspecting when the set goes off after messing about. A novel arrangement that is "ever-ready" is depicted in Fig. 1. This is nothing more elaborate than a small

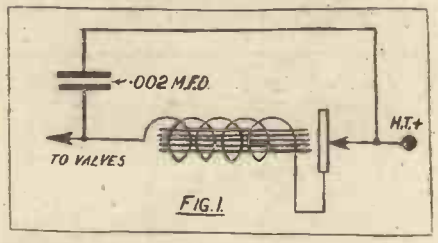


FIG. 1.

buzzer such as a Townsend, shunted by a ·002 block condenser and inserted in the positive H.T. lead.

If a valve happens to have the filament accidentally placed across the H.T. battery a warning buzz is emitted, reminding one to be careful.

As the inductance of the buzzer is appreciable the current never rises to a value sufficient to burn out the valve. As a matter of fact the filament is barely reddened.

The purpose of the block condenser is to act as a by-pass for high-frequency current, although if desired this may be omitted as it is not essential. The normal H.T. current is not sufficient to operate the buzzer and thus firm contact is maintained.

Controlling Reaction.

From time to time several methods of controlling reaction and self oscillation in regenerative receivers have been put forward, including damping plates, potentiometers, choking coil resistances, etc., all of which are successful.

Perhaps the method illustrated in Fig. 2 is not known, the writer having only recently tried it out.

Looking at Fig. 2, it will be seen that instead of using the usual grid condenser as a means of imposing changes of potential on the grid of V2, a different system is adopted.

A tuning plate, P, is made to slide over the tuned anode coil B, so that the plate coil itself forms the other. In this way the transference of energy from V1 to V2 may be controlled in such a manner that reaction becomes a real joy. On very short wave-lengths it will be found that a reaction coil becomes unnecessary.

An Interesting Experiment.

If the anode coil B is of the basket or honeycomb type, it is an easy matter to make a plate of brass or zinc the same size and to arrange it to either slide over the coil or swing in and out like a door.

When B takes the form of a cylinder, however, the plate must be made to fit half way round it and the same length.

It will be noticed that altering the position of the plate P necessitates a further adjustment of condenser C1. It must be remembered, of course, that when the Plate P is all in it reduces the wave-length range of coil B and condenser C1, and for that occasion it may be necessary to add a little extra inductance to the circuit.

It is an interesting experiment, and should prove useful in multi-valve sets employing several stages of high frequency.

Although in Fig. 2 the plate is shown interposed between the tuned anode coil and the reaction coil in order to simplify the diagram, it is much better to place it on the opposite side to that to which the reaction coil is coupled.

Accumulator Tests.

For those who do not possess a voltmeter the following is a very easy way of finding out the condition of an accumulator. Provided a battery which is known to be fully charged is at hand all that is necessary is one of those small one or two-volt bulbs used for tie-pins, or the like. For instance, looking at the diagram Fig. 3, if battery A (let it be six-volt) is known to be fully charged, and battery B, also a six-volt, is doubtful, then by connecting the two bat-

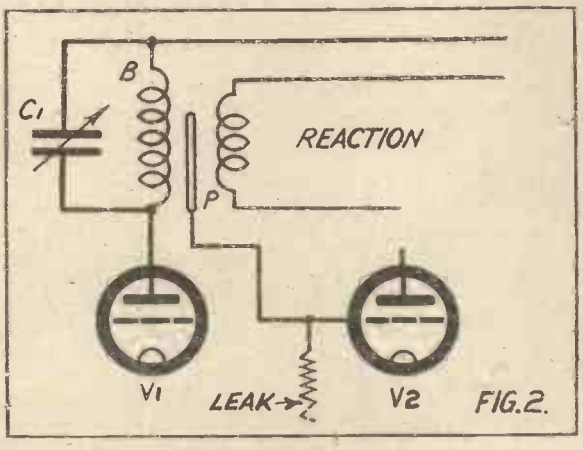


FIG. 2.

teries and bulb as shown, the brilliancy of the bulb is a good indication of the condition of B.

The explanation is, that since the two batteries are connected in opposition, the back E.M.F. of the discharged battery is not sufficient to counteract the E.M.F. of the charged battery, and hence a certain amount of current flows in the circuit, the amount of which is shown by the bulb. It will readily be seen that the lower the E.M.F. of one battery in respect of the other the brighter the bulb will be. It is absolutely essential to connect the two positive poles of the batteries together, and as a suggestion the two negative poles might also be connected together. Then instead of using a bulb, a small pocket compass placed over one of the wires would show by the deflection of the magnetic needle the strength of current flowing, or in other words the state of the battery which is run down.

Engraved Tabs.

It is sometimes desired to make and engrave metal tabs for certain purposes, but most amateurs are at a loss as to how to

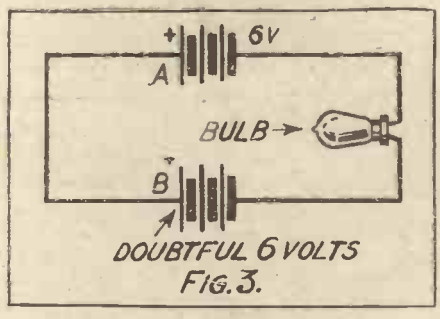


FIG. 3.

accomplish the task. The following description of two successful ways of doing it may therefore be of assistance.

By either of these methods it is possible and even simple, to engrave terminals, battery connectors, name plates, and a hundred and one different things. All that is necessary is a glass or earthenware jar, some copper sulphate crystals (which can be obtained at any chemist's), a battery, and some shellac varnish or paraffin wax.

The principle of the operation is that copper is electrically deposited on the material in such a way that one can have copper letters on, say, an aluminium background, or aluminium letters on a copper background. Brass, owing to its similarity in colour to copper, does not exhibit quite as good a contrast when finished as a brighter metal like aluminium or zinc.

The Process.

Let us take the first method and suppose a small tap is to be made for an accumulator case with the letters L.T.+ engraved on it.

Procure a piece of zinc sheet, which is an easy metal to work. Having cut it to the required shape, thoroughly clean it by sandpapering, and finish off with the finest grade of emery cloth, so that it will present a smooth polished surface.

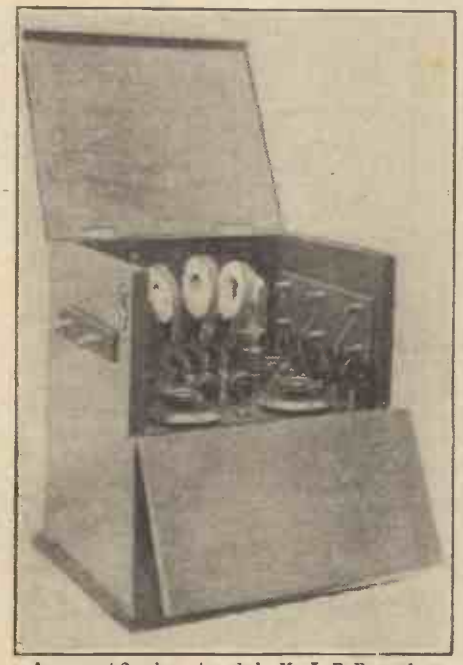
A copper wire connection must now be attached to one end, after which the whole is immersed in molten paraffin wax. Carefully drain off any superfluous wax and allow the zinc to cool, when it will be

(*Continued on page* 1190.)

A USEFUL SLIDE INDUCTANCE.

By O. J. RANKIN.

THE experienced enthusiast, having passed through the radio mill and having accustomed himself to the many rapid changes in the design of receiving apparatus, is very strongly inclined to regard the humble slide inductance as an obsolete tuning device; but there is no doubt that if this instrument is properly constructed, and used in its proper place, it still remains one of the most useful gadgets an experimenter can possess. A few points in its favour are: (1) It is simple in construction and use; (2) it is not expensive; (3) it is an ideal tuner for the beginner; (4) no tuning condenser is required; (5) it is the equivalent to a tapped coil which is tapped at every single turn; and (6) it is a very useful "gauge" for ascertaining the correct number of turns required for loading coils or for coils to be made up on the unit principle.



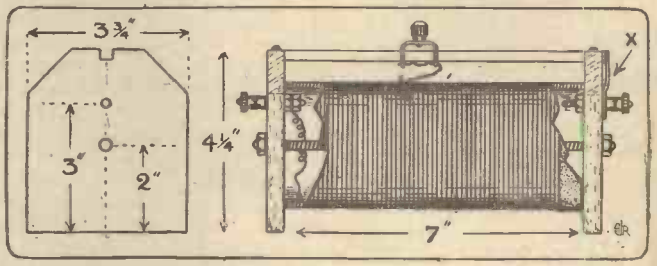
A compact 2-valve set made by Mr. L. R. Everard, "Fernlea," 70, Waterhouse Stree , Chelmsford.

Easily Constructed.

The instrument shown in the accompanying sketch was designed for use as a general purpose experimental coil on the broadcasting wave-lengths, and as such it has always given entire satisfaction. The two coil ends are cut out from ⅜ in. sheet fibre, the dimensions being as given in the figure.

The cardboard former is 7 in. long by 3 in. in diameter, and, after being well impregnated with melted paraffin wax is given a coat of thick shellac varnish and then wound with No. 24 enamelled copper wire, a space of about ½ in. being left at each end. The wire should be wound on when the shellac is in a semi-dried condition, and thus only about one-third of the former should be coated at a time.

If this operation is carried out in the proper manner, it will not be necessary to shellac the whole winding when the coil is complete. Having prepared the two end supports, fit an ordinary terminal to each and connect one end of the coil winding to the left-hand terminal, as shown in the sketch. The other end of the winding is, of course, left open, this being tucked away inside the former, as far away from the right-hand terminal as possible. The coil may now be temporarily clamped between the two supports by means of a 2 B.A. threaded brass rod and two nuts, a short strip of copper tape (X) being first clamped under the shoulder of the right-hand terminal.



Fisishing Off.

This forms the connection between the slider bar and the terminal, and is afterwards bent out clear of the fibre support, soldered to the end of the slider bar, and cut off flush with same. This operation should be carried out before screwing down the bar. A stout wire helix may be used in place of the copper tape, and, although this will not present such a pleasing appearance, it may be found a more convenient method of making the connection.

The slider bar is let in flush with the tops of the supports, as shown, and ,the slider is preferably of the flat spring type, as described in a past issue of POPULAR WIRELESS.

Before finally tightening the nuts on the central rod, the coil should be adjusted so that the slider makes a perfectly smooth yet firm rubbing contact along the whole length of the winding.

The instrument is completed by binding a length of "Empire tape" round each end of the coil, the ends being secured by means of a little seccotine.

PRACTICAL IDEAS FOR EXPERIMENTERS.

(Continued from page 1189.)

observed that it is covered all over with an insulating film of wax. With the aid of a pencil or sharpened match stick the letters can be inscribed through the wax, leaving the bare metal exposed underneath. The letters must be clear and distinct, and the brass which is visible must be clean in order to facilitate the copper plating which is the next part of the operation to be performed.

Copper Plating.

Pour enough boiling water into a glass jar as will accommodate the article to be plated. Mix the crystals into the water and dissolve sufficient to make a strong solution of copper sulphate. The liquid must now be allowed to cool until it is tepid. A piece of copper is next attached to the positive pole of either a 4-volt accumulator or a small flash lamp battery. If a piece of copper cannot be obtained, a length of heavy copper wire bent up will serve the purpose quite well. The tab is likewise connected to the negative pole and both placed in the solution about 2½ in. apart. If allowed to approach each other too closely the tab will become coated with a black scaly substance which easily peals off. When plated properly, however, it will assume a bright yellow colour on the letters. Half an hour is long enough to leave the tab plating. It must then be taken out, dried well, and the paraffin wax melted off. Copper letters will be left on the zinc, and the whole tab must be polished up with fine grade emery cloth again.

The second method is much more easy to carry out, and might be said to produce a better finish than the one described above.

In this case bright zinc letters are shown against a copper background. The zinc is cleaned thoroughly as before, but the letters this time are written in an insulating substance, like thin shellac varnish. The writer has found shellac varnish to be the best and simplest insulating liquid to use.

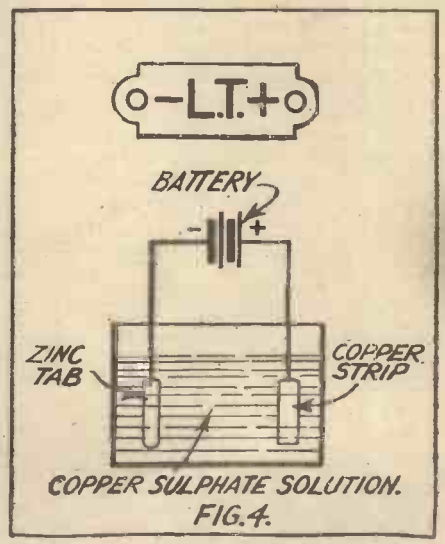


FIG. 4.

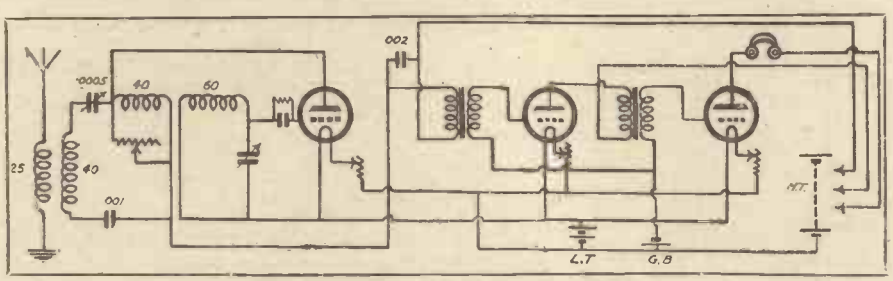
When the necessary writing has been carried out the varnish is allowed to dry—heating will cause it to dry rapidly. The copper plating is then carried out exactly as before. When a sufficient amount of copper has been deposited, the zinc must be dried and then immersed in methylated spirit for a little while, so that the shellac becomes dissolved off the zinc.

A SUPER-SELECTIVE CIRCUIT.

By L. W. CORBETT.

This is the second and concluding part of an article describing a circuit which has become exceedingly popular with American amateurs.

THE addition of two stages of L.F. amplification to this receiver should present no difficulty, and no departure should be made from the circuit itself. Signals of singular clarity and volume may be obtained from the completed three-valve receiver, and, providing good components are used throughout, it will make an ideal set for loud-speaker work.



Theoretical Diagram of the 3-valve Filter Circuit.

In the amplifier the transformers especially should be of the highest grade. The first should have a ratio of 1–5 or 1–4, and the second—if anything—a little lower. Faulty transformers are the cause of much distortion, which is often prevalent when L.F. amplification is employed—especially when two stages are in use.

If it is desired to eliminate the second stage of amplification at times, this may be accomplished quite simply by means of a single-pole double-throw switch, as shown in the accompanying diagram. The centre stud of the switch, to which the blade is attached, should be wired to the plate terminal of the first amplifying valve. One stud should connect to the plate of the final valve and the remaining stud to the input primary (I.P.) of the last L.F. transformer.

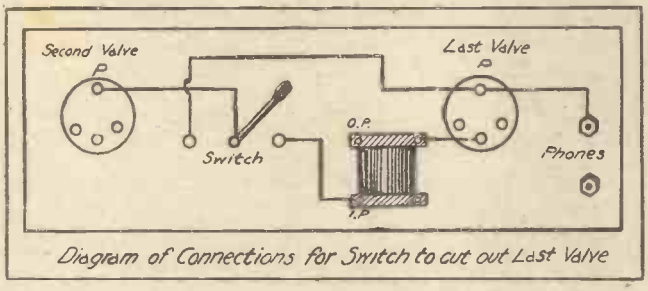


Diagram of Connections for Switch to cut out Last Valve

The Transformer Connections.

The correct connections for the two transformers (excluding the switch) are as follow (these may possibly vary with different makes): I.P. to plates, O.P. to H.T.+, I.S. to grid bias battery negative, O.S. to grids.

As will be seen by the diagrams, the ·002 fixed condenser, which was placed across the 'phone terminals of the original single-valve receiver, is left in this position, thus taking up a place across the primary of the first transformer, the primary of which is, of course, connected to the 'phone terminals. The voltage of the H.T. battery will depend on the valve used, but with the ordinary R. type a voltage of about 90 is advocated, and provision should be made to supply different voltages to each valve. The grid battery will probably be about 4½ volts. For this a flashlamp battery will be O.K., but it should be unsealed, so that either 1½, 3, or 4½ volts may be used. Two of these 4½-volt batteries in series may be necessary. Here is a list of the required parts for the complete three-valve receiver:

One panel 7 × 20 in. is a useful size if the valves are mounted inside the cabinet, American fashion.

Wooden cabinet—to take panel.

Three rheostats.

One variable rheostat, with a guaranteed minimum resistance of 10,000 ohms and maximum of over 25,000. Remember that I stated that this latter value was not very important. It should not exceed 100,000 ohms.

One tuner, built exactly to specifications.

One half pound of 20 S.W.G. wire, D.C.C.

One ·0005 mfd. variable condenser with vernier.

One ·00025 mfd. variable condenser with vernier.

One ·001 mfd. fixed condenser.

One ·002 mfd. fixed condenser.

One grid leak of 2 or 3 megohms.

One grid condenser of about ·0003 mfd.

Three valve holders.

Two L.F. transformers (1–5 ratio each may be used, but those specified preferred).

Terminals, screws, brass angles (for fixing coils to panel), etc.

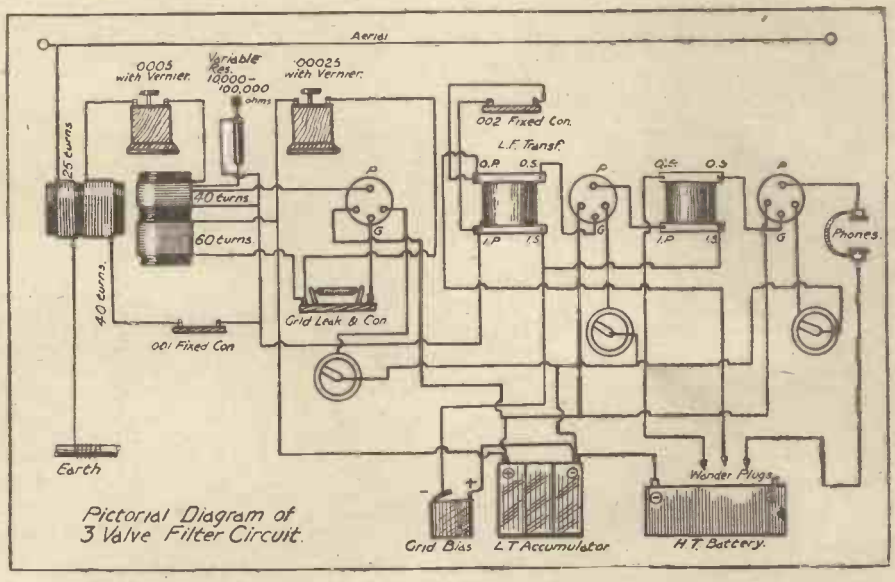
This completes the list, so you will see that it is no more expensive to build than any three-valve receiver.

Caused a Wire Shortage.

A ·005 fixed condenser across the output terminals of the last valve often improves the tone of the signals.

Let me again emphasise the selective properties of this circuit. One delighted builder wrote to the New York "Evening Journal," and said that he was able to cut out W E A F, and he was only a few doors away—and a neutrodyne failed to accomplish this.

Such a furore has the circuit created in America that it was at one time difficult to get 20 S.W.G. wire, so great was the demand for it. Another reader wrote saying that he was able to cut out his local station with a movement of less than one degree on his condenser dial. This shows how important it is to include verniers with the condensers.



MORE INTERESTING VALVE CIRCUITS.

By G. V. DOWDING, Grad. I.E.E., A.C.G.I.
(*Technical Editor "Popular Wireless."*)

At one time there was a great deal of interest displayed by amateurs in connection with "aerialless" circuits, but that was before it was discovered how really useful an indoor aerial can be if properly erected, and perhaps before it was realised that an outdoor aerial of most modest pretensions would in many cases give really good working results with conventional apparatus.

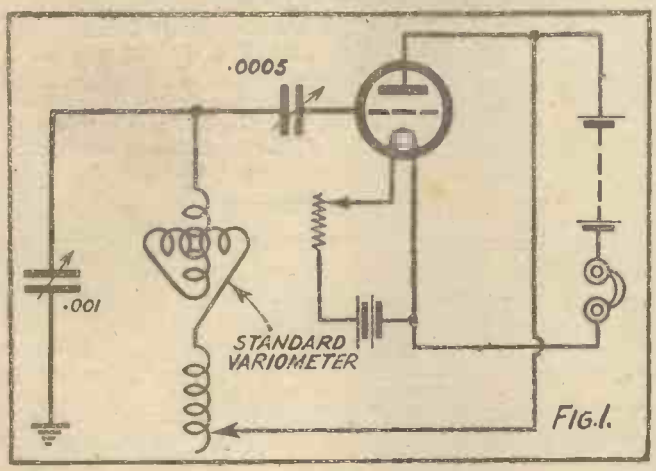


FIG. 1.

However, a circuit that will function well with only an earth connection can prove very useful, as it is possible to move a receiver constructed on such lines from room to room, obtaining earths on gaspipes and fireplaces.

The circuit shown in Fig. 1, which was initially described by that well-known contributor, O. J. Rankin, in "P.W.," some long time ago, has been credited with interesting performances.

In series with the variometer a coil is shown. This consists of 60 turns of 26 D.C.C. wire on a 3-in. former tapped at every fifth turn.

Two variable condensers are required, while it will be noticed that no grid leak is used. Some amateurs, however, have found that the insertion of this is essential for best results, and that such should be connected with the grid and L.T. battery minus. Others have found that a ·002 mfd. fixed condenser across H.T. and 'phones tends to improve reception.

Seekers after selectivity and readers who suffer badly from local jamming should give the circuit shown in Fig. 2 a trial. Range of reception and signal strength do not exceed ordinary one valve and reaction results, but it has been proved to be very selective when handled carefully. Basket or spider wound coils should be used, although some readers have discovered that the ordinary plug-in type are just as good for the purpose. The aerial coil (25 turns) should be kept well away from the other two coils and mounted at right angles to them.

Another selective circuit which is capable of greater ranges of reception is shown in Fig. 3. It will be seen that it is provided with capacity reaction, and that its tuning controls include three variable condensers.

It has been recorded capable of receiving all the B.B.C. stations with clearness in different parts of the country, but in no instance has it proved capable of even small loud-speaker work. The reaction control is provided by the condenser C 2, while C 1 is the actual wave-length tuning condenser. The filament control has been proved to be rather critical, so that in the manipulation of the circuit no less than five adjustments have to be attended to. The aerial coil can consist of either a 50-turn basket or honeycomb, while, as is indicated, a hard valve with a fair amount of H.T. should be used.

