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ADDING H.F. TO THE HALE.—By P. W. HARRIS

Popular Wireless

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INCORPORATING "WIRELESS"

January 15th, 1927.

CONTENTS

Our cover photograph shows a number of R.A.F. mechanics receiving instruction in wireless transmission.

A SIMPLE CIRCUIT FOR H.T. SUPPLY FROM A.C. MAINS

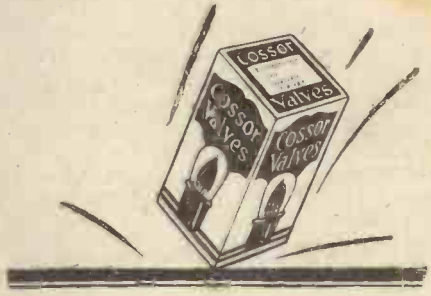
THIS circuit enables anyone with an electric light supply to dispense entirely with H.T. batteries, thus avoiding the expense of renewals, which frequently become necessary when using sets with three or more valves. The running cost is extremely low, more than compensating for the slight extra initial expense, whereas a reliable and constant H.T. supply is always available.

Centre: Capt. Barnard and the assistant editor of "Amateur Wireless."

Above: The "Wireless World" man retrieves one of the dropped Cossor Valves.

Crash!

"The world's most sensational Valve test"
—vide the Press.



Cossor Kalenised filaments unharmed after 500 feet drop from aeroplane

EXTRAVAGANT claims and bombast have never found a place in Cossor advertising. To demonstrate the immense strength of the new Cossor Kalenised filament we looked for deeds—not words. We determined to *convince* the public that through recent improvements the Kalenised filament is now practically indestructible. And so we asked for the co-operation of "Amateur Wireless," "Popular Wireless" and "Wireless World."

When we told them our plan of dropping twelve Cossor Valves from a height of 500 feet they were frankly incredulous. "It can't be done," they exclaimed, "no valve in the world could stand such a drastic test." But, knowing the vast strides made by our chemists during the last few months, we had confidence that the new Cossor Kalenised filament would withstand even this amazing abuse.

On December 20th at Stag Lane aerodrome this epoch-making test took place. Twelve Stentor Two Valves—previously sealed within their boxes without cotton wool or corrugated paper—were dropped from an aeroplane at a height of over 500 feet. One valve was lost owing to the high wind *but in each of the remaining 11 valves the Cossor Kalenised filament was unbroken.* One of the valves hit the tail plane with terrific force and was smashed. But even this filament was found to be intact.
This remarkable test from start to finish was directly supervised by the Technical Press and the sealed valves were afterwards opened and tested by them at our Highbury Works.

This test was carried out under the direct supervision of 'Amateur Wireless' 'Popular Wireless' 'Wireless World'

What this test means to you

Here is unanswerable proof of the tremendous strength of the new Cossor Kalenised filament—proof that every Cossor Dull Emitter will give long and enduring service. Of equal importance is the fact that the Cossor Kalenised filament never becomes brittle in use. This is because it gives off a terrific electron emission without visible glow. Heat has been practically eliminated. The Kalenised filament never loses its emission through over-running—any Cossor Dull Emitter can be operated from a fully charged accumulator without a rheostat without harm. Remember the wonderful Kalenised filament is to be found only in Cossor Dull Emitters—no other valve has it. Do not accept a substitute—no other valve is so strong or can give such economical service.

TYPES & PRICES

Cossor Point One

210H for H.F. use	... ...	14/-
210D for Detector	... ...	14/-
(2 volts ·1 ampere)		

Cossor Power Valves

Stentor Two	... ...	18/6
(2 volts ·15 ampere)		
Stentor Four	... ...	18/6
(4 volts ·1 ampere)		

All above Valves fitted with Cossor Kalenised Filaments

Cossor —the Valve which serves you longest

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Incorporating "Wireless."

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RADIO NOTES AND NEWS.

Rugby Opens the Ball—The Auto Back-patters—A Zad Ztory—The Public Mind—Dublin Calling—A Mystery Solved—Cheerio, Pharaoh!—That Next War—"Over There."

Rugby Opens the Ball.

I SAID 1927 would be a "bumper," and sure enough the young year opens in promising style with a telephone service to the States at £15 a touch! They tell me the speech obtained compares favourably with many a long-distance wire performance. But I do not understand the secrecy claimed for the service, and doubt whether the claim is official; if it is, I should like to know how secrecy is obtained in broadcast telephony. Well, there you are! Get out your fifteen Treasury notes, work them well down the slot—and you can have a chat with Henry Ford or Harold Lloyd.

The Auto Back-patters.