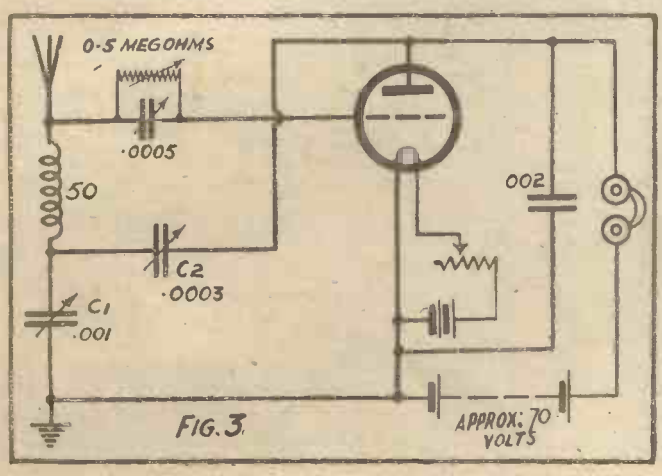


FIG. 3.

Once more we must stress the fact that most of the "interesting" one-valve circuits are only suitable for the use of amateurs who have had previous valve experience, as they are nearly all users of "fierce reaction," while the results claimed for them will only be obtained in fairly expert hands. Another point well worth emphasising is that in few cases can stages of H.F. amplification be added, or even L.F. unless separate batteries throughout are used. Therefore they are circuits that stand alone on their merits, and do not lend themselves to extension without modification and this latter generally tends to make the circuits assume orthodox powers.

NEXT WEEK.

Another supplement will be given away with every copy of next week's "P.W."
"Nineteen Pictorial Circuits" is the title, and amateurs will find these specially drawn circuits of great value and assistance when "trying out" various "hook-ups."

Order your copy of Next Week's "P.W." now.

Before concluding, readers will probably appreciate a few words in respect of suitable components for such circuits as have been detailed, or which will be dealt with in future articles. In general, "hard" all-purpose valves should be used; for example, the Marconi "R," B. T.-H. "R," Ediswan A.R. are bright emitters which generally function well in almost any "super."

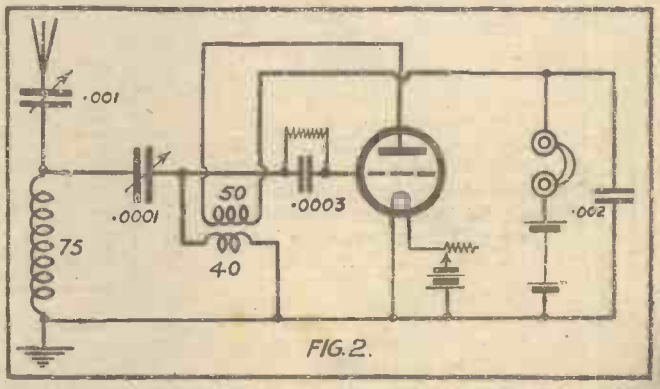


FIG. 2.

Among the dull emitters those taking ·25 or so amps., such as the D.E.R., should be favoured, although there are several dull emitters among the B.T.-H. range which, taking considerably less, behave well in most such circuits.

Important Points.

Variable grid leaks, even where not specified, are generally a useful addition, while the carbon type of filament resistance, such as the Lissenstat, would in every instance prove an advantage.

Extension handles to all tuning controls are to be advised, while variable condensers with vernier attachments are distinctly to be recommended. Attention should be paid to wiring and component spacing, the wiring especially being arranged as non-capacitively and non-inductively as possible.

HOW TO MAKE A TELEPHONE DISTRIBUTOR BOARD.

FROM A CORRESPONDENT.

This easily made component is one which every owner of a wireless set will find constantly useful.

WHEN one wishes to use three or four pairs of 'phones, the best way is to use a terminal board. The one illustrated will be found very simple to make, but serves the purpose admirably.

There is provision for four pairs of 'phones in series, and with a length of twin flex may be taken to any room in the house.

When less than four pairs of 'phones are being used, the spare terminals should be shortened with a U-shaped piece of wire.

Soldering is Advisable.

The ebonite is 6 in. by 3 in. by $\frac{3}{16}$ in. thick, and the end pieces are $\frac{1}{2}$ in. square, mahogany, fixed with two screws.

The drilling and wiring can be followed from the sketch and photos.

Eight telephone terminals will be required, and two W.O., or similar type, the latter being for the leads from the set.

The ebonite panel should be good quality, and unless guaranteed against surface leakage, should be rubbed down with fine glasspaper. Do not use emery cloth as the cutting material in this is a conductor, and a certain amount of the grit is sure to be left embedded in the ebonite, thus making a good leakage path.

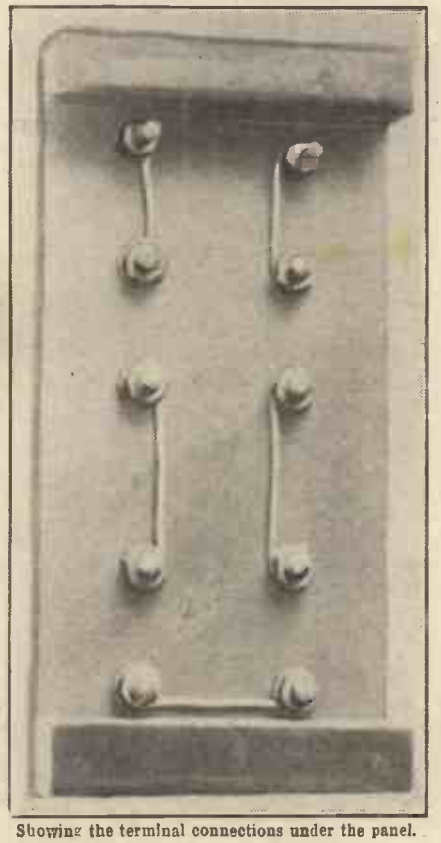
The holes are all $\frac{3}{16}$ in., with the exception of the four screw holes at the corners, these being $\frac{1}{8}$ in. Four brass button-headed screws $\frac{1}{2}$ in. long are used for fixing the two wood end pieces.

In the photograph the wiring is shown clamped under the terminal nuts, but these connections would be better soldered. Tin the ends of the terminals after tightening up and then again tighten them before soldering the connections.

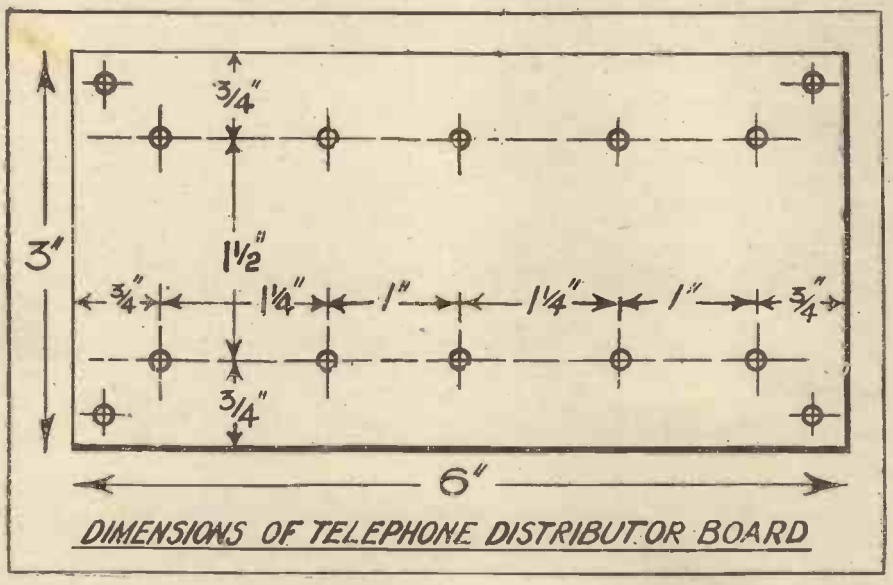
A photograph of the telephone board in its completed form. The two terminals at the back are for connecting it to the receiver.

The end pieces may be given a coat of varnish or polish and a hook may be screwed into one of them so that the board may hang up in any convenient place.

For a minimum expenditure we have a substantial article with no complicated switch, and quite easy for the most elementary amateur to construct.



Showing the terminal connections under the panel.



DIMENSIONS OF TELEPHONE DISTRIBUTOR BOARD

Conducted by Dr. J. H. T. ROBERTS, F.Inst.P.

Eliminating Spark Interference.

SO many experimenters, particularly in coast towns, suffer from spark interference, that the following brief summary of the methods by which it can be overcome, from the "Irish Radio Journal," seems well worth quoting:

"The best method of eliminating bad interference with broadcast reception by spark transmissions is to employ a two-circuit tuner, such as a loose-coupler, or by constructing plug-in coils in such a manner that one of the coils, together with the aerial and the earth, forms the aerial circuit, whilst the remaining circuit is formed by connecting the second coil to the L.T. of the first valve and to its grid. This will give a closed inductance circuit.

Loose Coupler.

"If a loose coupler is employed, a variable condenser of about ·0005 mfd. should be

(Continued on page 1222.)

Mainly About Broadcasting by The Editor

A REMARKABLE illustration of the effect of broadcasting on theatres is reported from the United States, where, quite recently, a crisis in the amusement world arose through the action of certain famous singers in giving a free broadcast concert. John McCormack, the famous tenor, and Lucrezia Bori, a soprano of the New York Metropolitan Opera House, decided to broadcast a concert to be relayed from seven different broadcasting stations. The American Press estimates that something like six to eight million people heard the concert.

What Will Happen ?

On the night of the concert theatre managers were dismayed to find their theatres practically empty. In fact, the only house to do any business was the New York Metropolitan Opera House. The theatrical managers immediately entered a protest against the McCormack-Bori concert. They declare that such concerts seriously threaten their business, and the fact that the theatres in New York were half-empty on the night of this special broadcast concert proves, in the managers' opinion, the desire of the public to stay at home and listen to concerts.

It is difficult to say what will happen if other famous "stars" decide to broadcast special concerts like this. But at the moment it seems hardly likely that many other stars will follow in this direction, because, in the present stage of radio development, it is impossible for big singers to obtain the fees by broadcasting which they obtain by giving concerts, etc., in the theatres and concert halls.

The Savoy Orpheans.

Recently, for the first time in history, the Queen's Hall, London, found itself in the hands of an American syncopated orchestra. I attended the concert given by the Savoy Orpheans, the Savoy Havana, and the Boston Orchestra. The Queen's Hall was packed from floor to ceiling. There was not a single seat vacant, and a more enthusiastic audience would be hard to find. One finds almost excessive enthusiasm at some of the Promenade concerts, but the Savoy Orpheans received this at the Queen's Hall almost to a pitch of frenzy.

* * *

I saw several famous music critics sitting in the hall with a puzzled look on their faces. No doubt the Savoy Orpheans had given them a severe jolt, and some of the high-brows must have been comparing the classical concerts given in the famous hall to the items played by the bands which every listener-in is familiar with. But say what you will, the Savoy Orpheans gave a thoroughly entertaining concert; there was not one dull item in their programme, the audience being kept at a high pitch of excitement throughout the evening, and such applause has, I should say, seldom been heard in the Queen's Hall.

I hope the Savoy Orpheans will give another concert. I am quite sure if they took the Albert Hall and allotted the majority of the seats at very reasonable prices they would fill it many times over.

* * *

The "Manchester Guardian" announces that preparations for elaborate researches into the effects of a solar eclipse on wireless transmissions are being made in the United States. The "Scientific American" is primarily responsible for these researches. It is expected that, by means of coupons containing seven questions relating to various phases of the eclipse on January 24th, when filled in by listeners who participate in the tests, will result in a collection of facts which will materially help to solve some of the problems of radio transmission which at this date remain clouded in mystery.

Listeners to Help.

Preparations are also being made for a number of very comprehensive studies of wireless conditions during the eclipse, and automatic recorders will be erected at several points in the shadow path for obtaining accurate records of the signal strength of certain broadcasting stations before, during, and after the eclipse. Listeners-in are being asked to note what is read out from certain broadcasting stations, and to report to officials any change in intensity in signals. They are also asked to report at what precise word in the speeches they notice any difference in signal strength —whether the signals fade or become stronger.

The National Research Council of America, and other bodies, anticipate, as a result of this test, much useful data which will throw light on the mysteries of "fading."

Sir Oliver's Lectures.

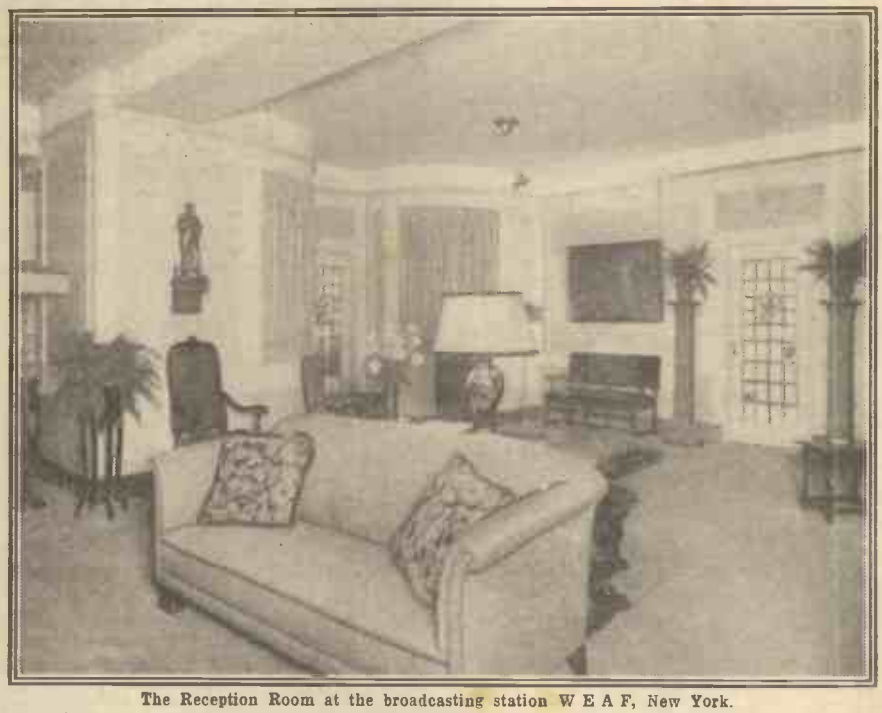
I have been receiving many letters from listeners-in asking me to convey to our scientific adviser, Sir Oliver Lodge, their good wishes for the New Year and their congratulations on his forthcoming series of broadcast lectures on "The Ether of Space."

* * *

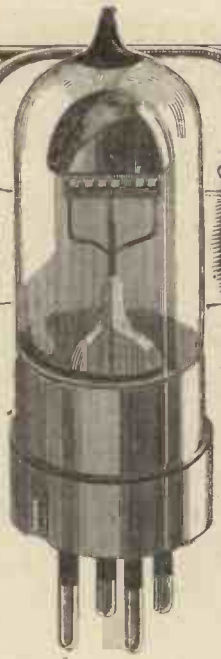
Sir Oliver asks me to mention in this issue that he very much appreciates the messages of goodwill sent to him from readers of POPULAR WIRELESS, and in a letter to me he says: "Please thank my kindly correspondents for their good wishes and prospective interest. It is indeed pleasing to know that so many readers are looking forward to my lectures."

* * *

Listeners-in for Continental broadcasting stations will shortly be able to tune-in the Hilversum station in Holland with greater ease, for alterations at that station are now nearly complete, and it will begin transmission on high power very shortly. Until lately Hilversum has not been very easy to receive, but with its power to be increased tenfold it is expected that its broadcast concerts will be picked up by simple valve sets. Hilversum is to have two 100-ft. aerial masts, and the wave-length will be 1,050 metres with the call-sign H D O. And the programmes are being framed to interest British listeners, and I hear that some world-famous orchestras and artistes have been engaged to broadcast from the station.



The Reception Room at the broadcasting station W E A F, New York.



Michael Faraday.

No. 1 of a Series.

The birth of a great idea

TO Michael Faraday we owe the discovery of induced currents. From his first simple experiment of winding two lengths of silk covered wires around a wooden cylinder, and placing in circuit with the one a simple battery and between the ends of the other a galvanometer, has sprung most of the great electrical achievements of to-day.

Without Faraday's masterpiece there could have been no electric motors, generators or transformers —in fact the whole structure of electricity is closely interlocked with the corner stone of electro-magnetic induction.

Truly the birth of a great idea from one simple little discovery.

And in its way the Cossor Valve provides a striking analogy.

Here you see the inventor carefully considering the action of the thermionic valve. How its whole success is bound up in the efficient use of the electron stream given off by the filament. He, too, gets a great idea. If electrical measurements so conclusively prove that losses in electron emission mean losses in signal strength, then why not redesign the Valve to keep these losses down to a minimum.

And so you see the inventor's dream crystallized into practical reality with the familiar arched filament almost totally surrounded by the hood-shaped anode of the Cossor

Cossor Valves

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TRANSMISSION OVER LAND AND SEA.

FROM A CORRESPONDENT.

Here is a clear and interesting explanation of a well-known phenomenon, full of interest to every reader of "P.W."

NEARLY everyone interested in wireless is aware that communication is more readily established over an intervening sheet of water than when the portion of the earth's surface between the stations consists wholly of dry land. Impure water, and especially sea-water, is a first-class electrical conductor. Curiously enough, absolutely pure distilled water—not tap water, which is anything but pure—is quite a good insulator. Such water, however, almost never occurs in nature, and for all practical purposes we may assume that the presence of moisture in or upon any substance increases its conductivity, usually to a very considerable extent.

The surface of the sea below, and the Heaviside Layer above, provide then two conductive surfaces between which the ether waves are, so to speak, guided on their way from the transmitter to the receiver. But besides being conductive, the sea is very nearly homogeneous—that is to say, its electrical properties vary little as between different parts of the ocean. It is also, of course, practically smooth.

When Conditions are Varied.

No doubt this latter statement will accord ill with the unpleasant reminiscences of some of my readers. But the "seas mountains high" of which one gets the impression during a heavy gale are really of negligible height compared with a slight swell in the ground ashore. Very few would overtop an ordinary house. Indeed, the greatest recorded height of a storm wave from trough to crest is only about 60 feet. And such waves are exceedingly rare.

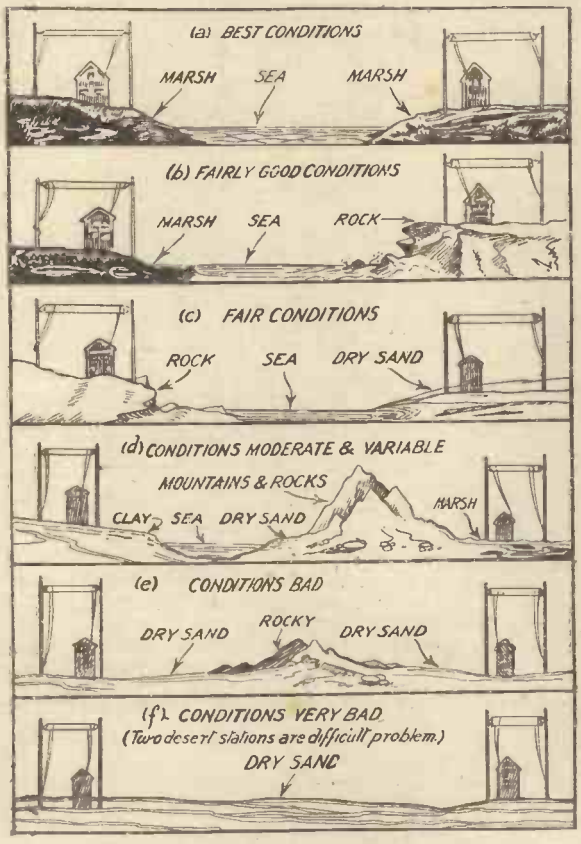
When we come to land, however, the conditions are not only far less favourable to effective transmission, but far more varied. In the first place, no land surface is nearly so conductive as sea-water. Even a fresh-water lake or marsh offers a higher resistance than water of greater salinity. If there were, anywhere in the world, an area whose surface consisted wholly of metal—unmixed with the foreign substances present in ores—it would, of course, provide a conductor of almost infinitesimal resistance. But such surfaces do not, so far at any rate as we know, exist anywhere. Even metalliferous ores rarely occur in any quantity actually upon the surface, and where they do they are more often a hindrance than a help to efficient reception (probably owing to magnetic properties).

Very Bad Areas.

Ores are also generally interspersed among rocks, and a hard rock, owing to its imperviousness to moisture, is one of the worst conductors we have to deal with. Probably the most unpromising regions of the globe from a wireless, as from many other points of view, are the great sandy deserts. Rocky, mountainous districts are not generally absolutely devoid of some overlying soil which, however thin, is yet sufficient to retain a modicum of moisture, as is evidenced by their ability to support some kind of vegetation. But in the deserts the surface is entirely and permanently dried up. Apart from the difficulty of getting a good "earth" at the actual stations, a difficulty largely superable by the use of an effective "counterpoise," the range obtainable with a given power in, or over, such areas is found to be very much curtailed.

Effect of Rain.

Ordinary soils vary much in their characteristics. At one end of the scale we have the ever-moist swamps and fens, affording, besides good "earths" at the stations, a highly conductive path for the signals. At the other are the sandy, gravelly and rocky districts, where "earths" are difficult to arrange, and the reception is often poor, even when an efficient arrangement has been arrived at.



The clays—on which, by the way, the writer's own station is situated—are a rather interesting intermediate type. Wet weather turns my part of the country—the Sussex Weald—into a morass of mud. Continued drought gives one a surface like a brick. This "summer"—quotes, please, Mr. Printer!—there has been considerably more morass than brick, and reception has been improved accordingly. But, ordinarily, the effect of wet or dry spells can be readily noticed, even if one is very careful to preserve the actual local earth connection. The whole district seems to go more or less "dead" in a dry season, while in a wet period it is first-class.

Although the local effects of these soil variations are pretty well known, many people do not seem to realise that it is not only the conditions at the ends of the line of communication that have to be considered. Both stations may be in excellent districts themselves, but if a desert or rocky region covers any large part of the intervening space the communication will be hampered thereby. Conversely the stations themselves may be badly placed; but if situated, say, on opposite sides of a marshy region, or of the sea, very excellent results may often be obtained. Various possible combinations of conditions are shown in the diagram.

Mountain "Shadows."

The effect of mountains and inequalities in the earth's surface is to absorb some of the impinging waves. But the loss from this cause, though much more serious than the negligible one due to the waves at sea, is still surprisingly local. There seems to be a kind of "shadow" of the mountain range, extending some distance in the direction of travel of the waves, but beyond this very limited area the mountains (unless they actually overhang the transmitting station) are of comparatively little account. This is understandable when we realise that the waves we receive are largely "reflected" waves from the Heaviside Layer, the height of which above the earth — about 50 miles — is vastly greater than that attained by the highest mountains. The writer hopes to return to the subject of mountains in a future article.

Enough has been said here to indicate that, whereas over-sea transmission is likely to be fairly easy and *constant*—apart, of course, from atmospheric and light conditions—that over land, besides being more difficult, will be *much more variable*. A heavy rainfall or long drought in some area between stations may make a great difference. And, unless the topography and geological formation, as well as the climatic conditions, over the intervening country are accurately known, it will not be easy to predict the "range" of a given transmission or reception. Even with the fullest information much will still depend on temporary and local conditions. It is thus not possible accurately to compare the decrease in amplitude—and consequently in signal strength—of waves as they

(*Continued on page* 1198.)

A VALVE-OPERATED D.C. MOTOR.

By S. J. M.

MANY enthusiasts whose first acquaintance with wireless dates from the inception of broadcasting, may be interested in the device described below, which was originally brought out some time ago, although very little concerning it has been published.

It is an electric motor which employs a three-electrode thermionic valve instead of the usual commutator, and is due to Messrs. W. H. Eccles, D.Sc., and F. W. Jordan, B.Sc., who described it in a paper read before the Physical Society of London.

How the Power is Obtained.

The connections of the motor are shown in Fig. 1, from which it will be seen that it is really an application of the well-known three electrode ionic relay. The principle of working is as follows:

A constant E.M.F. is applied between the filament F and the plate P and causes a steady stream of electrons to flow from the filament to the plate. Now, if a control voltage is applied between filament and grid the anode current increases if the grid is made positive relative to the filament, and decreases if the grid is made negative.

For example, in an ordinary receiving valve the anode current may be about 1·5 milliamperes when the grid is at the same potential as the negative terminal of the filament, and 2·5 milliamperes when the grid is at + 5 volts, and 0·4 milliamperes when at − 5 volts. The current flowing into the grid in the former case is 150 microamperes and in the latter zero. It will readily be understood, therefore, that if an alternating voltage is applied to the grid circuit, an alternating current is supplied at the anode superposed on the normal steady plate current. This alternating current is capable of doing work and the power thus made available is much greater than that which is expended in the grid or control circuit. This fact, of course, is implied when calling the valve a relay.

In the motor in question a number of iron teeth are carried by the rotating portion past an electro-magnet which is connected into the control circuit, and these teeth generate in the windings of the electro-magnet an alternating E.M.F. which is impressed on the grid of the valve. The corresponding alternating E.M.F. which appears in the anode circuit is passed through another electro-magnet placed near the rotor, and its position so adjusted that it tends to accelerate the movement of the rotor.

Not Difficult to Make.

The passage of an iron tooth, therefore, in front of the control magnet applies an E.M.F. to the grid that produces a current in the second electro-magnet in such a direction as to pull forward the tooth just approaching it. As may be expected, the speed of the rotor gradually increases until frictional and other losses consume all the energy of the battery in the anode circuit.

The motor may take any form desired by the builder. That shown in the sketch consisted of an ebonite disc ½ in. diameter, mounted horizontally on a vertical spindle. To this are fixed twelve iron teeth at equal distances around the periphery. The electro-magnets were taken from a pair of 4,000 ohm Brown telephone receivers. Naturally,

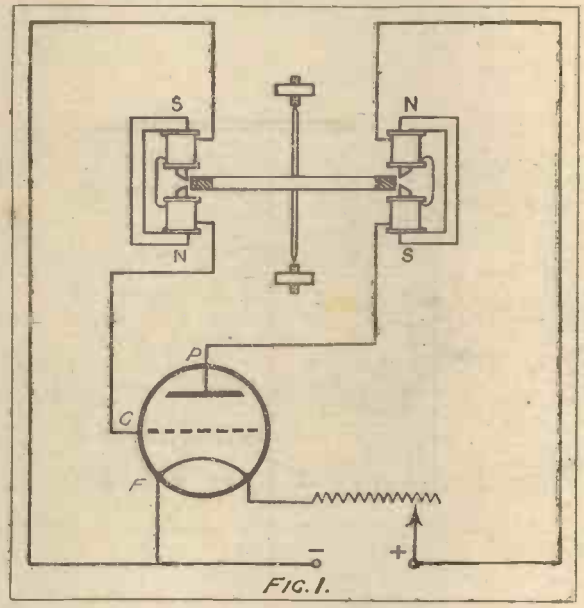


FIG. 1.

a motor of this type develops very little power, but apart from its interest, it can be used in experimental work, especially in physical laboratories where sometimes a wheel or disc has to be spun round with absolute freedom from sparking, which occurs even in the best of ordinary D.C. motors.

TRANSMISSION OVER LAND AND SEA.

(*Continued from page* 1197.)

travel over equal distances by sea and by land.

But the annexed table may provide food for thought. At the most conservative estimate oversea transmission is at least three times as effective as overland. The table shows, in geographical miles, the mileage oversea and overland between London and some well-known stations abroad. The B.B.C. stations are not included, as in all cases the distance is almost wholly overland. An outstanding feature is the very considerable proportion of the distance of Madrid, which is oversea. This may most likely account for the phenomenal strength with which this station can be received in England as compared with other much nearer ones. Another interesting point is that the table brings out the very strong probability that the recent signals from New Zealand came "the long way round."

TABLE OF DISTANCES (IN GEOGRAPHICAL MILES) BETWEEN LONDON AND VARIOUS STATIONS ABROAD.

Station.	Total Distance	Over Sea.	Over Land.	Remarks.
Brussels	170	105	65	Track passes down Thames estuary (considered as sea).
Paris	185	57	128	
Berlin	480	150	330	(See Brussels.)
Madrid	650	290	360	Crosses Bay of Biscay (see text).
Hamburg	375	150	225	Passes N. of Thames estuary and inland from Frisian coast.
Vienna	720	30	690	Crosses Channel near narrowest part (Dover-Ostende).
New York ..	3,010	2,710	300	Practically no land except across British Isles.
Cape Town ..	5,200	400	4,800	Crosses Africa and the Sahara. The worst case considered.
Dunedin (N.Z.):				
(a)	10,500	5,060	5,440	Eastern route, across Europe, part of Asia, and Australia.
(b)	12,000	11,850	150	Western route. Only intervening land Panama Isthmus and short distance from English coast (see text).

NOTE.—The above distances are approximate only, being taken merely from an ordinary large-scale atlas.

"BEST WAY" GUIDES FOR CONSTRUCTORS.

THE first of a new series of "Best Way" wireless books have been received for review. One is entitled "How to Make Valve Sets" and the other "How to Make Crystal Sets," and at the low price of 6d. each they easily represent the best value in wireless books ever offered to the amateur. These "guides for wireless constructors" supply a long-felt want, and we have little doubt that they will prove enormously popular.

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"How to Make Valve Sets" ("Best Way" Series, No. 162) contains constructional articles on building a One-Valve Set, a "Unidyne" Set, a Two-Valve Loud-speaker Set, a One-Valve Reflex Set, and a Two-Valve Reflex Set.

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HOW TO CONSTRUCT A FOUR-VALVE "EXPANDING" SET.

An Excellent Unit Receiver for Experimenters.

Built and Designed by J. LAURENCE PRITCHARD.

PART I.

Any number of circuits or arrangement of valves is possible with this set, specially constructed and described for "Popular Wireless" by one of the best known Radio constructional experts of the day. This article will be concluded in next week's issue, but the details given in the following first article will enable the amateur to plan out the set and collect the necessary materials.

THE four-valve set illustrated in Fig. 1 makes a special appeal to the wireless experimenter. By placing each valve on a separate panel, any number of circuits or arrangement of valves is possible without soldering or materially altering the wiring of the set. The set may be started as an efficient single valve receiver and enlarged without any alteration to the existing units.

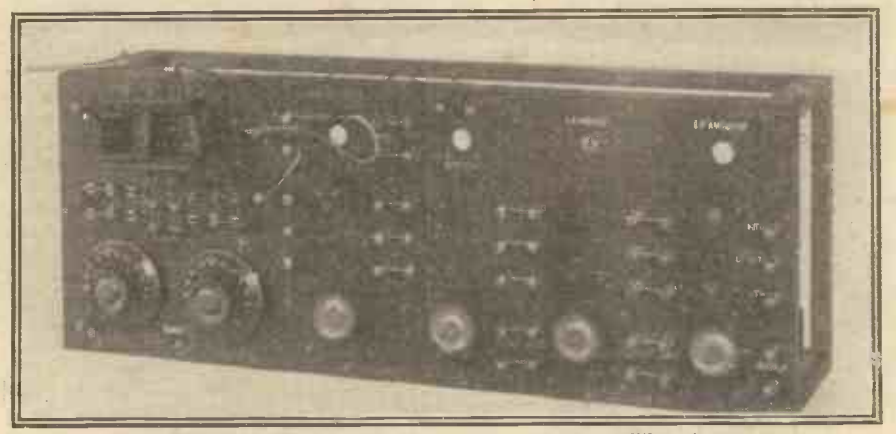


Fig. 1. Showing the completed and finished appearance of the unit set.

This unit type of receiver is probably the easiest for the beginner to tackle, as the wiring, which is his greatest stumbling block, is carried out in stages easy to follow. Again, the terminals are arranged on each side of the panels so that it is impossible to connect them up wrongly. In the tracing of faults the set has distinct advantages, as the amplifiers can be quickly omitted from the circuit, when trouble with the tuner and detector alone will not be difficult to locate. If these units should be in order, the amplifiers may be added one by one until the fault is traced.

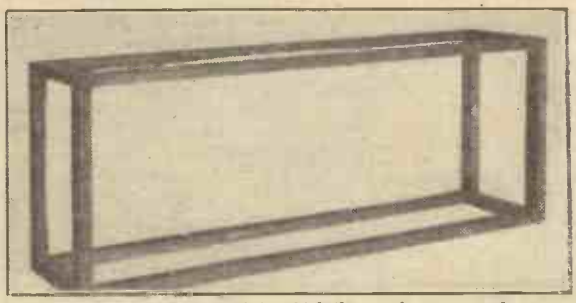


Fig. 2. The framework to which the panels are secured.

The panels are screwed to an open wooden framework which allows instant accessibility to the valves and the components at the back of the panel. The complete framework is illustrated in Fig 2. It is simply constructed from 1 in. by ½ in. deal, the external sizes being 24 in. long, 9 in. in depth, and 6 in. from back to front. The top and bottom are first constructed to form two flat oblong frames, the ½ in. side forming the inside and outside edges of the frames. The upright pieces are then glued and screwed between the top and bottom frames at the extreme corners, so that the ½-in. edges are to the front and back. The inside edges of the front of the framework are tapered slightly to give ample clearance to the terminals at the edge of the panel. To reduce the front edges of the framework to ⅜-in. width will be sufficient.

Universal Tuner Switching.

The tuning unit, which occupies the extreme left side of the case, embodies an open and closed aerial tuning circuit, either circuit being selected by the switching arrangements of a double-pole double-throw switch to the extreme left of the panel. A similar switch placed in a corresponding position on the right of the panel enables a variable condenser of ·001 mfd. capacity to be wired in series with or in parallel to the primary aerial tuning inductance. When an H.F. amplifier is introduced or withdrawn from a circuit, it is necessary to reverse the leads of the reactive coil. This is provided for in the tuner by a switch placed between the switches in the aerial tuning circuits.

Fig. 3 shows a front view of the tuner panel after completion. The panel measures

(*Continued on page* 1200.)

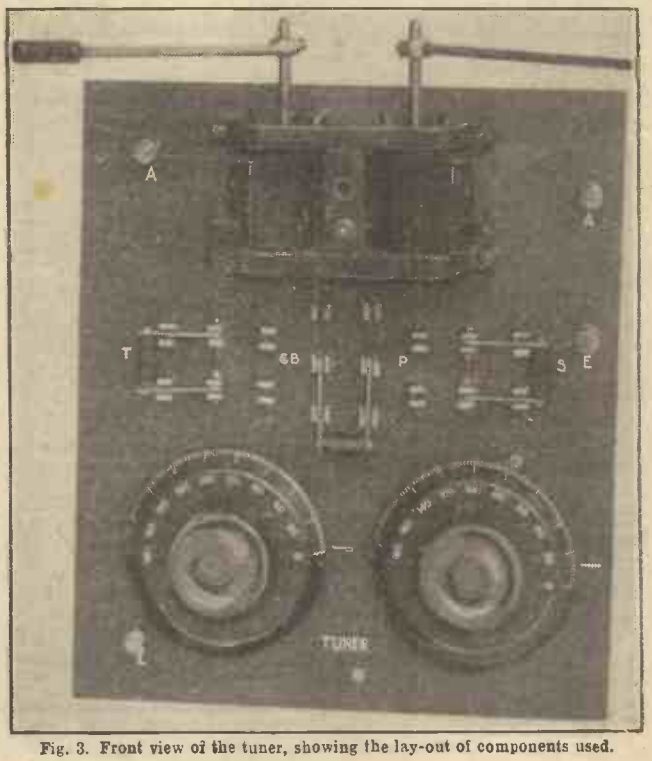


Fig. 3. Front view of the tuner, showing the lay-out of components used.

A FOUR-VALVE "EXPANDING" SET.

(*Continued from page* 1199.)

18 in. long and 9 in. deep. A 3-coil holder in which the aerial primary and secondary coils and the reaction coil are mounted, occupies the centre of the top of the panel. The second tuning condenser, of ·0005 mfd. capacity, is attached to the bottom left side of the panel, with the largest condenser to the right of it. Each condenser is 2 in. from the side of the panel to which it is adjacent, and in each case is 2¼ in. from the bottom edge of the panel. The positions of the coil holder and the three double-pole double-throw switches vary, but the switches should be of the miniature type, which are specially made for panel mounting. The aerial and earth terminals occupy the top and bottom left corners of the panel. These connect to the valve units, and are placed ⅝ in. from the right edge of the panel, being respectively 3½ in. and 1½ in. from the top edge of the panel. Two terminals are screwed to the back of the panel at the top end connecting wires and lead to the reaction coil. Thus, where reaction is required, two terminals placed on the front of the detector panel may be quickly connected to the terminals.

"Anti-Capacity" Wiring.

The wiring diagram of the tuner is shown in Fig. 4. It is drawn as the actual wires appear, where the tuner panel is viewed from the back. The switch positions are marked in this illustration, and it will be found convenient to mark the front of the panel correspondingly, remembering that the switch positions will appear reversed when the panel is viewed from the front. Wiring is done by the anti-capacity method, using $\frac{1}{16}$-in. square tinned wire. The end of each contact should be tinned with solder before any wire is connected. After this it will be found that many of the contacts have become loose. This is due to the partial melting of the ebonite under the heat of soldering. The loose contacts should be securely tightened up before proceeding. In connecting the wires to these studs, the operation should be performed with a minimum of heat. The cooling of the contacts is assisted by blowing on them immediately the soldered joint is set.

MATERIALS FOR EXPANDING SET

	£	s.	d.
Ebonite for panels and valve shelves		9	0
3 Coil Holder		6	6
3 Duolateral Coils @ 5 - each		15	0
3 Miniature Switches @ 2 - each		6	0
1 ·0005 mfd. var. condenser		7	6
1 ·001 mfd. „ „		8	6
4 Filament Resistances		2	0
4 M.O. Valves @ 12/6	2	10	0
1 H.F. Transformer		4	6
20 Valve Sockets		1	6
4 doz. Terminals, telephone type		6	0
Wire, Screws, etc.		2	3
Wood for Framework			9
H.T. Battery		13	6
6v. Accumulator	2	0	0
1 Pair Telephones	1	0	0
2 L.F. Transformers @ 15/- each	1	10	0
2 ·001 Fixed Condensers @ 2 - each		4	0
	£11	7	0

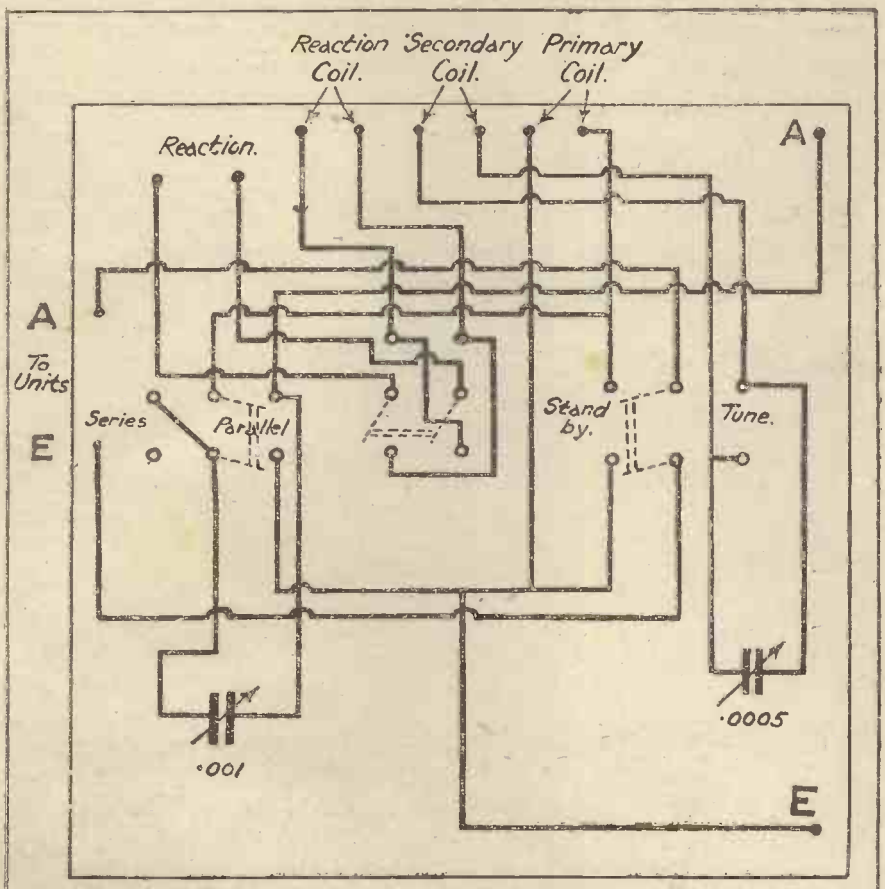


Fig. 4. Wiring of Tuner Panel as seen from the back.

Detector Panel Lay-out.

A back view of the tuner with the wiring completed is illustrated in Fig. 5. Connecting wires to the aerial primary coil and the reaction coil are made with flexible insulated wires. Electric lighting flex with the outer cotton casing removed will be found suitable, as it is less likely to break under continued movement.

The detector panel, also cut from $\frac{3}{16}$-in. ebonite, measures 4 in. wide and 9 in. deep. A panel lay-out showing the exact positions of the terminals is given in Fig. 6. The exact position of the terminals is important, as they will be required to register with the terminals on the high- and low-frequency amplifier. The position of the valve shelf will be made more clear in subsequent photos. The shelf is cut from a piece of scrap ebonite, and measures 2¼ in. by 2¼ in. In the centre of this shelf, four valve sockets are screwed to form a valve holder. A bracket of right angle brass secures the shelf to the main panel. A front view of the detector panel, with input and output correctly lettered, is illustrated in Fig. 7.

The Battery Connections.

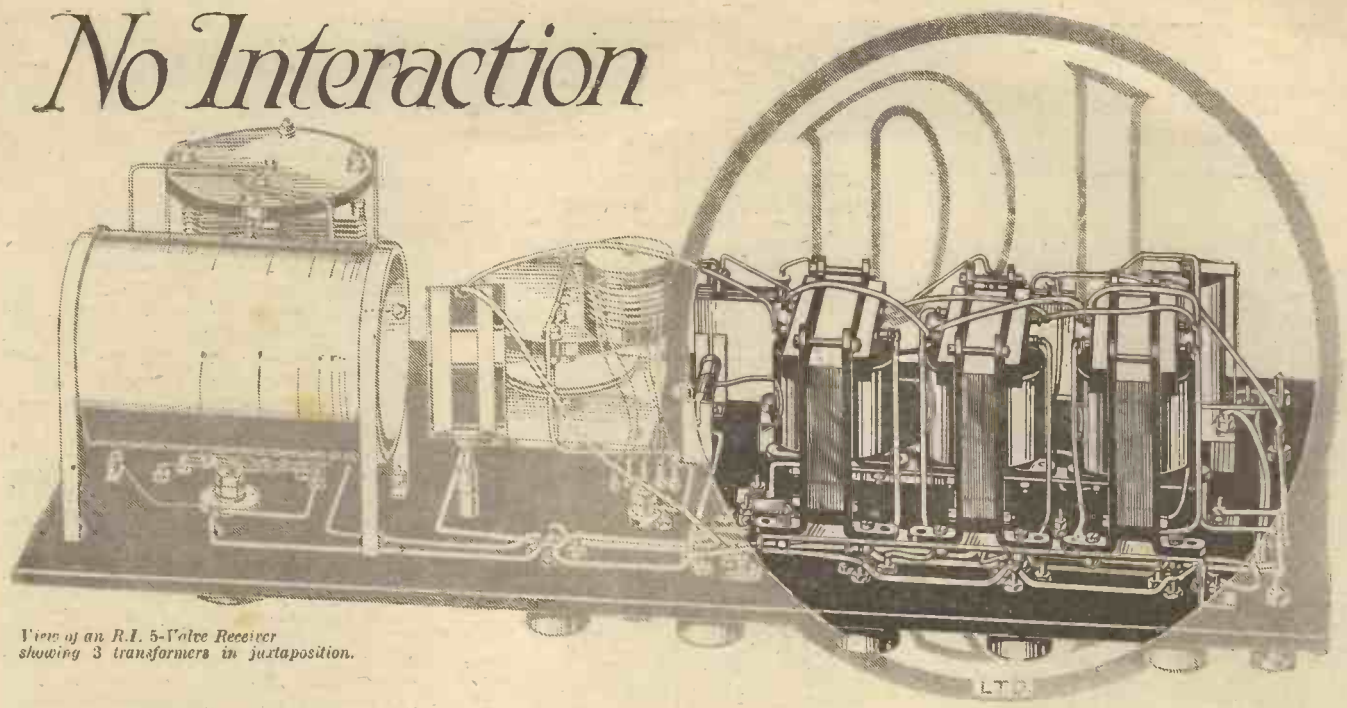
The wiring diagram given in Fig. 8 represents, in the same way as the tuner, the actual wiring of the detector panel from the back. This will be seen by comparing it with the back view of the detector panel shown in Fig. 9, with the wiring completed. The positions of the grid leak and condenser should be noted. The former has a resistance of two megohms and the latter a capacity of ·0003 mfd. The tuner and detector valve now finished, they may be mounted on the framework for a test. If it is intended to use the set in its present state of construction for any length of time, the two panels may be attached to the centre of the framework. The blank spaces either side may be filled in with figured wood panels stained or polished as required. Short connecting strips of stout wire are screwed in the aerial and earth terminals to the top right-hand side of the tuner, and join the two input terminals of the detector panel.