THE Second Report of the Wireless Telegraphy Commission could be reasonably described as the camouflage on a white elephant, for it is a canticle in honour of Rugby, and as two—and perhaps three—of the four signatories were intimately concerned with the design and/or construction of the station and the remaining one is the P.M.G. himself, I don't think "auto back-patters" is at all an inapt title.

What Are the Long Waves Saying?

ACCORDING to the Report they are saying that Rugby's signals have been heard "all over the globe." So have Mr. Marcuse's, but Rugby has twelve 820 ft. masts (or 2,400 tons of steel), 27 miles of aerial, 120 miles of "earth" wire, a three-storey building (103 ft. by 42 ft. by 60 ft. high) for the wireless plant alone, and can push 500 kilowatts into the aerial. All this, my brothers, at the beginning of the era of short-wave wireless, with the income-tax weighing like lead and the penny post costing us three ha'pence. Hence the Report—to gloss over the fact that except for the Beam stations the Post Office has got a slightly *passé* white elephant in its W/T Dept.

Have You Heard These?

THIS Week's Optimist: The beginner who bought a crystal set—and a Maori dictionary.

This Week's Careful Body: The man who asked the P.M.G. whether, if he plugged one ear with cotton wool, he could have a licence for five shillings.

This Week's Grandma: The dear old lady who, on being subjected to a bad demonstration of the Croyland Abbey bells by her grandson's 10-valve distorter, said she could distinctly hear the bats in the belfry.

Mr. E. H. Shaughnessy, M.I.E.E., of the P.O., who was largely responsible for the inauguration of the recent transatlantic telephone service.

A Zad Ztory.

THE writer of a letter to a daily newspaper said he was pierced to the marrow the other day because a Wicked Uncle announced a song as "Old Lang Zyne." How zilly! Being a B.B.C. man he should have said "Old Long Since." But, I say, it doesn't take much to horrify some people, does it? I wonder what our sensitive friend would do if he heard our "daily" saying (as she did recently) that she had enjoyed the wireless, "especially them Zincoplated Orphans playing a bit of *Sandow and Eliza!*"

The Public Mind.

TALKING about B.B.C. programmes—and I do a lot of it—what about that item on New Year's Eve? (It's harking back, I know, but not far.) Do you remember the wordy duel between "The Spirit of the Public Mind" and the Discontented Listener, John Somebody? Wasn't it rich? And didn't the Listener rag the Spirit beautifully? Of course, the whole item was an attempt on the part of the B.B.C. to smite all its critics one final, crushing blow. But I am positive the majority of those who heard it would give the cigar (or nuts) to the Listener—"on points." He was no fool, that lad. Oh, and I observed that amongst all the star turns served up in order to show John Somebody what a gratuitous grouser he was, *there was no Chamber music!* Good enough!

Dirty Work.

THE first blot on my New Year was dropped by one of the "P.W." technical staff, who hid himself behind an experimental model of a super-Anodyne and inquired whether now that the managing director of the old B.B.C. has been publicly honoured he might be called a Laurel Reith!

Another One "On the Air."

MR. C. R. GREEN, 32, Aldridge Road Villas, London, W.11, having received permission to oscillate on purpose, proposes to shake up the Anti

(*Continued on next page.*)

NOTES AND NEWS.

(*Continued from previous page.*)

podean ether, using the call letters 5 GN. No wave-length or other details of transmission given. So you may come across his signals by chance.

Dublin Calling.

THE Editor of "The Irish Radio and Musical Review" (179, Great Brunswick Street, Dublin) reminds me that the Dublin station (2 RN) now works on a wave-length of 319·1 metres, and asks listeners for reports on its transmissions. Now then, knights of the cat's-whisker, there's your meat. By the way, after having heard so much of recent months about the great gulf which is fixed between "radio" and "music," it is refreshing to see the two wedded together in one publication. Evidently in Ireland there is an *entente* between the "fans" and the fiddlers and pianners.

A Mystery Solved.

HA! the game is up and the mystery of Daventry is solved. We knew quite well that Daventry is pronounced "Daintry"; so did the B.B.C. And yet they continued to say "Dav-en-try," to our astonishment. We wondered what the B.B.C. Advisory Committee on spoken English would do about it. But the secretary of the committee has now explained that had "Daintry" been adopted it would have been impossible for French and German people to identify "Daintry" with "Daventry." Bless us! What a reason! As weak as seven days! Well, of course, if *that* is the criterion of the committee, we shall be hearing some queer sounds from the announcers, such as "Aperteen," "Ool," and "Blimmuss." Awfully kind of the British B.C. to tamper with "spoken English" for the sake of Gauls and Teutons —what?

"Farewell, Romance."