As shown in Fig. 8 high-tension positive is connected to the top of three battery terminals and low-tension positive at the bottom. The middle terminal is joined to high tension and low tension negative. In the case of each unit, battery terminals are connected to each side of the panel so that when other units are added they are quickly supplied with battery current by connecting strips of wire to the adjacent terminals on the panel already fitted.

The panels for the H.F. and L.F. amplifiers may be cut and matted at the same time, as with the exception of the positions of the input and output terminals they are the same. The sizes given for the detector panel may be used for the amplifying panels to a large extent. The positions of the valve shelf, filament resistance and battery

(*Continued on page* 1205.)

No Interaction



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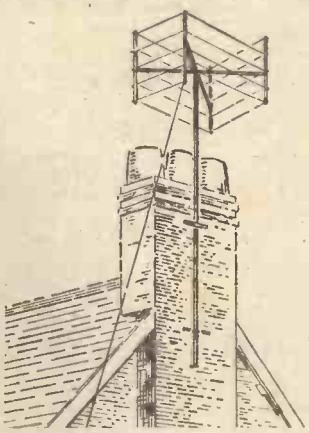

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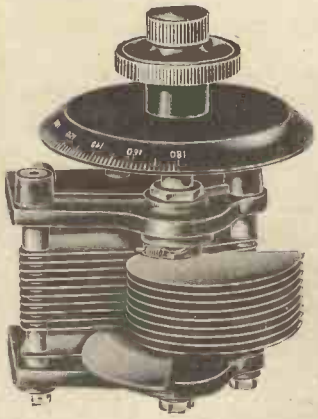

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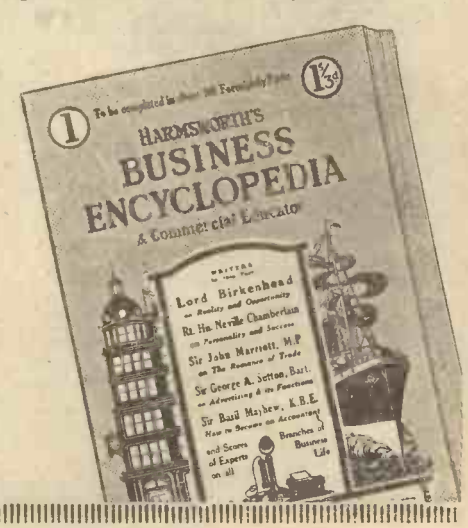

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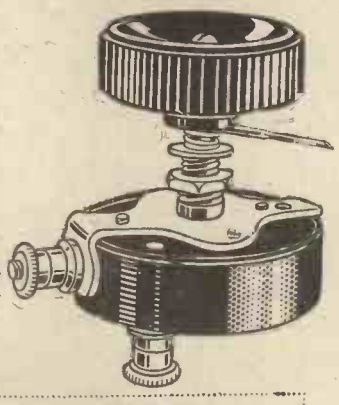

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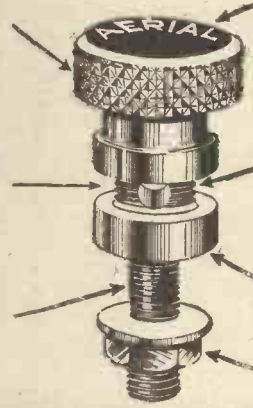

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(*Continued from page* 1200.)

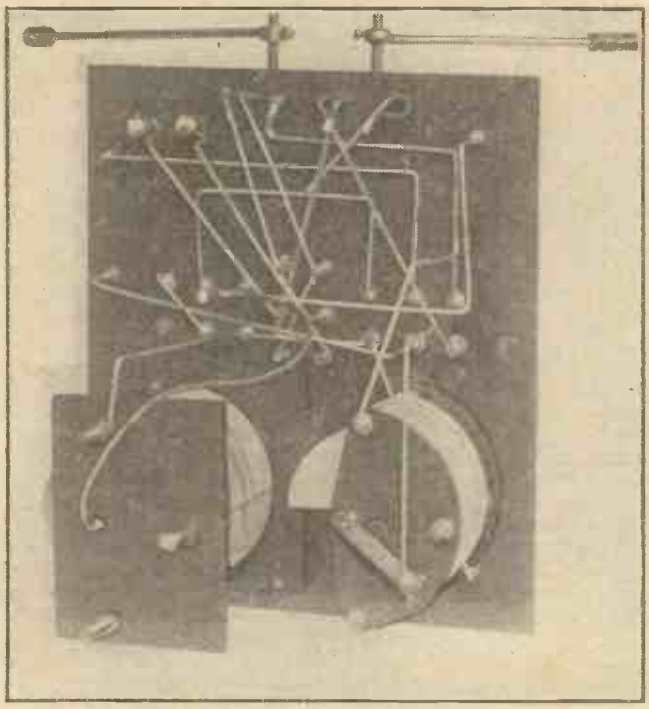

Fig. 5. The back of the tuner, showing wiring completed.

terminals are identically the same in the amplifying panels.

Dealing first with the high-frequency amplifier, input and output terminals are arranged on either side of the panel at the top, in line with the input terminals of the detector. The H.F. amplifier is primarily intended for transference coupling, a set of four valve sockets being attached equidistant from the sides and 3¼ in. from the top of the panel. From there four valve socket connections may be made to incorporate resistance capacity or tuned anode coupling. A front view of the panel showing the position of the H.F. transformer sockets is illustrated in Fig. 11. The wiring is carried out in the same way as the wiring of the detector panel, the hints on soldering to avoid loosening the terminals and valve sockets being borne in mind. The wiring diagram representing the back view of the actual wiring of the panel is given in Fig. 12. A back view of the wiring in which the connections to the transformer sockets are clearly shown is provided in Fig. 13. The correct way of making the connections to the transformer socket should be noted. Viewed from the back of the panel the top socket, which would be the grid socket of a valve holder, connects to the anode of the valve. Similarly the lowest anode socket joins the high-tension positive terminals with which it is in line. Of the two intermediate or filament sockets the one to the left, viewed from the back of the panel, joins high- and low-tension negative, and the lower of the input and output terminals. The remaining socket is connected to the upper output terminal.

To test the set the tuner unit is removed from its central position so that the H.F. amplifier separates it from the detector unit. The connecting wire from the aerial terminal on the right of the tuner is coupled to the upper of the input terminals of the H.F. amplifier, by means of a flexible insulated wire with Wander plugs attached. All the five terminals on the right side of the first valve unit are coupled to the corresponding terminals of the detector. Battery wires are connected as before to the terminals on the right of the detector, the telephones being attached to the output terminals. The object of the flexible lead is to cut out the high-frequency valve if desired.

Fig. 7. Front view of the detector panel.

(*To be concluded next week.*)

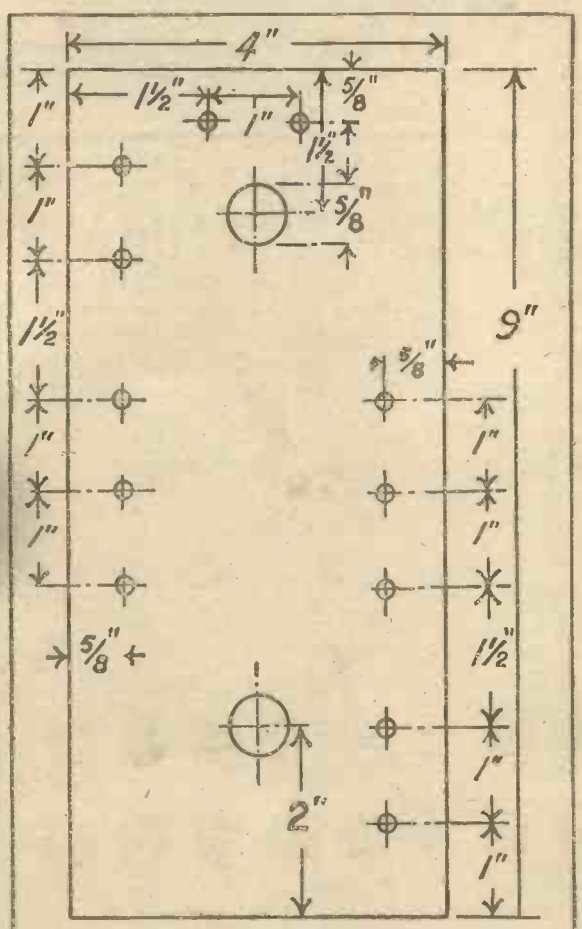

Fig. 6. Detector Panel. Lay out Front View.

This article will be concluded next week. The diagrams and photographs mentioned in the text on this page will be given, together with a résumé of the references made.

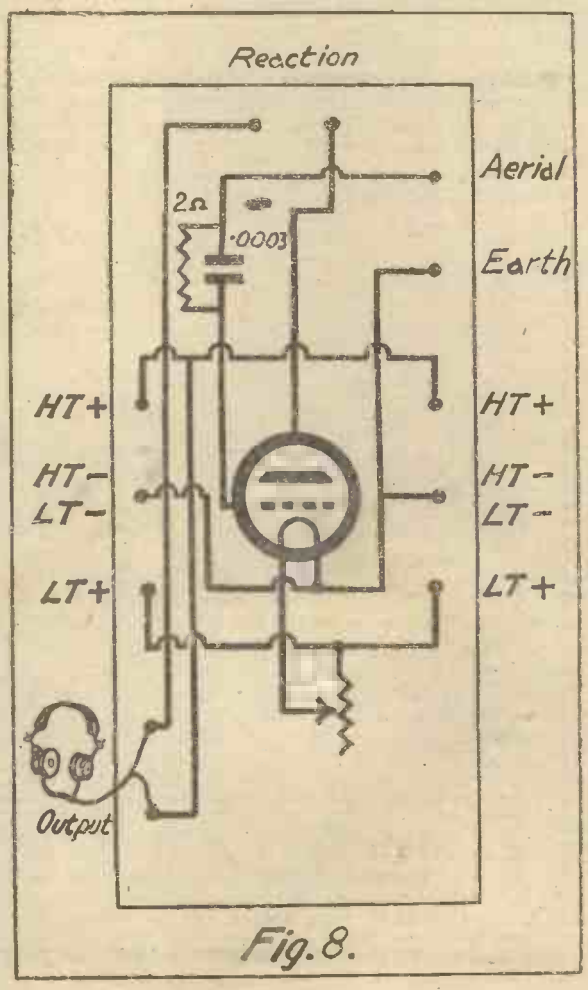

Fig. 8.

WIRELESS FOR THE BEGINNER.

By E. BLAKE, A.M.I.E.E.

PART 10. THE THERMIONIC VALVE.

CONDUCTORS of electricity harbour within their inter-molecular spaces electrons which are free to move about, in addition to those which are more or less fixedly associated with atoms. There are reasons to warrant the assumption that these free electrons behave in some ways like the molecules of a gas. They are in constant motion, continually colliding with the metallic molecules and other free electrons; the velocity of their motion increases with increase of temperature, as also do their mean free paths. If the temperature of conductor reaches a certain value the surface tension is overcome and electrons leave the conductor. This effect may be compared to evaporation and we may regard the electrons as *boiled* out of the conductor.

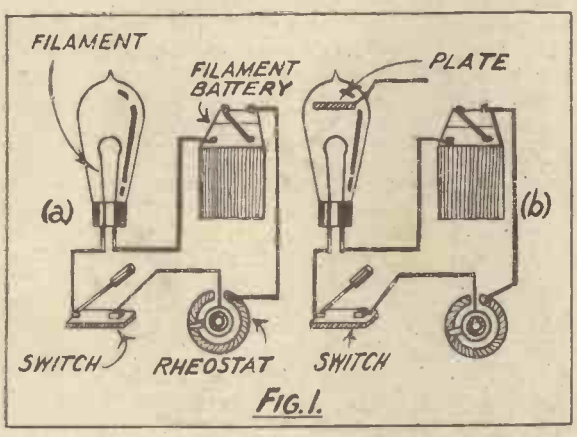

FIG. 1.

Origin of the Valve.

Fig. 1 (*a*) depicts an electric lamp; the filament is, we will say, of tungsten, and the lamp is connected to an electric battery, a switch by means of which the current can be switched on and off, and a variable resistance (a rheostat) by means of which the amount of current passing through the filament can be varied.

Consider that the resistance is adjusted so as to let as little current as possible flow. The filament glows dull red. Now, electrons are already escaping from the surface of the filament, and the space around the glowing wire is a cloud of negative charges, and we may picture the electrons as a swarm of flies hovering over a pot of jam. But as the electrons repel each other—on the principle that like repels like—a number of them are knocked back into the filament, and as the filament, when it loses electrons, thereby becomes positive, as explained in a previous article, it raises no objection to the re-entrance of these electrons. Therefore there is on the one hand the glowing filament flinging out electrons, and on the other a cloud of electrons trying to knock back all new-comers. Eventually a sort of equilibrium or stale-mate is arrived at, the number of electrons leaving the filament being equal to the number which re-enter it, and a permanent cloud of electrons hovering in space like the permanent cloud of vapour which hangs over Niagara in summer.

If the rheostat now be varied so that some resistance is removed from the path of the current, the filament will become brighter, more electrons will be shot out per second, the cloud of electrons in space—known technically as the "space charge"—will become larger, and finally equilibrium will again be reached. The preceding statement holds true for any further increase in the filament current or, what is the same thing, increase of filament *temperature*—unless the temperature is raised so high that the filament is burnt, an experience which most of us have suffered.

Now suppose that we place within the glass bulb of our lamp a metal plate (Fig. 1 (*b*)), and suppose also that we charge this plate positively. Knowing what we do about the habits of electrons we shall not be surprised to learn that the electrons in the "space charge" make a bee-line for the positive plate in order to remedy its deficiency of electrons. So that we now have a stream of electrons from filament to plate—and that, as you know, is *a current of electricity*. The positive plate is a kind of a store for the electron output of the filament. But it is not of unlimited capacity—it can only hold so many. If it has no distributing agency to pass the electrons out again it will simply end by becoming negative, and then it will not only be unable to take more electrons but will actually repel them. Fig. 2 shows how this difficulty can be, and is, surmounted.

Overcoming the "Space Charge."

We make the plate positive by connecting it to the positive terminal of a battery, and we connect the negative terminal of the battery to the filament. The result is a circular tour for the electrons; they reach the plate, pass through the battery, re-enter the filament from the outside, and line up, as it were, ready to go into the front line and be pushed out again into the No Man's Land of the space inside the bulb, where once more they make for the plate, which being thus relieved of surplus electrons is kept positive.

The battery which heats the filament is the low-tension battery, and that which is connected between plate and filament is our old friend the high-tension battery. The current, which flows through the "plate circuit" (that is, from filament to plate to high-tension battery to filament) is called the plate current. It is limited by several conditions; for examples, the material and size of the filament. The maximum plate current which will flow under a given set of conditions is called "saturation" current, and this characteristic of a valve is due to the inability of a given area of the filament to shoot out more than a certain number of electrons at a certain temperature.

The "space charge" still plays an important part in the scheme of things, even after the introduction of the positive plate. Consider the situation of any one electron midway between the filament and the plate. It is subjected to two influences. Firstly, there is the attractive influence of the positive plate; it wants to get to that plate, which is a sort of "spiritual home" for any unattached electron. But secondly there is the malign and repulsive action of all the electrons between it and the plate

Action of the Grid.

Our electron's chance of reaching the plate depends upon which is the stronger, the repelling influence of the intervening electrons or the attraction of the positive plate. It is like the gang of bad boys trying to keep the good boy from Sunday school. If the delights of street-running prove in the end more attractive than the peace of a good conscience—and the possibility of being included in the "school-treat"—the boy does not reach Sunday school. Similarly our electron must be more attracted by than repelled from the plate, if there is to be a plate current. We arrange matters accordingly, and make the plate very positive by making the high-tension battery of sufficient voltage.

Continuing our useful—not to say moral—analogy, let us suppose that whilst the good boy is hesitating between the blandishments or threats of the gang and the remembered injunctions of his mother,

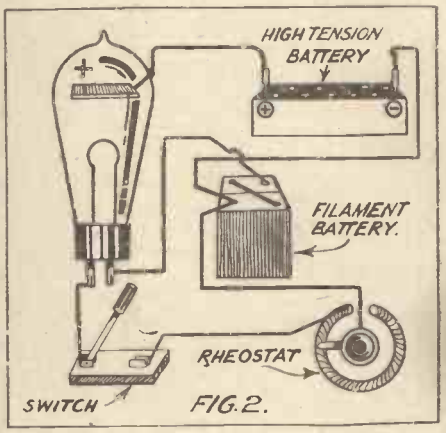

FIG. 2.

there happens along the school teacher. What a changed state of affairs! The teacher is bound to control the situation. He can gently lead the good boy to school, or he can pass by with a look of pain on his face. Upon his attitude depends the size of the Sunday school class. Coming down to more mundane affairs, namely, a valve receiver, we find that there is in the valve a similar controller. It is called the grid, and upon the part it plays depends the value of the plate current. It can cause the plate current to increase, to decrease or to stop altogether. *And on the changes in the plate current depend those vital processes, rectification (or detection) and amplification of wireless signals.*

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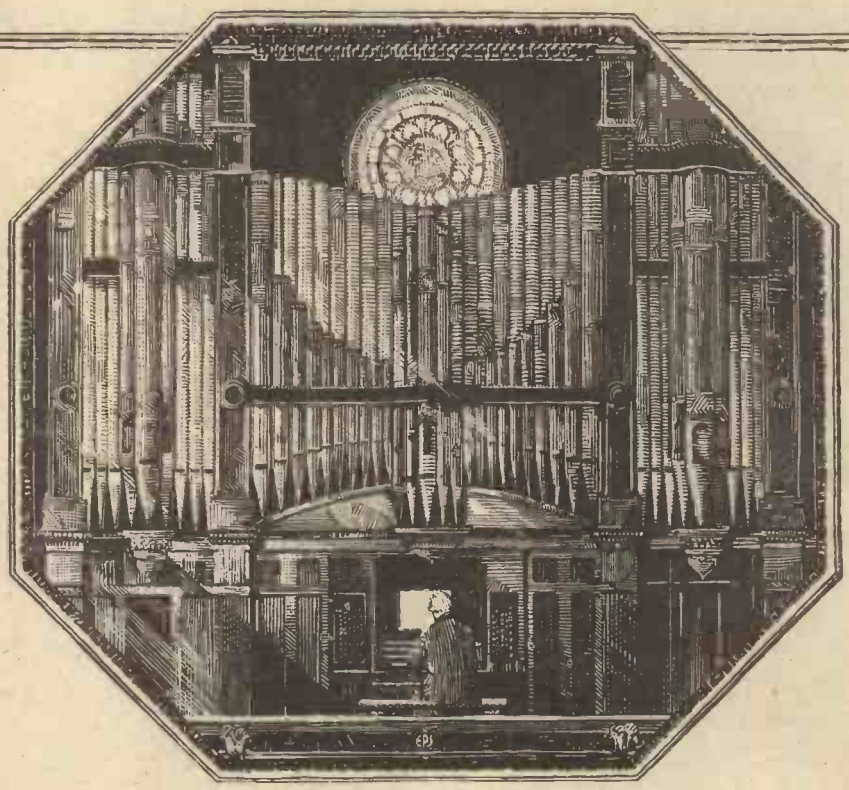

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Mr. John Huntingdon.

Few people would have deliberately chosen the bagpipes, the ukalele or the balalaika, to say nothing of the harp or the banjo, yet one and all when handled by real artistes of their craft have become powerful mediums. A recent performance extraordinarily successful was the playing on the harpsichord, the forerunner of the piano, by Mrs. Gordon Woodhouse, who, incidentally speaking, has made a life study of ancient instruments, and also the solos on bells by Miss Nellie Norway.

This artiste will be remembered by every faithful adherent of Maskelyne and Cooke's Hall of Mysteries, for Miss Norway has been one of its chief artistes there. Her table of silver bells was always one of its great features, and another recent performance there but a few weeks back only served to reveal fresh nuances. When heard again also at 2 L O recently, her bells radio'd exceedingly well, especially when towards the end her table was moved nearer to the microphone.

The Musical Event of the Week.

Chief musical interest of last week has been centred on the second of the International Symphony Concerts at the Opera House, Covent Garden. Mr. Ernest Ansermet, the famous Swiss conductor, has been intimately connected with M. Monteux, who conducted the first last month, and he was indeed leader of the Kursaal Concerts d'Monteux, in Paris. Mr. Ansermet has allied himself with the interests of the Russian Ballet of Serge Diaghileff, and toured the United States and South America with it.

Claude Debussy.

During these tours he directed a number of new works of Stravinsky and Manuel de Falla, so it was only natural that the B.B.C. programme should include such well-known foreign composer's names as Debussy and Stravinsky, the latter being represented by "L'Oiseau de Feu," and the former by his popular "L'Après Midi d'Un Faun." This work, though in reality one of the slightest of the composer's works, seems to have impressed itself more on the public mind than any other of his numerous compositions.

Famous Violinist.

It is a piece of sheer musical impressionism, an attempt to depict the dreams of a faun slumbering at midday. Of a far higher standard is his opera "Pelleas and Melisande," which took nearly thirteen years to complete. His death in 1918 robbed the French world of one of its chief musicians, and the inclusion of his work again at the concert testifies to his popularity in this country. The English element was, however, admirably supplied by the engagement of Mr. Albert Sammons for Elgar's violin Concerto. For the third of the series next month, Herr Bruno Walter, the German conductor, will lead.

Miss Sybil Maden.

The B.B.C. has striven nobly to give all-round satisfaction, and few people realise the magnitude of the task, but I think the maintaining of two different programmes at the London and Chelmsford stations is the solution of most problems. Their first experiment when "Prince Igor," the Russian opera, was broadcast from Brussels Opera House through 5 X X, while from 2 L O a fine musical comedy programme was given, was sufficient proof that both "high-brow" and "middle-brow"—if I may use the term—can be satisfied at one and the same time.

Some Clever Singers.

2 L O may be said to make a special "bid" for good singers, and it would be hard to find better voices than those heard at some of the S.B. programmes. One of the most popular is Mr. John Huntingdon, a singer who has figured prominently in most of the provincial concerts of note as well as in London. He has a baritone voice which radios well by reason of its sweetness of tone as well as virility, and his songs are always well chosen.

Another singer heard not only in the operatic but in the solo recital programmes is Miss Sybil Maden. She is one of the most promising singers also in the Manchester district, where she has established herself very firmly in popular favour. Originally a member of the Stockport Maia Choir, she took a scholarship at the Royal College of Music, subsequently training in Paris under Mme. Jeanne Brola. Her rich contralto voice lends itself particularly well to operatic music, and in the recent studio performance of Humperdinck's "Hansel and Gretel," she took the part of the Sandman most daintily.

Mr. Roy Henderson.

Bournemouth.

Some of the best music of the month has been heard from 6 B M, especially during the recent Symphony Concert, the seventeenth of the series. There is always a tendency to give the more familiar and oft-times hackneyed words of each composer, and the idea therefore of hearing the more rarely performed works lent a freshness to the scheme highly acceptable.

As an instance was the overture, "Children of the King," of Humperdinck, instead of the inevitable excerpts from "Hansel and Gretel," and the "Don Juan's Serenade" of Tchaikowsky. Another good point is the breaking up of the lengthy symphonies, thus obviating boredom, only natural when a work takes nearly an hour to play.

Amongst the soloists announced were Miss Marjorie Hayward, the soloist and leader of the Vituoso Quartet, and Mr. Roy Henderson, a clever young baritone, whose recitals in Edinburgh last year and at Wigmore Hall last month resulted in much favourable notice.

Mr. Henderson has a baritone voice of flexibility and power, and these qualities lend themselves well to the needs of the microphone. As some proof of his abilities may be mentioned his interpretation of difficult arias of Bizet and the "Song of the Flea" by Moussorgsky.

I hope we shall soon hear some more from him via one or other of the stations.

Miss N. Norway.

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The Technical Editor of "Popular Wireless" will be pleased to receive wireless sets and component parts for test. Reports will be published under this heading.

THE first stage of L.F. amplification can be more or less satisfactorily carried out with any type of L.F. transformer of approximately the correct ratio, but the second stage calls for something a little better than the majority if distortionless reproduction is to be obtained. Recently we had sent us a Eureka Concert Grand, and although this is recommended for first stages and a special Eureka produced for seconds, something in the appearance of its solidity determined us to try it out in the last stage of a five-valve set employing power L.F. valves. Results were excellent, and using an Ediswan Televox, the absence of extraneous noises and the general purity of reproduction was remarkable, and far superior to any other we have yet heard considering the extent of the volume. This provides clear proof that it pays to employ first-class components, and as a matter of fact, few transformers would stand the heavy potential that the Eureka has to deal with without completely breaking down.

* * *

From Mr. S. Lyons, of 119, Clerkenwell Road, E.C.1, we have received samples of the "Lion" Crystal-valve combination, which retail at 2s. 3d. per pair post free. The combination consists of Tellurium and Gillingham crystals, the latter being of a bright yellow colour similar in general characteristics to copper pyrites only more sensitive. They provide an excellent detector for both plain crystal and valve-crystal work, are sensitive and yet sufficiently stable for even "double duals." Contact adjustment requires to be fairly firm, and once "set," sensitivity is retained over quite a considerable period.

* * *

Messrs. Beard & Fitch, Ltd., of 34, Aylesbury Street, Clerkenwell, E.C.1, realising a considerable demand, have produced the "Success" Neutrodyne variable condenser. It is a neat little instrument designed for "one hole" panel mounting, and provided with a most ingenious system of adjustment, which allows both coarse and "vernier" control. It can be reduced to an almost negligible capacity, and the component is so constructed that adjustments can be carried out without "hand capacity" causing trouble. In view of the popularity and undoubted merits of the Neutrodyne stabilising system, this latest "Success" component should meet a ready market at the retail price of 3s. 6d.

A neat valve set, the Revophone II.

* * *

The Ashley Wireless Telephone Co., of Liverpool, has sent us samples of new plugs and jacks. Of the latter, the two standard types are being produced at 2s. 3d. and 2s. 6d. each, while the plug is retailed at 3s. They are well made and efficient in operation, both in point of smoothness and positiveness of contacts. They should not be confused with the "ex-service" telephone plugs and jacks, as they were designed and produced particularly for wireless purposes. Plugs and jacks are more used in the States than in this country, but nevertheless the general usefulness of such items is realised by a great number of amateurs for quick telephone and loud speaker and circuit change-overs.

* * *

An item that will appeal very strongly to the amateur constructor has been brought to our notice by Mr. F. L. Hart, of 28, Mount Park Avenue, South Croydon. It is a small soldering stove and iron designed for connecting by means of a flexible rubber tube to the gas supply. It is a well-made article, neat and solid in appearance, and is to be supplied at the low price of 4s. carriage paid, together with a most suitably-sized soldering iron for wireless con-

(*Continued on page* 1212.)

Make your Wireless Evenings — Pleasant Evenings with a C.A.V. LOUD SPEAKER

STANDARD
120 ohms.
£4-15-0
2000 ohms.
£5
4000 ohms.
£ s
5-10

JUNIOR
2000 ohms.
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TOM TIT
2000 ohms
50/-

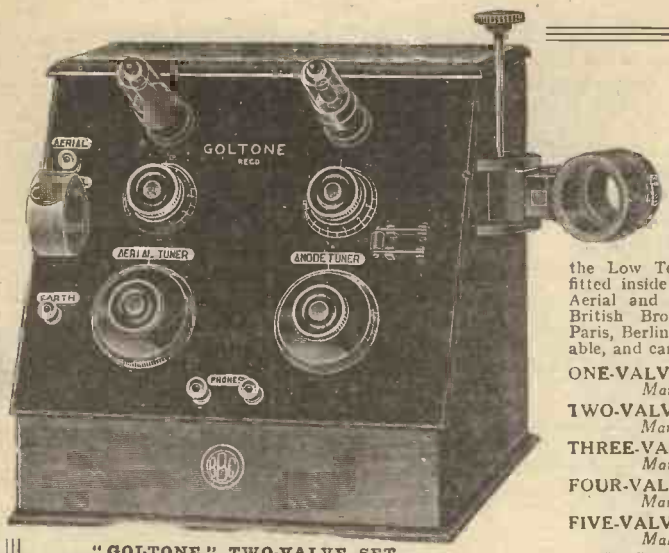
We are members of the N.A.R.M.A.T.

L.F. TRANSFORMERS
Give a high degree of amplication over a wide band of frequencies, and make possible the reproduction of speech and music free from distortion 27/6

The aim of the C.A.V. range is not to obtain the maximum of noise with a minimum of signal strength, but to reproduce the original sounds transmitted, without distortion due to factors in design and construction. Connect one to your set and you will obtain a purity of note formerly associated only with crystal and headphones. *Folder on request.*

IMMEDIATE DELIVERY.

C.A. Vandervell & Co., Ltd.
ACTON VALE, LONDON, W.3.



"GOLTONE" TWO-VALVE SET.

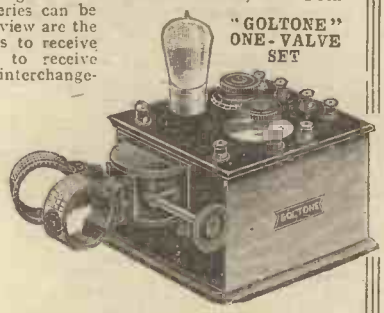
"GOLTONE" (Regd.)

WIRELESS RECEIVING SETS

(BRITISH MADE.)

Elegant appearance. Highly selective. Simplicity in Tuning. Designed for receiving on any Wavelength. The Two-Valve Set clearly receives British Broadcasting and Continental Stations, and for Loud Speaker reception the Three- Four- and Five-Valve Sets have proved entirely satisfactory in all parts of the Kingdom. Polished Cabinet, with removable back, Ebonite panel fitted with Valve Holders, Filament Resistances, Condensers for Tuning Aerial and Anode Circuits, Knife Switch for High and Low Tension Circuit, &c. Both the Low Tension and the High Tension Batteries can be fitted inside the cabinet, and the only wires on view are the Aerial and Earth. Provided with Plug-in Coils to receive British Broadcasting Stations. Plug-in Coils to receive Paris, Berlin, and other high-wave Stations are interchangeable, and can be supplied.

"GOLTONE" ONE-VALVE SET



ONE-VALVE PANEL - - - £2 18 0
Marconi Pat. Royalties, 12/6 net.

TWO-VALVE CABINET - - £7 10 0
Marconi Pat. Royalties, 25/- net.

THREE-VALVE CABINET £10 10 0
Marconi Pat. Royalties, 37/6 net.

FOUR-VALVE CABINET - £13 10 0
Marconi Pat. Royalties, 50/- net

FIVE-VALVE CABINET - - £19 10 0
Marconi Pat. Royalties, 62/6 net.

See Catalogue No. R.111 for full details.

PANEL SWITCH

Size 1½ × 1 in.

Highly finished. Neat design and perfectly reliable. Price 2/- each.

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"Goltone Concert Grand." 22 ins. high, 14 ins. Bell Mouth. Represents the best possible value. Unequalled for volume of sound and purity of tone. Adjustable diaphragm. 2,000 ohms. Complete with Cords, £4 0 0

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Large 32-pp. illustrated Radio Catalogue post free on request. Enclose Business Card for Trade Terms.

These lines are stocked by the leading Radio and Electrical Stores. Write direct if unobtainable.

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An extremely effective instrument, when used in conjunction with a variable condenser, ·0005 mfd., for eliminating signal interference up to 600 metres, easily attached.

No. R5/750. Price 12/6

Fitted in polished hardwood box with ebonite panel and suitable Condenser ready wired.

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BONTONE are made throughout in our own works. Made of the best materials procurable and covered by a guarantee. Compare these BONTONE advantages with the conditions when purchasing Continental Telephones. BONTONE are sensitive—we make our own magnets, wind the bobbins, make them from beginning to end—BONTONE are British Made.

Manufactured up to High-Efficiency down to a Popular Price.

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BONTONE ORIGINAL

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All phones are stamped B.B.C.

SENSITIVE, DURABLE, COMFORTABLE & BEAUTIFULLY FINISHED.

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CARPAX

Tested Specialities for RADIO Enthusiasts.

Rusonite Permanent Detector, ideal for Reflex Circuits. No Cat's-whisker worry .. 4/6	**Carpax Valve Protector.** Connect to one terminal of your H.T. battery and absolutely prevent valve blow-outs 2/6	**Electrad Certified Grid Leaks.** Every one guaranteed, 2 megohms, 2/6
Carpax "Varimeg," the ideal Variable Grid Leak at last. Not compression type. Smooth variation, stable resistance .. 3/- Range, ½ to 5 megohms	**Carpax "Varinode."** A variable anode resistance on same principle as Varimeg. Range 20,000 to 250,000 ohms. 3/-	**Grip Tite Connector Clips**, 1/- each, small size, 4d. each. **Indorarial**, 7/6. Send for list of complete receiving sets, 30/- to £11 10s.

Radio experimenters should send for our list of Tested Radio Specialities. This list is Free and Post Free. It will save you money and add to your enjoyment.

The above specialities are on sale at most dealers or direct from:

CARPAX COMPANY, Ltd.,
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You are not getting the best out of your Set
Your Panel is acting as a Slow Leak

"INSULEX"

The Latest Discovery in Wireless

A scientific preparation for applying to the surface of wireless panels. NOT A LIQUID VENEER or VARNISH.

The efficiency of a wireless set depends to a great extent on the dielectric value of the ebonite used in the panel. When this becomes dirty, or coated with moisture in damp weather, the dielectric value falls, the high-frequency currents from the aerial taking the shortest path to earth—across the surface of the panel—causing a pronounced loss in signal strength. This applies to both crystal and valve sets.

On panels treated with "INSULEX" this can never happen. Your set will work better and look like new after one application.

"INSULEX" The result of two years' serious research. Is the only preparation made specially for the treatment of ebonite.

"INSULEX" Removes finger-marks, stains, etc. (No more green and discoloured panels.)

Treated occasionally with "INSULEX" your panel will keep its colour for all time.

Start your wireless season by giving your panel a clean up with "INSULEX" and enjoy improved reception.

"INSULEX" in bottles, 1/6; Large Size. 2/6. *Post 4d extra*

Direct from the
DANUM TRADING CO., Scientific Chemists, 2, French Gate, DONCASTER.
TRADE ENQUIRIES INVITED

APPARATUS TESTED.

(*Continued from page* 1210.)

structional purposes. Its gas consumption is very low, not being more than about 1¾ c. ft. per hour. In our opinion it is one of the best value-for-money propositions brought forward within the last year, and should prove an indispensable item in the home for numerous purposes besides wireless. On test we found it to be perfectly satisfactory in operation, a clean, hot iron being available a few moments after lighting.

* * *

Quite unique is "Junit," a self soldering wire, samples of which have recently been sent us. In appearance it is similar to No. 18 gauge tinned copper wire, but it really consists of metal that acts similarly to ordinary solder. It retails at 4 yards for 6d., sufficient length to wire up at least a two-valve set of ordinary design. Naturally it is rather soft, and in making "bridge" connections one has to be careful lest the main leads melt away. Nevertheless it is an interesting little side line.

* * *

From Messrs. Radions, Ltd., of Bollington, we have received samples of their Radion G. P. valve, which takes approximately ·48 amps. at about 4 volts. It is, as its designation implies, a general purpose valve, although in our opinion it operates more efficiently as a detector than amplifier. It is, however, quite a good all round valve, and, comparatively speaking, well made and finished. It is necessary to run the filament rather brightly to get the most out of it, and we should have thought that this would tend to reduce its life. While we are on the subject of valves, might we respectfully draw the attention of valve manufacturers in general to the fact that to our knowledge there is no valve, at least on the English market, designed especially for dual amplification. If there is, then it has not been very well brought forward. The number of "reflex" receivers in use must be enormous, there must be a few tens of thousands of possessors of "P.W." Combination sets alone, and yet no valve manufacturer has come forward and said: "Here we have type so-and-so, designed particularly to perform the functions of dual amplification."

Whatever are the arguments against this, *and we know some*, the fact remains that there are only one or two bright emitters really suitable for reflex circuits, while there are many both specified amplifiers and general purpose valves which *are not*.

A special loading coil for Paris, manufactured by Messrs. B.T.-H. Ltd.

* * *

From the Radio Manufacturing Co., of 100, Dale End, Birmingham, we have received samples of R.M.C. "S" and "C" type variometers. Both of these are designed for one-hole panel mounting and to cover the normal band of broadcasting wave-lengths. The "C" type, which retails complete with knob and pointer at 4s., is of conventional tube and ball style, but more especially in respect of connections embodies exceptional features. It is a well-made little instrument, and sound value for money at the price mentioned above.

The "S" type is of special spherical design, having a ball rotor and a "skeleton" spherical stator. The latter consists of a stiffly self-supported winding to reduce self-capacity losses, and to enable a closer separation of winding to be obtained, a graduated scale is provided with this model. It retails at 6s. 9d. complete.

We have tested both types and very satisfactory results were obtained both in crystal and valve circuits. Adjustments in both cases were mechanically smooth but not loose, and positive electrical connections and contacts maintained throughout.

* * *

We recently received a cabinet from Messrs. Pickett's Cabinet Works, Bexley Heath, S.E., which is to be used for a special receiver we are constructing. It is one of their "Concert" types, finished in light mahogany, and shows excellent workmanship throughout.

This type, known more generally as "American," is rapidly increasing in popularity in this country; it offers many advantages besides being handsome in appearance.

The Radiovox
Vaneless Square Law
Variable Condenser
is a Revolution in condenser design

8/6
Postage 3d. extra

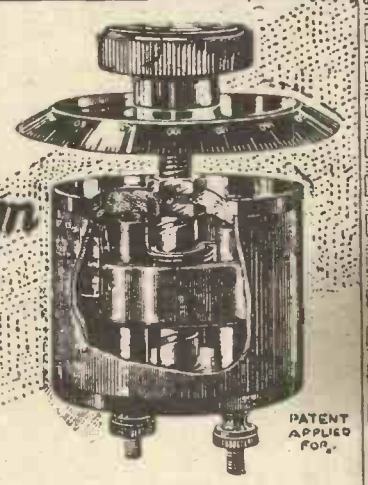
The "Radiovox" is a revolution in condenser design. It has an even scale of capacity variation throughout the whole of its range and, owing to the small size of the electrodes the losses are reduced to a minimum.

The "Radiovox" Variable Condenser is a sound, engineer built component—is entirely enclosed in a strong fibre case and an ornament to any set.

There are no delicate vanes to get damaged or dusty. The movement is firm and smooth and the position of the electrodes eliminates hand capacity effects.

Tuning is exceedingly fine and, although there is only one knob to turn, vernier adjustment is obtainable over the whole scale. The tuning in of distant Stations is simplified.

The "Radiovox" is British made and is guaranteed by the makers.



·001 ·0005 and ·0003 mfd.

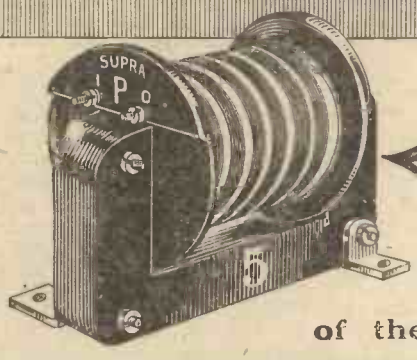
It serves further to demonstrate the superiority of British components.

The price includes first-class knob and dial. All orders will be taken in strict rotation and will be dispatched immediately on receipt of remittance.

RADIOVOX CO.
(B. Dept) 57 CHANCERY LANE.
LONDON, W.C.

S.S.S. 4.

It's the windings



This illustration shews covering removed and one layer of the sectional winding.

of the

SUPRA

THAT MAKE THE DIFFERENCE!

The efficiency of your valve set depends upon getting the maximum from each valve.

This is governed by the transformers you use. The "Supra" low frequency transformer has a ratio of 5 to 1, and is specially designed to give the utmost amplification without distortion.

The windings are in insulated layers, each having six sections, reducing self-capacity to a minimum.

Thirty-eight laminations of finest soft iron compose the core.

Those who have marvelled at the rich, full tone of our "Supratone" Amplifier, which incorporates two "Supra" transformers, will agree that our claims are not exaggerated.

12/6

Acknowledged the best

all over the country; everywhere that sets are being constructed you will find the "Microstat" being installed. Why? Because it is unquestionably the finest form of filament control, giving noiseless micrometer adjustment from zero to 100 ohms with any type of valve. Fitted as standard on our "Supratone" Amplifier. One-hole fixing.

The MICROSTAT - 2/9

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Works: LONDON, BIRMINGHAM, and WESTCLIFF.

'Phone: Gerrard 575 and 576. 'Grams: Zywateseng, Westcent.

This means your discovery of a perfect Crystal

When you see the distinctive "Hand-and-Crystal" on the carton (as shown below) your search for full sensitiveness ends.

Eye-straining, temper-ruffling "prodding" in the vain hope of getting a "better spot"; breaking into an interesting musical item because the Crystal has 'gone dead"; all this is ended if you accept the invitation of the "Hand-and-Crystal" and fit Sylverex Crystal to your Detector.

Sylverex Crystal gives silver-toned, perfect rectification, and is exceptionally efficient in long-distance reception. It is sensitive all over and right through and carries a definite money-back guarantee—each Sylverex being exhaustively tested on actual Broadcast transmission before despatch.

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'Phone: Franklin 6003. Trade enquiries invited.

2/-

In airtight container; with Special Catswhisker and full directions.

If you cannot obtain Sylverex from your Radio Dealer, send P.O. 2/- direct, with your Dealer's name and address, and we send the Crystal by return post free. Remember, whether you buy Sylverex from your Dealer or direct, you test it at **OUR** expense; if you are not satisfied in every way your money is returned.

RADIOTORIAL

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Technical queries are answered by post at a charge of 6d. a query, or 1s. for three. All queries must be addressed to the Technical Query Dept., POPULAR WIRELESS, *The Fleetway House, Farringdon Street, E.C. 4, and must be accompanied by a stamped and addressed envelope. Copies of the queries sent should be kept, as the original query cannot be produced in the answer. Cash should be sent in the form of a postal order.*

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and 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 trader would be well advised to obtain permission of the patentees to use the patents before doing so.

PATENT ADVICE FOR READERS.

The Editor will be very pleased to recommend readers of POPULAR WIRELESS *who have any inventions to patent, or who desire advice on patent questions, to our patent agent. 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.*

Questions and Answers

NOVICE (Nottingham).—What is meant by oscillation interference?

This is due to the effect of excessive reaction in a valve set in such a way as to cause the valve to oscillate and energise the aerial. If reaction on the aerial is used, or if H.F. valves oscillate, a small oscillating current flows up and down the aerial and sends off ether waves of a wave-length approximating to the wave-length to which the oscillating set is tuned. This wave "gets mixed up with" other transmissions (e.g. broadcasting transmissions) and upsets them, producing a beat note as the two waves get in and out of step, for they will not be of exactly the same wave-length. This beat note is heard in other listeners' sets in the form of a high-pitched whistle, which will drown or interrupt anything else being received.

* * *

S. J. E. (Redhill, Surrey).—My neighbour's aerial is parallel to my own, and we share the same mast. When my three-valve set is tuned to the local station his signals are greatly increased, apparently by interaction, and he is unable to tune-out and listen to other stations. How can this effect be lessened?

To reduce interaction, the aerials should run at right angles instead of parallel, and reaction should not be used on either aerial or secondary circuit. Where aerials are separated only by a few feet it is impossible to avoid a certain interaction between them.

* * *

INDOOR (Camden Town, London, N.W.).—I am unable to erect an outdoor aerial, and have been told that I can use the electric light mains instead. Would this be an effective substitute, and is there any danger from shock in such circumstances?

The results obtainable with an "aerial" of this kind can only be ascertained by test, as they are sometimes remarkably good and sometimes very disappointing. There is no danger, providing that one of the specially constructed connectors of reliable make is used, and that the instructions are carefully followed.

* * *

R. A. E. T. (Witney, Oxon).—What type of amplifier, L.F. or H.F., should be added to a crystal set to increase very indistinct signals?

Generally speaking an L.F. amplifier is added to increase the volume of signals being received, but to add an L.F., signals must be clear and distinct in the first instance. Thus it would be advisable to add an H.F. in this case, to amplify the very weak impulses before they are passed on to the crystal for rectification.

(*Continued on page* 1218.)

HULLO! C.Q., WILL DAY CALLING
FOR
WHERE THERE'S A WILL THERE'S A DAY.

T'ANDCO BASKET COILS (100 to 4,500 metres.)
Duplex wound, 25 gauge D.C.C. wire, sewn supports unwaxed, very firm and strong, recognised as the finest type Coils yet made. Enamelled.