THE old wind-jammers are disappearing from the face of the seven seas, and with them Romance—for those who never sailed in one. Now the old romance of whaling has had its death-blow, for the whaling vessels are being fitted with radio. Marconi sets of ½ kw. power, specially designed for being worked by a harpoon-gunner in full kit, have been fitted to all the ships of the Southern Whaling and Sealing Co., Ltd. They are operated by stout levers which are easily manipulated by heavily gloved hands, and reception is by loud speaker. The "C. A. Larsen" has been heard 2,000 miles away by the "Sir James Clark Ross," on telephony, with a wave-length of 400 metres. Well, by the time they get to bagging the whales with a death-ray I guess the bottom will be out of fishing as a fine art.

Sir Alexander Roger, Chairman of the Telephone Development Assoc. who was one of the first to speak to New York by means of the new telephone service.

Piracy a Back Number.

YES, sport ain't what it was, as the fox said when they fitted the hounds with direction-finders. Even piracy has gone phut, for radio broadcasting being now a mere sub-section of the wireless sub-section of the telegraphy section of the engineering branch of the Post Office, the collection of the licence fees becomes as dull and deadly a process as that of "stinging for income-tax." The radio "pirates" have little hope now, for it is mooted that special machinery has been devised untotheir undoing. So all that remains to the "something-for-nowt" brigade is to drop radio and collect stamps—or bang twenty saxpences every annum. I believe some of 'em would rather emigrate to Greece, where there is no broadcasting.

Sir W. Mitchell Thomson, the P.M.G. under whose auspices the new wireless telephone system has been inaugurated.

Good News from Mexico.

IT is reported that the Mexican Government is about to spend 8,000,000 dollars on the improvement of its telegraph and wireless systems. Doubtless they are going to make the windows of the offices shot-proof, and to employ some living operators in place of the late perforated staff. (R.I.P.)

Cheerio, Pharaoh!

THE Marconi Co. is going to brisk up the land of Tut. It has bought the Post-Office station at Abu Zabal, and is going to shove a "Beam" in the Sphinx's eye. So mote it be. It is also going to give the "Gippies" a real wireless telegraph service. And doubtless the Sphinx will go on smiling as it broods over the sight of the descendants of the Pharaohs listening in to a ukelele-saxophone fox-trot or a talk on excavation in the Valley of the Kings.

SHORT WAVES

"I should like to make it clear that I am not objecting generally to this remarkable invention."—(Sir Thomas Beecham, on "Wireless"—Evening Standard.)

We understand that the B.B.C. is overjoyed.

* * *

Waggling of the ears is being recommended as an aid to beauty. It is a useful accomplishment, too, if wireless headphones are found to be a trifle tight.—(London Opinion.)

* * *

Headline in Daily Paper: "Wireless Works."

A correspondent wrote the other day to ask us when.

* * *

Radio comedy will never be really popular until somebody invents a method of broadcasting a custard pie.—(Ideas.)

* * *

The wireless pirate sits alone,
A furtive soul is he.
His horrid deeds must not be known,
And though he listens free
To song and jazz, the fellow has
Moments of agony. . . .

But though a sob that tears his heart,
He possibly may fetch,
He still pursues his wicked part
Till the abandoned wretch
On some sad day is led away
To do his seven stretch.

("Touchstone," Morning Post.)

* * *

A reader who wishes to build a set for use in India has written to us as follows:

"Notes on the following would be useful: Mitigation of atmospherics; DX's are awful out there."

Many other readers are not so reserved in their descriptions!

* * *

Radio shrinks the earth!—(Headline, Provincial Paper.)

The country amateur who had to walk six miles to get his battery recharged said this was a fallacy.

* * *

Listeners without licences never hear any good of themselves.

That Next War.

DON'T say I didn't warn you. If you want to have peace in the next war go to Andorra in the Pyrenees and keep goats. Mr. Elmer Ambrose Sperry has been awarded the John Fritz gold medal, which is the highest award in the United States engineering profession. Why? Because he can control aerial torpedoes by wireless. And for a distance of thirty-five miles he can direct them unerringly against the target. Gollies! I'll have to invent a wirelessly controlled target—which can dodge Elmer's bombs. (Don't Trouble: Ed.)

Kindness to Aerials.

THE 45-kilowatts broadcasting station which the Marconi Company is building at Lake Vattern, some miles south-west of Stockholm, is a model of kindness. Even the electrons are to be kept warm. The facts are that in winter there is a pest called "silver thaw," which coats the aerial with ice to such an extent that the wire would break with the added weight unless some means of melting the ice were provided. So arrangements had to be made whereby a current is sent through the aerial wire sufficiently strong to cause the wire to become hot. This was, I believe, first done when the Glace Bay (Nova Scotia) station was built, many years ago, after Senatore Marconi had proved the possibility of wireless across the Atlantic. Cold and "silver thaw" were then unforeseen enemies of radio.