Size 1.	2 in.,	approximately	150 to	300 metres	5d. each.	No. 1.	4d. each
2.	2½ in.,	"	250 to	400 "	6d. "	2.	5d. "
3.	2¾ in.,	"	350 to	550 "	7d. "	3.	6d. "
4.	3 in.,	"	450 to	650 "	8½d. "	4.	7d. "
5.	3½ in.,	"	600 to	750 "	10d. "	5.	8d. "
6.	4 in.,	"	700 to	1,000 "	1/2 "	6.	9d. "
7.	4½ in.,	"	950 to	1,350 "	1/4½ "	7.	10d. "
8.	5 in.,	"	1,300 to	1,750 "	1/8 "	8.	1/- "
9.	5½ in.,	"	1,700 to	2,600 "	2/- "	9.	1/2 "
						10.	1/4 "
						11.	1/6 "
						12.	1/8 "

COIL HOLDERS. 1/6 each

The new "Dayzite" Variable Condensers fitted with Aluminium End Plates, and both sets of Vanes adjustable. ·001, 7/9 each; ·0005, 5/8 each; ·0003, 5/1 each; ·0002, 4/7 each; Vernier 3/11 each. Postage 6d. each extra.

IF YOU WOULD SECURE IMMUNITY FROM LEAKAGE IN YOUR SET HAVE YOUR PANELS CUT TO YOUR SIZE FROM OUR FAMOUS EBONITE, ORDINARY FINISH, 4/6 PER LB. MATT FINISH, 5/- PER LB. AMERICA EASY ON ONE VALVE.

MAKE NO MISTAKE IN YOUR SELECTION. Do not keep wasting money on crystals of unknown repute.
GET A CRYSTAL THAT HAS STOOD THE TEST OF TIME.

DAYZITE REGD.

Sold only boxed with Silver Cat's-whisker, 2s. 6d. each, postage 3d. extra. Makes excellent contact with Zincite for a Perikon Detector.

We had a call from a delighted customer recently who stated he received 2 L O at Brussels quite distinctly on a DAYZITE crystal.

Write at once for our new catalogue, post free by mentioning "Popular Wireless."

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19, LISLE STREET, LEICESTER SQUARE LONDON, W.C.2
'Phone: Regent 4577. Telegrams: "Titles, Westrand, London."

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Retail Prices
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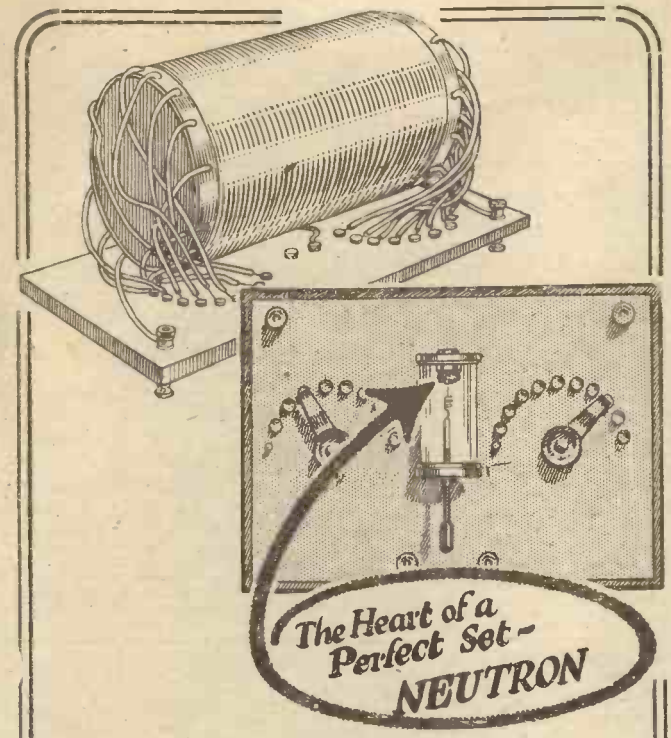

The one great essential to perfect Crystal or Crystal-valve reception is a really efficient Crystal. A good aerial, heavy-gauge inductances, low capacity, good phones—all these help, but *the one vital point is your Crystal.* And the finest Crystal in the world—Neutron—costs you but 1s. 6d.

An indoor Aerial with Neutron equals an outdoor one with ordinary crystals. Neutron will even compensate for poor phones or inefficient coils; but be sure you get *Neutron*, in the black and yellow tin—the guaranteed and concert-tested wonder crystal.

NEUTRON TRADE MARK

The World's Greatest Radio Crystal —Concert Tested and Guaranteed

FIVE PAIRS OF 'PHONES.

"I have tried this Crystal and now I should like to say I am quite satisfied with it. It might interest you to know it is at present in use on an ordinary crystal set and works with good strength five pairs of phones."

G.H.S., S.W. 1.

Sole Distributors: **V. Zeitlin & Sons**, 144, Theobalds Road, London, W.C.1. 'Phones—Museum 3795 and 6841.

Long-distance Circuit Diagram FREE.

Ask your Dealer for Free Diagram (given on request to every purchaser of a Neutron) of the circuit used by 5 B T in receiving Brussels from Chiswick on a Neutron. We send one direct with sample Neutron if you enclose stamped envelope and 1/6 with Dealer's name.

Stocked by the Best Radio Dealers. Packed in tin with silver cats-whisker. Insist on Neutron, in the Black and Yellow Tin

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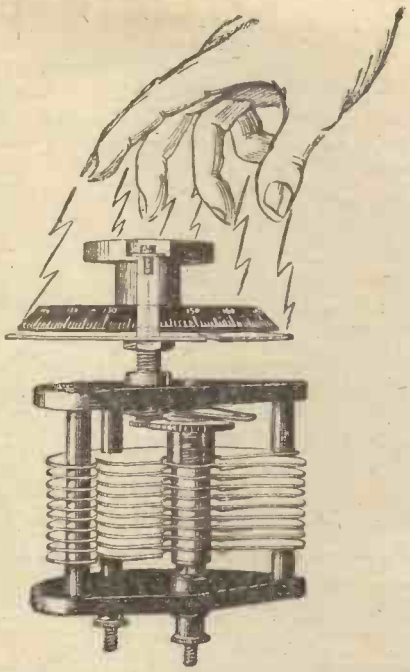
NEUTRON, Ltd., Sicilian House, Southampton Row, London, W.C.1 'Phone—Museum 2677



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The Naylor "Fulstop" Condenser enables tuning to be carried out with a wider range of accuracy than has hitherto been obtained. In addition to being a square law condenser, which avoids the overcrowding of stations at any particular point, the dial of the "Fulstop" Condenser is graduated over the complete circumference and geared at two to one in relation to the moving plates, thereby giving twice the rotary movement of any other condenser and enabling stations to be picked out with the greatest of ease. Further still, the abolition of all hand capacity effects is guaranteed unconditionally by the makers.

Protected throughout the World.

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	·001..13/6	·0003..10/3
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Stocked by most Wireless Dealers, but if you have any difficulty write to:

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Fulstop VARIABLE CONDENSER

HULLO EVERYBODY!!

All these Goods sent by Post. Foreign Packing and Post extra. Orders in Rotation.

POST FREE COLUMN

SORBO RUBBER EARCAPS .. .. pair	1/8
2-WAY EBONITE COIL STANDS	3/6
2-WAY EBONITE EX-HANDLES	4/3
2-WAY CAM VERNIER COIL STAND ..	5/6
2-WAY GEARED COIL STAND	5/11
AERIAL, 7/22 100 ft. and 6 INSULATORS	3/6
BASKET COIL HOLDERS, EBONITE.. ..	1/6
MURRAY VALVE HOLDERS	1/6
EBONITE SOLID ROD HOLDERS	1/3
LEGLESS ANTI-CAP. HOLDERS	1/3
GOSWELL DITTO	1/9
TWIN SILK MINIATURE FLEX doz. yds.	2/-
RED AND BLACK TWIN FLEX .. 12 yds.	2/6
EBONITE VARIOMETERS, BALL ROTOR	5/11
PATENT BATTERY LINKS .. .. .. doz.	1/4
"KENITE" RADIO PANEL 8 × 6	1/6
" " " 9 × 6	1/9
" " " 10 × 8	2/3
" " " 12 × 9	2/8
(Above fine value, easily worked.)	
D.C.C. COIL, 1,600 metres Chelmsford	2/3
72 in. 'PHONE CORDS, best quality ..	2/3
DIAMOND WEAVE (5) COILS, AIR SPACED	3/6
(equal 25, 35, 50, 75, 100 honeycomb.)	
GOSWELL INSULATED VALVE LEGS, Set	1/3
BRUNET SHROUDED L.F. TRANSFORMER	13/6
MANSBRIDGE CONDENSERS, 1· mfd. ..	3/6
DITTO, 2· mfd. .. 4/3 ·25 mfd.	3/6
D.C.C. 16 gauge .. .. 1 lb.	3/6
NEUTRON CRYSTAL AND WHISKER ..	1/6
RATIO MICRO ·06 VALVE	13/11
SIMPLEX LEAD-IN	1/9
REACTONE T.W. INDUC. COILS 5 for	4/6
DITTO. FOR CHELMSFORD	2/6
T.C.B. 6, 13, or 30 ohms	4/-
T.C.B. POTENTIOMETER, 300 ohms ..	5/-
MYERS UNIVERSAL VALVES	12/6
MYERS D.E. VALVES	21/-
PHONES, TELEFUNKEN TYPE (4,000) ..	10/11
N. & K. MODEL (4000)	9/11
RAYMOND FIXED CONDENSERS, ·01 ·02..	1/9
·001 to 0005, 1/2 ; ·002 to ·006	1/3
EBONITE PANELS, 6 x 6 and 7 x 5, each ..	1/8
8 x 6 and 9 x 6 .. 2/6 10 x 8	3/6
12 x 9 .. .. 5/- 12 x 12.. ..	6/-
(Stock Sizes.)	
NEUTRON CRYSTAL SETS 10/6	15/-
COPPER TAPE AERIAL 100 FT..	3/3
BURNDEPT CRYSTAL DETECTOR	5/6
SET OF 7 TWIST DRILLS	2/-
TELEPHONE TERMINALS .. .. ..doz.	1/9
SLEEVING. 6 yds.	2/3
1/16 SQUARE BUS-BAR HANK FOR	1/-
2 VOLT 40-AMP HART ACCUMULATOR ..	15/-
ALLEN VARIABLE GRID LEAK	1/9
D.P.D.T. PANEL SWITCHES (nickel)	1/9
S.P.D.T. PANEL SWITCHES (nickel)	1/4
BRETWOOD VARIABLE GRID LEAK ..	3/-
BRETWOOD ANODE RESISTANCE	3/-
WATMEL VARIABLE GRID LEAK	2/6
WATMEL ANODE RESISTANCE	3/-
SUCCESS SUPER L.F. TRANSFORMER ..	21/-
SUPER-STANDARD L.F. TRANSFORMER	16/-
NEUTRODYNE VERNIER (COLVERN) ..	3/6
INDEPENDENT VERNIER (COLVERN) ..	2/6
SHIPTON STRIP RHEOSTAT, 7 ohms	3/3
SHIPTON " " 30 ohms	3/3
SHIPTON " " 60 ohms	3/3
SHIPTON POTENTIOMETER, 600 ohms ..	4/9
MIC MET DETECTOR	6/6
MICROMETER ENCLOSED DETECTOR ..	2/9
VALVE TEMPLATES	6d.
VALVE WINDOWS, 2 for	1/4
McMICHAEL'S BARREL H.F. TRANSFORMERS—	
300/600	10/-
1,100/3,000	10/-
Other sizes stocked.	
McMICHAEL'S 100,000 ohms Resistance ..	2/6

The Only Way to Save Money

CALL AT RAYMONDS.

RAYMOND VARIABLE CONDENSERS

HIGH QUALITY. NEW PRICES.

"DE LUXE" MODEL

AS SHOWN, WITH DIAL, KNOB AND BUSH.

·001	6/11
·0005	5/6
·0003	5/-
·0002	4/9

POST 6d. SET.
UNSURPASSED FOR FINE TUNING.

NEW MODEL

With Knob and dial.
WITH VERNIER.

·001	8/9
·0005	6/11
·0003	6/9

With EBONITE DIAL and Two Knobs. Post 6d. Set.

No. 3 CONDENSER

WITH KNOB.
POST 6d. SET.

·001	6/11
·0005	4/11
·0003	4/6

18, Gosford Road,
Beccles, Suffolk
17th October, 1924.

I received the "Square Law" Condensers, and I tried them in my "reflex" (single valve), and the results were so remarkable that I have given up all thoughts of building a 3 valve which I had ordered them for.

Thanking you for your prompt attention, I shall be pleased to recommend you to my friends.

(Signed) P. BULTON.

NEW MODEL SQUARE LAW

With Vernier.
With Knob and Dial.

Aluminium Ends.		Ebonite Ends.
·0003	8/6	10/-
·0005	8/11	10/6

Post 6d. Set.

TWIN CONDENSER SQUARE LAW

EBONITE ENDS	
·00025	12/6
·0003	12/6
·0005	18/11

TWIN (Ordinary)
Equal units of ·00025 or ·0003 9/-
Complete with Knob and Dial.
Post 6d. Set.

LONDON'S LARGEST Stockist of

JACKSON BROS.'

"J.B." Variable Condensers, Complete with Knob and Dial.

SQUARE LAW		STANDARD	
·001	9/6	·001	8/6
·0005	8/-	·0005	7/-
·0003	6/9	·0003	5/9
·0002	5/6	·0002	5/-

Other sizes as advertised by "J.B." Post 4d.

ACCUMULATORS FOR CALLERS ONLY at present.
See Callers' List.

Formo, open 12/6

47 Bucks "Powquip" 12/6

Manchester "Powquip," 15/6

Ormond 14/6

Shrouded 'Powquip,' 18/-

Standard 'Powquip,' 14/6

GOSWELL ENGINEERING

Patent Valve Holder	1/6
Goswell 2-way Vernier Coil Holder ..	9/-
3-way Coil Holder ..	7/6
2-way Panel Mounting	3/-
3-way Panel	5/-
Goswell 3-way Cam Vernier	12/6

LISSEN

Variable Grid Leak..	2/6
Anode Resistance ..	2/6
Lissen Minor	3/6
Lissenstat..	7/6
Do. Universal	10/6
2-way Switch ..	2/9
Series Parallel ..	3/9
T1 Transformers ..	30/-
T2, 25/- ; T3,	16/6 ;
Coils : 25, 4/10, 30, 35, 40 4/10, 50 5/-. 60 5/4. 75 5/4, 100 6/9.	
5 point switch ..	4/-
Lissen choke.. ..	10/-
Aux. Res.	1/3

DUBILIER

·001, ·002, ·003, ·004, ·005. ·006, Fixed ..	3/-
·0001, ·0002, ·0003, ·0004, ·0005 ..	2/6
Type 577, ·01	7/6
Grid Leaks, each ..	2/6
Anode Resistance 50,000, 70,000. 80,000 100,000, on stand complete	5/6

ALL VALVES ON POST SENT AT PURCHASER'S RISK.

VALVES

THORPE K4 (5-pin)	17/6
PHILLIPS 4 ELECTRODE	12/6

(Both for UNIDYNE.)

BRIGHT EMITTER 12/6 each

B.T.H. ..	R. Type
Ediswan	A.R. "
Marconi-Osram R. or R 5 V	"
Mullard-Ora	"
Cossor ..	P.1 "
Cossor ..	P.2 "
Mullard H.F. (Red Ring)	
Mullard L.F. (Green Ring)	

DULL EMITTER

21/- each	Type
B.T.H.	B.3
Ediswan ..	A.R.D.E.
Marconi-Osram	D.E.R.

25/- each	Type
B.T.H.	B.5
Ediswan ..	A.R.O.6
Marconi-Osram	D.E.3
Mullard ..	D.F.Ora

DULL EMITTER POWER VALVES
For use with A.R.D.E. and D.E.R. Valves.
Marconi-Osram. Type D.E.6,2–2·5 volt. ·25 amps. 25/-

DULL EMITTER POWER VALVES
For use with ·06 Valves:

B.T.H. Type B.6 ..	35/-
Marconi-Osram Type D.E.4	30/-
Mullard, Type D.F.A.2	30/-

POWER VALVES
For use with Bright Emitters

B.T.H., .. B.4	35/-
Marconi-Osram .. D.E.5	35/-
Mullard ..D.F.A.1	35/-

Phillips' "R" ..	6/11
French "R" ..	6/11
·06 Valves	12/6 & 13/11
Dutch "R"	5/11
Metal ·06	15/11

Post 6d. each.

HEADPHONES

We can recommend these as being excellent Headphones, with a great reputation.

B.T.H. 4,000 ohms..	25/-
G.R.C. 4,000 ohms..	20/-
BRANDES 4,000 ohms (Matched Tone) ..	25/-
BROWN'S 4,000 ohms (featherweight) ..	25/-
STERLING 4,000 ohms	25/-

ALL POST FREE.

Genuine DR. NESPER HEADPHONES

Adjustable diaphragm, detachable receivers, double leather-covered head-springs, long flexible cords, nickel plated parts. Very comfortable fitting to the head.

LOOK FOR THE TRADE MARK.

4,000 ohms.. .. .. 13/3
Post 6d. pair.

Genuine N and K No. 3. Latest Model 17/6

New 3-pole Laminated Magnets, which ensure an even magnetic null and still greater volume. Windings well insulated. Large size earpieces and leather headbands of standard "N & K" comfortable design. Technically, "N & K" Headphones represent the last word in Wireless Reception.

IMPOSSIBLE TO EQUAL FOR CRYSTAL SETS.

RIGHT OPPOSITE DALY'S GALLERY DOOR

K. RAYMOND

27, LISLE STREET, LEICESTER SQUARE, W.C.2

No responsibility accepted on post orders unless cheques and postal orders are crossed and made payable to the firm. Moneys sent must be registered

HOURS OF BUSINESS:
DAILY - 9 to 7.45
SUNDAY - 10 to 1

'Phone: GERRARD 4637.

HULLO EVERYBODY!!

IMPORTANT NOTICE.

TRADE COUNTER OPEN

will oblige you with any lines in stock, less 20% on Proprietary articles.

NO POST ORDERS TRADE.

Schools allowed 3/- in the £ on proprietary articles only

NO POST ORDERS for these.

PANELS DRILLED FREE WITH ORDERS OVER 20/-.

PANELS DRILLED and ENGRAVED FREE WITH ORDERS OVER £5.

West End stockist of Edison Bell, Igranic, Goswell (quality), Polar, Jackson Bros. (J.B.), Marconi, Cossor, Mullard, Ediswan Valves, Sterling, B.T.H., McMichael's, Lissen, Dubilier, goods.

CRYSTAL SETS

Wonderful little set extra. Fitted for Chelmsford. Complete with crystal. Post free 10/-

RE-ECHO (genuine) SUPER SET. Sloping cabinet, extra Chelmsford fitting.

Post free 17/11

L.F. TRANSFORMERS

Eureka Concert Grand	30/-
2nd Stage	22/6
Igranic New Model	21/-
General Radio 83	15/-

Also see illustrations.

LOUD SPEAKERS

Postage 1/- each.

Dr. Nesper	21/-
Sterling "Baby"	55/-
C.A.V. Tomtit	39/-
Amplion "Junior"	27/6
"Ultra"	27/6

BRUNET 'PHONES

Latest Model now Ready.
(Not the one with green cords).
Beautifully made. Very Comfy.

Per pair 16/6.

Postage 6d. per pair.

PARTS FOR 2-VALVE UNIDYNE

2 Thorpe K 4 Valves, terminals, 2 microstats, 1 var. grid leak, S P D T Switch, ·0005 var. Condenser with vernier. Cam vernier 2-way stand, 2 5-pin valve holders, 2 fixed Condensers, G R C Transformer, tinned copper wire nuts, screws, etc. The lot for .. .. .. **£3 : 15 : 0**

Carriage paid. All best quality.

POLAR

·001 var. Condenser	10/6
·005 " "	10/6
·0003 " "	10/6
Cam Vernier 2-way Coil Holder	11/-

STERLING SQUARE LAW

with Vernier.

·001	30/-
·0005	25/6
·00025	23/6

CALLERS! THESE 4 COLUMNS FOR YOU NO POST ORDERS FROM SAME

Warning! Note name RAYMOND on shops. You will not be able to buy these goods otherwise. Nearest Tube Leicester Square. This address is at the back of Daly's Theatre. Open Weekdays 9 to 8, Saturdays 9 to 8.45, Sundays 10 to 1.

SUNDRIES

Lead-in tubes: 6d., 7d., 8d.
Valve Pins and Nuts 2 a 1d.
Stop Pins and Nuts 2 a 1d.

Nickel Terminals	2d.
Nickel Contact Studs 2 for	1½d.
Nickel Switch Arm (one-hole fixing)	1/-
Voltmeter	4/6
Gamages Permanite	1/-
Condenser Brushes	6d.

RAYMOND FIXED CONDENSERS.

·001, ·0001 to ·0005	10d.
·002, ·003, ·004 ..	1/-
·006, 1/3 : ·01 1/9 : ·02	1/9

ACCUMULATORS

No Post Order at present

2 v. 40 amps. ..	9/6
4 v. 40 amps. ..	16/6
4 v. 60 amps. ..	18/6
4 v. 80 amps. ..	23/6
6 v. 60 amps. ..	27/6
6 v. 80 amps. ..	33/-
6 v. 105 amps. ..	38/6

Hart's Stocked. All High Quality.

Microstat	2/6
Switch Arms 8d. to	1/-
Flex (Red and Black) per yd.	3d.
Shellac	5d.
Shorting Plug and Socket	4½d.
Contact Studs 4 for	1½d.
Nickel ditto 2 for	1½d.
Nickel Switch arm	1/-
Sorbo Ear Caps pair	1/4
Tumbler Switches	1/4

'Phone Cords 6 ft. 1/-.	1/3
Nugraving	6½d
Empire Tape 2 yds.	1d.
Allen Var. Grid Leak	1/3
Best Sleeving 3 yds.	10d.
Rubber Lead-in 10 yds.	1/-
Thick ditto., 1d., 2d., & 3d.	
Aerial, 7/22 100 ft.	1/10½
Ditto, Extra Heavy 100 ft.	2/3
Anti Cap. Handles	8d.
Tumbler Switches	1/-

NOTE!
Our Wonderful Micrometer Adjustment Glass-enclosed Detector Why pay more? **1/9**

5 Waxless Coils 200/2000	1/3
5 equal 25 to 100 ..	1/8
5 ditto, Extra Air Space	2/-
6 waxed 200/3600	1/6
7 waxed 150/3600	1/11
Chelmsford D.C.C. 1/-. 1/3.	2/6
Basket Holders 9d. 1/-	1/3

Switch Arm 12 Studs, 12 Nuts, 12 Washers. Lot 10½d.

VERY SPECIAL OFFERS

Crystal Set fitted for Chelmsford	7/11
RE ECHO set, worth 25/-, for	15/-

SPECIAL. To callers only. To customers purchasing 20/- worth of our own goods we supply a first-class pair of 4,000 ohm 'phones for 5/- as an advertisement only.

REACTONE COILS STOCKED.

For Chelmsford ..	2/6 set
" Broadcasting	4/6 set

HONEYCOMB COILS.
No dead ends.
High-class make.

25 ..	4/-	200 ..	7/-
35 ..	4/-	250 ..	7/3
50 ..	4/2	300 ..	7/4
75 ..	4/5	400 ..	8/3
100 ..	5/8	500 ..	8/6
150 ..	6/4		

Legless valve holders	1/-
ANTI CAP valve holder	1/-
2 mfd. Mansbridge	3/9
1 mfd. Mansbridge	3/3
·25 Mansbridge ..	2/11
Colvern Vernier ..	2/6
Neutrodyne ditto ..	3/6

Radio panels "KENITE" (stand 5,000 volts), 6 x 6, 9d.; 7 x 5, 9d.; 8 x 6, 10d.; 9 x 6 1/-; 10 x 8, 1/-; 12 x 9 2/-; 12 x 12, 2/3. Above 3/16 in. thick. ¼-in. also stocked.

Legless Valve Holder	1/-
Solid Rod Ditto. ..	1/-
Under Panel Ditto.	1/6
Ebonite Dials .. 8d..	1/-
Valve Templates 2d.	4d.
Adhesive Tape Roll	2½d.
Copper Foil per foot	2½d.
1 in. Fibre Strip 3 ft.	2d.
Insulated Hooks 4 for	3d.
Ditto Staples 5 a	1d.

Twin Flex 4 yds.	6d.
Twin Silk Small 6 yds.	6d.
D.C.C. Bell Wire 10 yds.	5d.
Knobs, 2 B.A. 2d. 3d.	4d.
Small Knobs 6 B.A.	3d.
Small Knobs 4 B.A.	3d.
Wander Plugs pair	3d.
Egg Insulators each	1d.
Tape Aerial 100 ft.	2/-
Valve Windows 4d. to	9d.
Mica	2d.

RAYMOND CRYSTAL SETS
7/11 9/11 12/11

2 B.A. rod per ft.	2½d.
4 B.A. Rod per ft.	2d.
Basket Holders ..	8½d.

Also at 10d.. 1/-., 1/3, 1/6

2-way Coil Stands	1/11
3-way ditto	3/6
2-way with ex handles	2/11
2-WAY COIL STANDS	1/3, 1/9
VARIOMETERS	1/-. 1/3
DUTCH VALVES ..	4/3
LARGE DETECTORS	11d.
5 WAXLESS COILS..	1/3
Do. EXTRA AIR SPACE	1/3
'PHONES 4,000 OHMS	6/11
N. & K. PATT. 4,000 OHMS	8/11
VARIABLE GRID LEAKS	1/2
VALVES FOR UNIDYNE	12/-
5-PIN Ditto.	13/11
PORCELAIN D.P.D.T.	1/4
Ditto. S.P.D.T.	11d.
L.F. TRANSFORMERS	8/11
SPECIAL BASKET HOLDERS	8½d.
Ditto. for Chelmsford Coils	9d.
SINGLE COIL formers with spokes	8½d.
BRUNET 4,000 ohms, NEWEST MODEL..	15/6
ACCUMULATOR CARRIERS ..	2/3
FLUSH PANEL sockets complete.. ..	4 for 5d.
EBONITE BUSHES 1d.	dozen 10d.
C.W. BATTERY LINKS	2 for 1½d.
"LEDION" sets of 5 COILS .. 1/8 and	2/6
GEARED 2-WAY COIL STAND	5/3
CAM VERNIER ditto..	4/6
CLIMAX U.P. VALVE HOLDERS	1/3
RHEOSTAT for D.E. or R. VALVES	2/2
2-WAY COIL STAND, ex handles	1/11
Ditto nickel fittings ..	2/9
Half opal and ebonite enclosed DETECTOR, worth 2/-. My price..	1/-
TAPPED COILS for CHELMSFORD ..	1/6
Ditto for Broadcasting	1/-
GRID LEAK CLIPS..pr.	1d.
Valves : PHILLIPS "R" type..	6/11
Valves : FRENCH METAL "R" ..	6/6
Valves : DUTCH .06 (good)	11/-
Valves : DUTCH DETECTORS .. 4/3 and	4/9
Valves : DUTCH "R" TYPE	4/11
Valves : FRENCH METAL .06 ..	12/11
Valves : RADIO MICRO .06	12/11

VARIOMETERS.
Finest Value in London. 1/4, 1/6, 2/3. JUST TRY THEM.

WEDGE-SHAPE COIL PLUGS Extra value	7½d. and 8½d.
EDISON BELL ditto	11d.
Fine little RHEOSTAT, 1 H.F.	1/-
H.F. TRANSFORMERS, B.B.C.	2/6
Red and Black TWIN FLEX .. .. 6 yds.	10d.

This is the shop for BARGAINS
See the name RAYMOND.

SUNDRIES

Terminals complete—

Brass Pillar ..	1d. 1½d.
W.O. or 'Phone	1d. 1½d.
Fancy Patterns	1d. 1½d.
Extra large ..	2d. 3d.
Valve Sockets 2 for	1½3.
Machine cut Screws Stocked (Best).	
Pulleys	4½d.
4 Taps and Wrench	2/11
Screwdrivers ..	6d.

D.C.C. Wire, per ½lb.—
13 g. .. 9d. 20 g... 9d.
22 g. .. 10d. 24 g... 1/-
26 g. .. 1/1 28 g... 1/3
30 g. .. 1/6 Etc., etc.

H.T. BATTERIES

60 v.	7/6
30 v.	4/6
60 B.B.C.	8/11
36 B.B.C.	5/6
9v. B.B.C.	2/6
1·5 (D.E.)	1/9
Ditto	2/- to 3/-

D.P.D.T. SWITCHES.

Mini Panel	1/-
On China Base ..	1/4
On Ebonite Base	1/11 2/6

S.P.D.T. SWITCHES.

Miniature Panel ..	10½d.
On China Base ..	11d.
On Ebonite 1/3 to	1/9
Murray Valve Holder	1/3
Spring Washers 4 a	1d
Coil Plug on Base	10d.

De Luxe Crystal Set	7/11
4 Whiskers, 1 Gold	2d.
Coil Plugs (ebonite)	6d.
Ditto	9d.
Shaped .. .. 8½d.	1/-
5 ohm Rheostat ..	1/-
Various 1/3, 1/6, 1/9,	1/11
With Dial	1/11
Ormond	1/9
'Phone Connector	1d.
Nuts 2, 4, 6 B.A. doz.	2d.
Washers .. 12 a	1d.

BOXES

7 × 5	9 × 4	12 × 9
8 × 6	10 × 8	12 × 12

BUY RAYMOND GOODS

EBONITE STOCK SIZES	6×6 .. 1/4
	7×5 .. 1/4
	8×6 .. 1/10
	9×6 .. 2/-
	10×8 .. 3/-
	12×6 .. 3/-
	12×9 .. 4/3
3/16 in.	12×12 5/6
	14×10 5/6

Cut to size ½d. sq. in. WE STOCK ¼-in. EBONITE.

RIGHT OPPOSITE DALY'S GALLERY DOOR

K. RAYMOND
27, LISLE STREET, LEICESTER SQUARE, W.C.2

No responsibility accepted on post orders unless cheques and postal orders are crossed and made payable to the firm. Moneys sent must be registered

HOURS OF BUSINESS:
DAILY . 9 to 7.45
SUNDAY . 10 to 1

'Phone: GERRARD 4637

THE BIG THREE

Make Wireless Worth While!

RADIO-PLAN No. 1. Two Shillings.

EVENING TRIPS TO AMERICA

BY THE "P.P.V.2" ROUTE.

This Radio-Plan tells you how to build the most simple, powerful and successful long range set in the world. A Two Valve Wonder. Works loud-speaker or carries 20 pairs of headphones within 30 miles. Receives all B.B.C., European and Continental Stations and

AMERICA EVERY NIGHT.

RADIO-PLAN No. 2, Two Shillings.

YOUR OWN WIRELESS ORCHESTRA!

A Band in Your Home!

This Radio-Plan explains the building of the Big Super Set THE "P.P.V.4."

Gigantic Volume of Perfect Melody. No Distortion. No Blare. No Rattle.

The "P.P.V.4" is the "last word" in wireless. Receives all European Stations on loud speaker and at least one American programme at fair loud speaker strength. One, two, three or four valves can be used at will. Just a few very simple parts. No complicated wiring. Quite easy for any amateur to build.

No Crystal. No H.F. Nothing to Puzzle.

The "P.P.V.4" is the Queen of all Circuits.

RADIO-PLAN No. 3. Two Shillings.

AMERICA ON ONE VALVE!

This Radio-Plan details the easy construction of "P.P.V.1" the simple super circuit, and the "T.C.1" the most simple and powerful regenerative circuit ever to have been designed.

With either you can tune in all European and one American programme nearly every night. Both are as powerful as most two valve circuits. Both require only a few parts costing a few shillings. One variable and a few fixed condensers, wired in a certain way. Result—*miracles.*

Either or all of the above sent direct by return post on receipt of remittance.

The Big Three—Make Wireless Worth While

PRESS EXCLUSIVES (Wireless Publishers)

2, Wine Office Court, Fleet St., London, E.C.4

INVENTIONS

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BROWNE & CO., Patent Agents,
9, Warwick Court, Holborn, London, W.C.1.
Established 1840. *Telephone: Chancery* 7547.

ACCUMULATORS.

C.A.V., Fullers, etc. Guaranteed brand new and perfect, but slightly soiled. We refund cash with carriage both ways if returned within 7 days.

2v—40a	8/6	4v—100a	32/6
2v—60a	11·6	6v—40a	25/-
4v—40a	17/-	6v—60a	32/6
4v—60a	21/9	6v—80a	40/-
4v—80a	27/6	6v—100a	46/-

Special Line:—
2v—100a (Actual) C.A.V. 27/6

MAUDE RUBBER CO., 58, PRAED ST., LONDON, W.2

AERIAL MASTS, TUBULAR, STEEL

In four sections, complete with pulley and straining eyes, 30 ft., 17/6; 40 ft., 25/-; carr. forward.
STANLEY & CO.,
93, Railway Arches, Dalling Rd., Hammersmith, W.

ARE YOU STILL USING CRYSTALS?

If so, discard them and use

SHEEN

and notice the improved reception.
Price 1/6. Special Whisker 6d.
Every piece Tested and Guaranteed.
If your dealer is unable to supply, send P.O. together with his name and address and we will send to you post free.
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'PHONE REPAIR SERVICE

ALL MAKES of Ex-Army 'Phones rewound. 4,000 ohms, 5/- per pair; 8,000 ohms, 1/6 extra. Remagnetising and adjusting, 2/-; postage, 6d. Transformers rewound any ratio, from 5/-.
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Sheet, rod, and tubing in all sizes kept in stock and cut to any required size while you wait or sent by post on receipt of cash.
We can turn anything in Ebonite.
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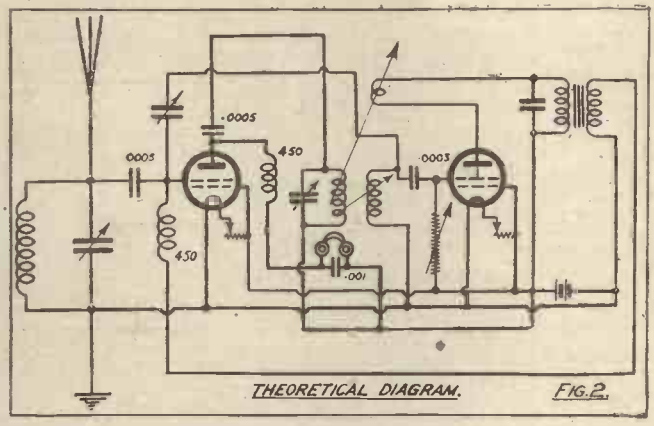
'Phone: Holborn 50.

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from page* 1214.)

D. C. (Glasgow), O. L. A. (London, W.), and several others ask us to reproduce the theoretical diagram which should have accompanied Mr. Marcus's article on a Unidyne Neutrodyne Reflex circuit in "P.W.," No. 135.

The diagram is appended. It will be noted that no values are given for the aerial, anode, or Neutrodyne condensers. These should be of ·0005, ·0003, and ·00001 mfd. respectively. Special condensers for Neutrodyne purposes are now being manufactured. The ordinary "vernier" is not suitable unless its plates are very considerably reduced in size.



THEORETICAL DIAGRAM. FIG. 2.

* * *

J. H. R. (Sheerness).—In "Radiotorial" of "P. W." 134 (December 20th), the description of the wiring of the three-valve reflex set—in reply to "Three-Valve-Reflex" (Twickenham)—does not appear to agree with the original description. When Captain Twelvetrees described the connections in "P.W." 94 (March 15th), he stated: "The O.P. terminals of both transformers are now joined direct; from H.T. terminal a lead is taken direct to I.P. of No. 2 transformer," etc. Was the first description right? In my own case the results obtained by altering the transformer connections as per "P.W." 134 are well worth the trouble involved.

The apparent discrepancy is due to the fact that it is not possible to describe the correct connections for I.P. and O.P. (or for I.S. and O.S.) to cover all conditions of working. Every constructor must decide for himself which is the best way round to connect the primary of his L.F. transformer. This applies to every set employing this component, but is especially noticeable in reflex sets.

If the I.P. and O.P. connections have never been reversed it is always advisable to try them in both ways. It often makes little or no difference to the results, but occasionally signals are greatly strengthened, and there is often less distortion after reversal.

* * *

"Short Wave" (Hertfordshire).—I am building a Super Heterodyne receiver with six valves, but wish to use this for both ordinary wave-lengths—200-500 metres—and for short waves of 50 upwards. Will this mean that I have to alter all the components, the intervalve transformers as well as the aerial tuner?

No, as long as the aerial tuner is arranged so that the first detector picks up the required signals, and the oscillator is tuned to heterodyne this incoming energy so that the "beat" produced is of the required frequency—usually corresponding to wave-lengths between 3,000 and 10,000 metres—nothing else need be changed. The intervalve H.F. transformers remain the same, all you have to alter are the aerial tuning, reaction coil, and oscillator coils, so that the correct heat frequency is produced. Once the intervalve H.F. transformers have been set they need not be touched unless something goes wrong with the set or the adjustments are altered by mistake. These transformers have to be tuned fairly accurately, of course, or the signal strength suffers considerably. Needless to mention, perhaps, is the fact that the super heterodyne is usually a very powerful oscillator, and as such should not be used coupled to an outdoor aerial on broadcast wave-lengths during broadcasting. As a matter of fact, the receiver can be a source of considerable interference to neighbouring sets when it is used on a frame aerial, so you must use the utmost care in handling it.

* * *

"Novice" (Chadwell Heath).—How can I tell when my set (one-valve) is oscillating? I can get 2 L O very well but cannot tune in other stations, or cut out whistling noises when I turn the condenser knob.

You should first of all move your reaction coil as far apart from the aerial coil as it will go, and tune the condenser until signals are at a maximum. You are now tuned in without reaction, and speech should be perfectly clear but not very strong. To strengthen, move reaction coil *a little* towards aerial coil, and retune slightly if necessary. All controls must be moved slowly and carefully, and the adjustments noted when the signals begin to strengthen.

If you move reaction too near to aerial coil you will oscillate, and interfere with all listeners in your area, so *great care is necessary.*

To tell when the set is on the edge of oscillation, and to keep it so on the different wave-lengths without actually slipping over into oscillation, is the whole art of tuning, and requires some practice and great care. At first, therefore, you should not attempt this during broadcasting hours. Tune into the higher wave-lengths, and listen to shipping, or to G.N.F., on about 600 metres, and notice the effect of reaction upon signals from spark stations. Some of these have high musical notes (like a flute), and you will find this can be greatly strengthened up to a point without altering its tone. As soon as reaction is pushed too far the note becomes hoarse and raucous, sounding, in fact, like a totally different station, until reaction is loosened again. Notice carefully how this change is accompanied by a soft, rushing sound as the valve commences to oscillate, or by a kind of click or plop in the 'phones.

Try the effect of tapping a moistened finger on the aerial terminal of the set when it is nearing oscillation point, and notice how loud and sharp the clicks grow suddenly when too much reaction is used.

The whole operation must be carried out very carefully, as every time the set oscillates it becomes a small transmitter, sending out a carrier wave which can cause interference.

You would do well to write to the B.B.C., 2, Savoy Hill, W.C.2, asking for their leaflet, "Anti-Oscillation," which will be forwarded free of charge. Copies may also be obtained from the nearest Radio Society, by joining which you could probably get practical lessons in handling sets, which are naturally of greater value than a mere description.

You will find in general that too much reaction invariably spoils your own reception (by distorting speech, etc.), as well as causing interference to all neighbours, so there is absolutely no advantage in keeping the coils too closely coupled or the filament and H.T. voltage too high.

Our Query Department.

In future a charge of Sixpence per Query will be made for answering all technical questions submitted to the Technical Staff of POPULAR WIRELESS. A group of three queries will be answered for One Shilling. Postal Orders must be enclosed with all queries and a stamped addressed envelope in addition.

THIS NEW ARRANGEMENT IS NOW IN FORCE.

Since the inception of POPULAR WIRELESS, readers have had all their problems settled for them free of charge, but with the great increase in the circulation and the corresponding increase in the number of queries sent in, the task of dealing with the latter has become gigantic. A large Technical Staff is now employed answering queries, and it is with the object of relieving the pressure on them that we have decided to make the small charges mentioned.

Readers of POPULAR WIRELESS know that the Editor and Staff of this journal have always had, and always will have, their best interests at heart.

BLAND'S BIG BARGAINS

Please Send Ample	Postage		
	£	s.	d.
Sebphone 2-Valve Portable Set (complete)	15	15	0
Sebphone Super Crystal Set (for Chelmsford or other stations)	1	5	0
Sebphone Double Headphones (We want offers for 100 lots.)		15	0
Telefunken Adjustable 'Phones	1	1	0
Radio Micro Valve ·06		12	6
F.T.H. Valve ·06		18	6
Phillips' Valve (No more to be had after this delivery.)		8	6
Dr. Nesper Loud Speaker	1	5	0
Ultra Loud Speaker	1	7	6
Cuckoo Loud Speaker	1	17	6
Electric Soldering Iron All Voltages (guaranteed one year.)	1	0	0
F.A.R. Transformer (French)		15	0
Sebphone Variometer		2	0
Raestat Filament Resistance (for D. E. or Bright Valve)		2	6
Chaseway Battery Charger (Direct Current)	1	5	0
Job Line Wireless Pliers		1	0
2-Coil Holder (Panel Mounting)		3	3
60-Volt Battery Box		6	0
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Wireless and Electrical Engineer,
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'Phone: Central 8521.

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Radiax designs cover a series of most up-to-date Sets, which, without undue complication, include many refinements rarely included in any one set. Series, parallel condensers, valve switches, filament switches, fine tuning devices, etc., make Radiax suitable for long or short waves. In fact, they are Universal. You may BUILD YOURSELF or BUY COMPLETE.

No. 61. 2-VALVE REGENERATIVE.

A really wonderful Set, simple to handle, but sharply tuned, it will give good Loud Speaker results up to about 20/25 miles, and will also pick up most British and Continental Stations.

Including pair of Broadcast coils **£4 15s.** (Supplied as factory completed set only.)

With: Valves, Batteries & Accessories, including a first-class make of Loud Speaker **£10**

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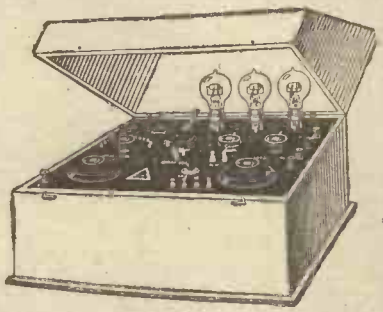

These are real "distant" sets with one High-Frequency Amplifier, and whether you buy complete or build up yourself from our constructors set, it is an outfit you will be proud to possess.

	Constructors Set £ s. d.	Factory Completed & Tested £ s. d.
No. 24. 2-Valve	4 15 0	6 12 6
„ 26. 3 „	7 5 0	10 17 6
* „ 28. 4 „	9 15 0	15 0 0
„ 30. 4 „	9 7 6	15 0 0

*No. 28 has double circuit aerial tuning with 3 coil holder. All above sets subject 12/6 per Valve Marconi Royalty.

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WE SATISFY YOU

Barclays 596

Six Sixty

The Best Dull Emitter

THERE IS MORE IN IT THAN MEETS THE EYE

If you could see the filament of the average dull-emitter under a powerful microscope you would perhaps be surprised to find that the all-important thorium "coating" takes the form of a deposit of globules. The filament is not covered.

An examination of a "Six Sixty" filament would, however, reveal to you a very different state of affairs. The filament is manufactured from Molybdenum, a metal which takes a *complete* thorium coat. That is one of the secrets of the "Six Sixty."

It ensures a much greater electron emission which gives *volume approximately 50% greater than a standard bright-emitter* and, bear in mind, that with the "Six Sixty" an accumulator charge lasts over 10 times as long.

If you cannot get the "Six Sixty" at your dealers write direct to us.

FILAMENT VOLTS 1·5 to 2.
FILAMENT CURRENT ·25 amps.
20/-
Of all principal dealers or post free direct.

The ELECTRON Co. Ltd. TRIUMPH HOUSE, 189 REGENT ST. LONDON W.1.
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LOOK!

YOU MUST HAVE THESE IF YOU WANT THE BEST FROM YOUR SET.

BARRIES' LOW CAPACITY VALVE HOLDER, 1/3 each

Variable Grid Leak: ·2-5 meg. 3/6; 5-10 meg. 4/-. Variable Anode Resistance: 25/50,000 ohms. 3/6; 50/100,000 ohms, 4/-; 70/140,000 ohms 4/6. Variable Loud Speaker Modulator: 100/250,000 ohms. 5/-; 100/500,000 ohms. 5/6.

"P.W." says, 15/11/24: "It is entirely original, highly successful, and in all cases constant. Enterprise people have introduced a really good Grid Leak. We have tested these ingenious Enterprise products and can certainly recommend their use for Unidyne and ordinary circuits.

If your Dealer cannot supply, mention his name and address, when we will send POST FREE

ENTERPRISE MFG. CO., LTD.,
11, GRAPE STREET, LONDON, W.C.2.

MH CRYSTAL

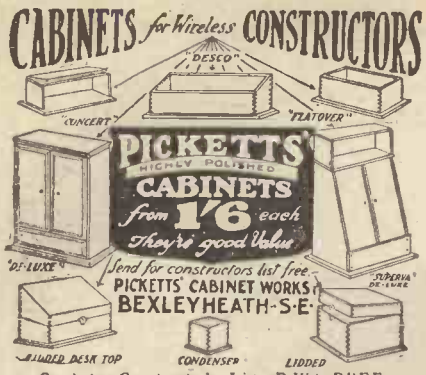
A high-grade crystal of Special Selectivity contained in dust tight metal box with glass top. A well-made non-corrosive spear-point cat's-whisker is included in each box.

It is so sensitive that a blind man can use it.

PRICE in Box **1/6**

L. McMICHAEL LTD
IN CONJUNCTION WITH B. HESKETH LTD
RADIO CORNER, 179 STRAND, LONDON W.C.2.

Barclays 633



Send for Constructor's List (P.W.) FREE.

HEADPHONE REPAIRS

Rewound, re-magnetised and readjusted. Lowest prices quoted on receipt of telephones. Delivery three days.—THE VARLEY MAGNET CO., London, S.E.18. 'Phone 888-9 Woolwich. Est. 26 years.

GUARANTEED 'PHONES.

A FEW OF "OUR" PRICES.

Genuine Telefunken (the World's best) - 17/-
" Dr. Nesper's (adjustable) - - 12/6
" Ericsson's (Continental No. 10) - 11/-
Post Free.

Price List of other brands on application.
We save you money on all 'Phones.

RUST & CO., Reavill's Yard, Foreman Street, NOTTINGHAM.

Paris and other Stations

Clearly heard on Loud Speaker near London using the "MIRACLE" MASTER 2-Valve Set. £3-12-6, plus Royalties. 1, 2, 3, and 4 Valves. Trade supplied. Send Stamp for particulars.
World's Wireless Stores, Wallington.

AMERICA ON 12/6 '07's

TESTIMONY *Nom de plume, Salisbury.*
"Using bright emitter valves I had been able to receive America (WGY, KDKA, WBZ, and two or three others) nightly, and was quite willing to pass your Pliotron S.S. as satisfactory if it would only pick up the carrier waves of these stations. I was extremely pleased to find that if anything there was an increase in signal strength from these stations. I shall most certainly recommend this valve to my friends as the best obtainable, no matter what the price." Unsolicited testimonial, original may be inspected.
Fil. volts 2·3, max. con. ·07, anode 40-80. Concert tested and sent with instructions for use, post free on 24 HOURS' APPROVAL.
P.W. UNIDYNE D.E.'s. Phillips 4 Electrode Dull Emitter, so creditably mentioned in the Nov. 22nd issue of "Popular Wireless," page 714. 12/6
Phillips 4 Electrode D.E. 1·8 volt. ·16 amp. 25/-
Phillips 4 Electrode Bright Emitter 12/6
(See Correspondence Columns P.W., Dec. 13th, p. 954)
Thorpe K4 Bright Emitter (5 pin) 17/6
Concert tested, post free, 24 hours' approval.
N.B.—We now insure valves against all postal damage at customers' request on extra remittance of 9d. per 12/6 valve, 1/- per 17/6 or 25/- valve, the only condition being notification of damage within 24 hours.
ANELOY PRODUCTS (Dept. P.25),
Eton Works, Upland Road, London, S.E.22.

Be sure to mention POPULAR WIRELESS when replying to Advertisements

A LION'S STRENGTH.

The "Lion" Crystal-Valve Combination.

Have you heard of the Wonderful YELLOW Precious Stone Power Crystal GILLINGHAM used in conjunction with TELLURIUM? The results it gives are truly marvellous. No cat's-whisker, consequently no annoying adjustments. Set in a second; keeps set for months. Supreme for Crystal Sets. Increase volume on reflex circuits. Sent post free. Obtainable only at 2/3 per pair from S. LYONS, 119, Clerkenwell Road, London, E.C.1.

Powerful, Pure, Perfect Reception.

LONG RANGE ONE VALVE RECEPTION.

The Editor, POPULAR WIRELESS.

Dear Sir,—I think the results obtained on receivers built according to the enclosed diagrams will be of interest to you. On an indoor aerial four yards long I receive Aberdeen, Birmingham, and London. Other English stations have been received but not identified. Aberdeen, about 850 kilometres, is, strange to say, as strong as 2 L O.

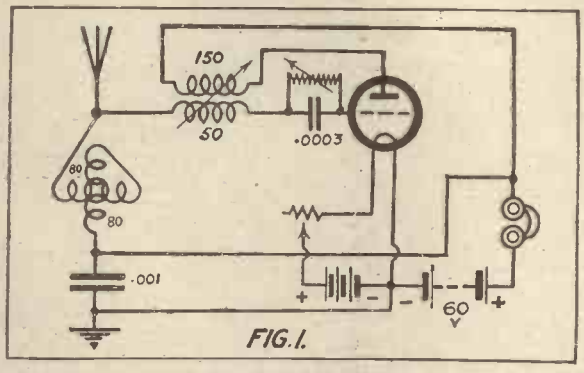


FIG. 1.

Music is audible three feet from 'phones. I may state that the valve is of German manufacture, designed somewhat like Myers valve (price 2s. 6d.). Tuning is sharp, tone very pure. I intend to try the sets in short with the aerial of the ribbon type described in POPULAR WIRELESS.

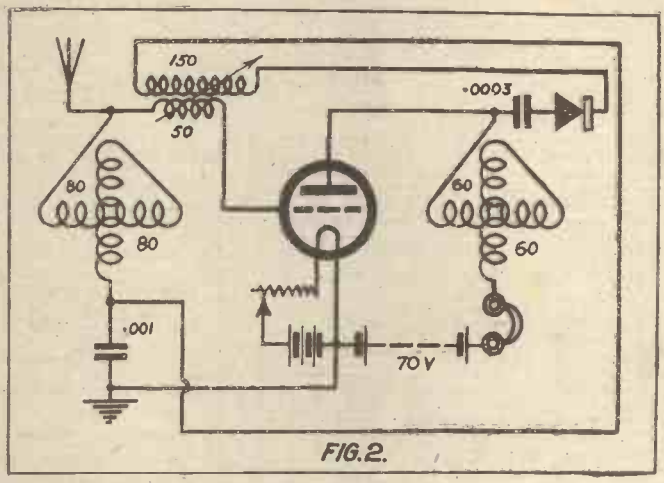


FIG. 2.

I remain, yours sincerely,
G. THYNELT.

33, Rue Longue,
Ostende.

ANOTHER GENEROUS READER.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have in my possession a good number of "P.W.'s," ranging from Volume IV. to Volume VI, the numbers being, 75, 81, 86, 87, 88, 89, 90, 92 to 112 114, 115, 118 to 132. Having no use for them, and having seen letters in "P.W." from readers offering other "P.W." readers numbers of this popular paper, anyone desiring these numbers can have same by applying to the address below, when all books will be sent on free of charge.

Yours faithfully,
JOHN CARMICHAEL.

25, Wellgreen, Stirling.

RE SOME INTERESTING ONE-VALVE CIRCUITS.

(Issue of December 16th, 1924.)

The Editor, POPULAR WIRELESS.

Dear Sir,—A few facts concerning the Hopwood Circuit mentioned in above article might be of interest to you.

I made up this circuit from a diagram in an issue of your paper of last February, and I was astonished at the results given by it. Have received *every* British broadcasting station in England and Scotland (not relays), as well as Belfast. Aerial is about 28 feet high (not screened at all), and 80 feet long, including lead in. Earth wire is 4 feet long, on to waste pipe.

In operating the set I find the results I get depend entirely on the amount of L.T. and H.T. which I put through the valve. After practice, the correct relative value of these two can be found, and on this everything depends for the quiet working of the set, which carelessly handled will howl badly.

Being seventeen miles from 2 L O, I am fortunate in being able to tune in the other stations while 2 L O is "on," but without interference. Recently on a Sunday I got the church services from Glasgow and from Newcastle, both quite distinct and separate, though only a matter of a twist of the condenser of 5°.

Also a French station came through well with instrumental music, and a few minutes afterwards I got a German station with "speech." Am able to get Madrid without any trouble at all, and the other night I enjoyed the "Messiah" from Belfast direct. It was so easily followed that I was able to detect in one instance where the soloist's rendering was different from that in the score I was using.

My observations on this circuit are that for a one-valve set it wants a lot of beating. I cannot get loud-speaker strength on it with dull-emitter valve, but with 'phones I can get 2 L O *without aerial or earth*, as clear as the ordinary crystal reception at that distance. The set is made up into a mahogany cabinet, and is self-contained, the accumulator (a 5/- Exide) and H.T. battery (60 volts) being accommodated at the side of the panel, the valve being behind but in sight, yet out of harm's way.

Wishing your paper every success.

I am, sir,
Yours faithfully,
"SATIS EST."

Walton-on-Thames.

CURING "MICROPHONIC" TROUBLE.

The Editor, POPULAR WIRELESS.

Dear Sir,—Perhaps the following hint may prove of interest to those of your readers who are troubled with vibration effects in their wireless sets, such as those caused by heavy traffic outside, or even by someone walking over the floor of the room in which the set is installed. I was much troubled in this way myself, until I adopted the following expedient.

One evening, when the trouble seemed worse than usual, and I was wondering what I could do to remedy the nuisance, in a fit of desperation—and inspiration—I rushed to the bathroom, got the rubber sponge, cut it into four pieces, and placed them one under each corner of the base of the cabinet. I was immediately rewarded with perfect peace from annoyance for the rest of the evening. Of course, I got into trouble from "Blossom" for my act of vandalism, but it was nothing compared with the other trouble!

I have since glued the four pieces of sponge on to a piece of stiff cardboard, the same size as the base of the cabinet. The device forms a perfect shock-absorber or anti-vibration cushion, and is well worth the small sacrifice entailed.

To those of your readers who are troubled as I was, my advice is—TRY IT!

Yours truly,
A. J. WOOD.

41, Nicolas Road, Chorlton-cum-Hardy, Manchester.

A "P.W." ONE-VALVE REFLEX.

The Editor, POPULAR WIRELESS.

Dear Sir,—You will be interested to know that I made up your one-valve reflex receiver, as shown in

(*Continued on page* 1221.)

THE SKINDERVIKEN MICROPHONE BUTTON

Pat. No. 120,734.

5/- **5/-**

Will enable you to Work a loud speaker off a crystal set. Magnify the sound of your gramophone up to 200 times. Fit up an efficient house telephone. Transmit piano, violin or gramophone music anywhere. Magnify sounds otherwise inaudible, etc. etc.

Everyone interested in sound transmission should write to-day for the "Marvels of the Microphone." Price 6½d. Post free from Mikro Ltd.

MIKRO Ltd., 32c, Craven St., Charing Cross, W.C.2

CORRESPONDENCE.

(*Continued from page* 1220.)

No. 131, Vol. VI, which proves most satisfactory. I receive Chelmsford, 18 miles distant, loud-speaker strength. I also receive London and Paris, the latter somewhat faint. The set gives much better results on higher wave-lengths.

Wishing you and your paper every success.

I remain,
Yours faithfully,
EDGAR PARFECT.

Sunny Bank, Sawbridgeworth.

INTERESTING "D X" RESULTS.

The Editor, POPULAR WIRELESS.

Dear Sir,—It may interest you to know that on my home-built two-valve set (straight D. and L.F.), I have received the following stations: 6 B M, 2 L O, 5 I T, 5 N O, 2 Z Y, 5 W A, 5 S C, 2 B O, 2 B E, 5 X X, 2 D E, 6 L V, 5 P Y, 5 N G, 6 F L, 6 S T, 6 K H, Radio Paris (S F R), Ecole Sup. (P T T), "Le Petit Parisien," Leipzig, Frankfort-on-Maine, Hamburg, Munich, Munster, Brussels (S B R), Amsterdam, Madrid (R I), Zurich (Höngg). All the above were "roped" in on a standard P.M.G. aerial, only 16 feet high.

Wishing "P.W." all the best.

Yours faithfully,
ERNEST W. SONES.

Westergate Street, Aldingbourne, Sussex.

"ALL B.B.C. 'SMALL FRY' TO UNIDYNE."

The Editor, POPULAR WIRELESS.

Dear Sir,—Of late I have, and am still, having some remarkable successes with the famous one-valve Unidyne. The Thorpe K4 seems to have become ultra sensitive with age and use. All B.B.C. stations can be considered as "small fry." So can most European stations. American transmissions, I get nightly. W S M, when 550 miles away, came in at good 'phone strength recently. The remarkable part of it is I can tune in Madrid, 800 miles away, on the earth wire alone (3 feet long). Music is quite good, but speech a trifle blurred (due to earth currents, I believe). But to get Madrid on one valve, with 3 feet of earth wire, calls for what Mr. Dowding calls "Operation."

Wishing your valuable paper all success.

Yours faithfully,
D. J. JENKINS.

School House, Gellinudd, Pontardawe.

P.S.—The set is as per specification in "P.W.," No. 112.

BROADCASTING FROM A LINER.

The Editor, POPULAR WIRELESS.

Dear Sir,—I wish to report one-valve reception between 01·00 G.M.T. and 02·44 G.M.T. this morning (December 16th), of pianola music transmitted from the grand ballroom of a liner 2,400 miles S.W. of Land's End, on a wave-length close to that of shipping. Jamming was experienced from untuned spark and a harmonic of G.F.A., but at quiet periods the following items were heard clearly: "Hungarian Rhapsody" (Liszt), 01·00 G.M.T.; "American Medley" (One Step), 01·45 G.M.T.; "Rigoletto" Selection, 02·30 G.M.T.

Before closing the announcer, speaking to American listeners, wished them a Happy New Year, and hoped they had been received. He also added that they were due in Southampton on December 21st.

It would be interesting to know the name of the liner in the above transmission.

Yours faithfully,
H. G. NEVILLE.

11, Carden Road, Peckham, S.E.18.

[This was W S M, the s.s. Leviathan. Ed.]

THE UNIDYNE NEUTRODYNE.

The Editor, POPULAR WIRELESS.

Dear Sir,—Just a line to tell you that I have made up the two-valve Unidyne neutrodyne given in your paper of November 22nd, and am very pleased with results.

I had previously made a D. and L.F. Unidyne set, but the first mentioned is a great improvement, and the best I have heard. I am sending a card to Mr. Marcus, and I must thank you all for such a fine set. I was pleased to see Marconi's apology. I thought of writing to him myself.

Yours faithfully,
A. W. BUTLER.

3, Old Church Yard, Liverpool.

B.B.C. AND THE THEATRES.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have read, with much consternation, the views of Sir Oswald Stoll, in an article by "Ariel" in your splendid paper.

Has Sir Oswald realised that the ether is the B.B.C.'s theatre?

I wonder what Sir Oswald would say if it were possible for another company to erect a stage in the Coliseum, and start a rival production at the other end of the theatre?

The B.B.C. must have the monopoly of the ether, as a company has of a theatre, so as to ensure a good organisation.

Yours faithfully,
W. I. LONG.

Longlands, Carlton, Newmarket.

Gilbert Ad. 2079

Experientia docet!

THE very first Loud Speaker ever built for wireless use in this country was a creation of S. G. Brown Ltd. Indeed the very term "Loud Speaker" was actually originated by them to describe this entirely new Instrument. Its name on any Loud Speaker is visible evidence that it has been built by master craftsmen—that it definitely conforms to the highest scientific standards of sound reproduction—and that irrespective of purchase price its tone is perfectly lifelike and natural.

See it at your dealer's to-day—examine its superior workmanship—but, above all, hear it on actual demonstration.

Prices

H1. 21 inches high.
120 ohms £5 : 5 : 0
2000 ohms £5 : 8 : 0
4000 ohms £5 : 10 : 0

H2. 12 inches high.
120 ohms £2 : 5 : 0
2000 ohms £2 : 8 : 0
4000 ohms £2 : 10 : 0

Q. The de-luxe model £15 : 15 : 0 in all resistance

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67 HIGH ST., SOUTHAMPTON

Brown

Gilbert Ad. 2071.

TECHNICAL NOTES.

(*Continued from page* 1193.)

connected in parallel across the secondary coil of the tuner. This will considerably increase the selectivity of the circuit and will thereby help to cut out local ship stations.

Another Method.

"Another good method of eliminating spark interference is to arrange an H.F. amplifying valve in the circuit, and the coupling between this valve and the detector valve should preferably be of the tuned-anode type.

"Spark interference can also be cured, to a certain extent, by re-arranging the earthing system of the receiving apparatus and by trying other means of earthing the set.

"Residents in coast towns will often find that it is only after a considerable amount of experimenting with various circuits, on the lines suggested above, that the trouble may eventually be overcome."

The Heaviside Layer.

A good deal of speculation surrounds the "Heaviside layer," the conducting region, which is supposed to exist in the atmosphere at a height of a few miles above the surface of the earth, and which is thought by some to account for the bending of wireless waves round the curvature of the earth. Experiments have been conducted in France by General Ferrie, using short waves—45 metres—and the results seem to support the belief in the Layer.

According to "Popular Radio" (N.Y.), "it is found that observations of the signal strength of the fundamental and the first harmonic at different distances from the transmitting station are most easily interpreted on the hypothesis that the waves have been reflected downwards from the supposed conducting layer." In reporting the results, Commander Mesny, of Gen. Ferrie's staff, says: "The results are well explained by the hypothesis of a reflecting action in the high atmosphere. This action, very intense at night, is not negligible by day. But the existence of a conducting layer is not yet absolutely proved." Further tests are in progress. Further information on this subject may be found in "The Very Short Waves," Pt. 2, by René Mesny.

(*Continued on page* 1123.)

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TECHNICAL NOTES.

(*Continued from page* 1222.)

Strength of Signals.

Some very interesting experiments on the intensity of sounds, as interpreted by the ear, are reported in the "Physical Review" (Sept., 1924) by Dr. Harvey Fletcher. One point of importance in wireless, is that the ear itself, contrary to popular impression, is not a perfect acoustical instrument, and if the amplitude of the sound waves exceeds a certain limit, the ear actually begins to introduce distortion. This should be remembered in connection with loud speaker reproduction.

Another interesting point, although this has been known for some time, is that the apparent intensity of a sound depends, other things being equal, upon its pitch. Thus, if two sounds are of equal amplitude and different pitch, the one higher in pitch will seem the louder. This is to be expected from ordinary energy considerations.

Loud Speakers.

In this connection it should be remembered that, although at times we are inclined to think that no loud speaker was ever near perfection, the present-day developments in loud speaker design and construction are (at any rate, to my mind) very wonderful, considering the enormous difficulties that have had to be overcome. I myself have been very closely associated with acoustical research work for some years, both during and since the War, and I venture to say that no-one who has not had similar experience can fully appreciate the difficulties that are encountered in making a really faithful reproduction of the human voice. I mention this, not in any way with a view to apologising for present-day loud speakers —which, as I have said, I think are very good—but in order that we may perhaps appreciate them a little more when we bear in mind the immense amount of work which has been necessary to bring them to their present state.

Listening-in to Electrons.

To the many wonderful experiments carried out by the physicists of the General Electric Co. of America has now been added an investigation of the value of the electronic charge by a novel method which has been popularly described as "listening-in to the electron." An arrangement of valve amplifiers is used, by means of which it is estimated that a sound-magnification of close upon a million is obtained.

According to "Radio Digest," "the roar of iron atoms as they are attracted by a magnet is plainly heard by the use of a special device used in connection with a vacuum-tube amplifier and a wireless loud speaker. The special device carries out the idea of a German scientist, Dr. Barkhausen, of Dresden.

"A piece of soft-iron is inserted in a coil of 17,000 turns of wire, which is connected to the amplifying system. As the soft-iron atoms turn about in accordance with the polarity of a magnet close by, the roaring sound is produced in the loud speaker or headphones attached to the amplifying system."

The preceding description, although expressed in rather more than "popular"

(*Continued on page* 1224.)

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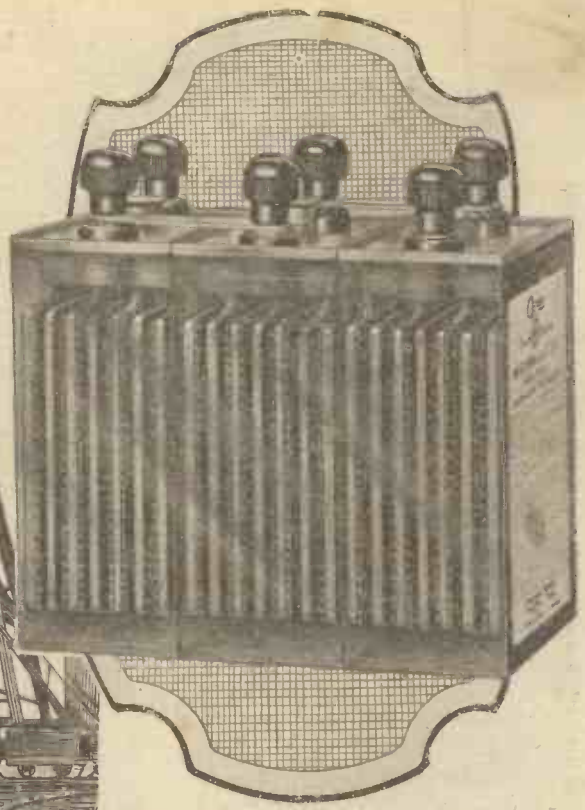

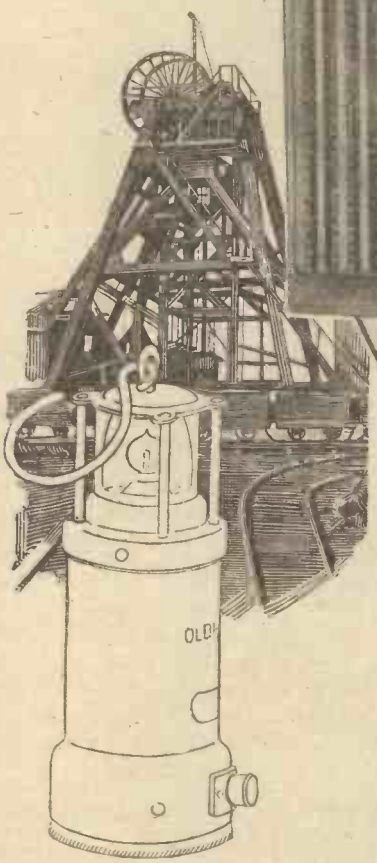

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TECHNICAL NOTES.

(*Continued from page* 1223.)

language, will give the reader an idea of the general nature of the investigations, and the principles upon which they are based.

Electronic Charge.

It will be remembered that probably the most accurate determination ever made of the value of the electronic charge was that of Prof. Millikan, and it is interesting to note that the determination which has now been carried out by Dr. Hull and Dr. Williams, who are the scientists responsible for the experimental work referred to at the General Electric Co.'s research laboratory at Schenectady, gives a value for "e" which agrees to within one-half of 1 per cent. with that obtained by Millikan.

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