"Over There."

A FRIEND of mine has just returned from those Yewnited States, where he went to find out what they are doing over there in radio. You will be interested to know that crystal sets are obsolete, and that there is not much doing in any sets with less than four valves. The whole country is divided between super-hets and neutrodynes. "All mains" sets are common, thanks to the general prevalence of uniform A.C. mains supplies. Valves are sold at about 8/- apiece. Cabinet multi-valve sets, with all-mains drive, enclosed loud speaker, and special power-amplification stage, can be got for about £100. There are two picture theatres in New York playing to crowded houses which feature wireless-synchronised films—a five-year advance on us, I calculate. But then, *we* are verging on television. Portable sets are a drug on their market, and a six-valve set can be got for £6. Thinking it all over, I *druther* be a blooming Britisher, nevertheless.

ARIEL.

Mr. J. C. Stobart, who broadcast the much discussed "Grand Good Night" on Christmas Eve.

Adding H.F. to the Hale

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

In response to a large number of requests from readers Mr. Harr is has specially designed an H.F. amplifier for attachment to the Hale receiver.

THE Hale circuit, which was first introduced to readers of this journal in November last, has proved so immensely successful that many constructors have wondered what additional efficiency can be gained by adding a stage of H.F. In response to a very large number of letters asking for particulars of how to add such a stage, I have carried out a number of experiments, the results of which are given below.

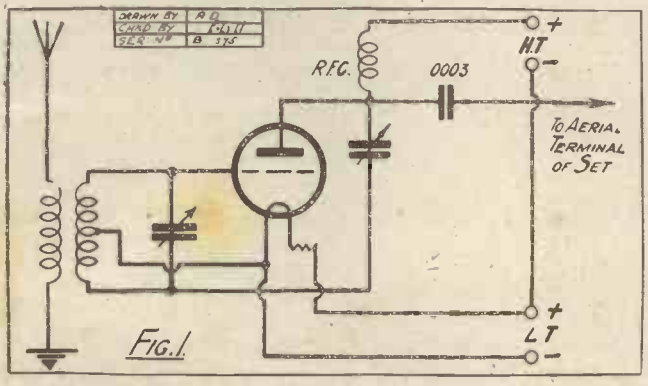

FIG. 1.

At first thought, it might appear a very simple matter to add one of the conventional H.F. stages to the Hale circuit, but in practice, as many readers have found, difficulties occur. Some of these difficulties vanish on close investigation, and when we realise that the adjustments of the original Hale circuit no longer hold good when the aerial is removed.

The H.F. Stage.

Incidentally, the H.F. stage which I have built up to precede my experimental Hale receiver is applicable at once to any other set, without any alterations to its wiring, for the output terminals of the amplifier are connected directly to the receiver in place of the usual aerial and earth wires. Let us first of all examine the theoretical diagram.

Fig. 1 shows the theoretical circuit in conventional form. The aerial is connected to a plug-in coil (25, 35 or 50, according to your aerial, when used on the ordinary broadcast band), and this is coupled inductively to the grid coil (which for the lower broadcast band can be a No. 60 or 75). For convenience in experimental work, I have placed these coils in a coil holder which, in the photograph, happens to be a three-coil form, although the third socket is not used. It is not necessary, however, that the coils should be movable in relation to one another, and the two sockets can be of the ordinary fixed board-mounting type, placed fairly close to one another.

The aerial coil is of the ordinary type, while the grid coil is of the centre-tapped variety, obtainable from several makers, including Lissen and Gambrell. The variable condenser is connected across the whole of this tapped coil, one end of this coil being taken directly to the grid and the other end to a neutralising condenser. The centre tapping of the coil is taken to the negative filament leg of the valve, and the plate of this valve besides being connected to the neutralising condenser, goes to a radio-frequency choke (through it to positive H.T.), and to one terminal of a ·0003 mfd. fixed condenser. The second terminal of this condenser carries a flexible wire for connection to any set to which it is desired that the H.F. stage should be joined.

Neutralised Circuit.

The circuit used is that known as the Rice "bridge" circuit, and can be adjusted for complete stability. The object of the radio-frequency choke and the fixed condenser is to enable the output side of the amplifier to be connected to the aerial terminal of the Hale or other set without the necessity of any high-tension current flowing through its normal aerial windings. If, however, the aerial of the set to which this H.F. unit is joined is tuned and inductively coupled to the grid of the next valve, and there is no direct connection between the earth terminal and the battery of the second set, the radio-frequency choke and the fixed condenser can be dispensed with. The plate of the H.F. valve is then taken to the aerial terminal of the set, the earth terminal of which is connected to H.T. positive. However, many sets have the aerial directly connected to the grid, and the earth to the filament, and if we were to use the direct

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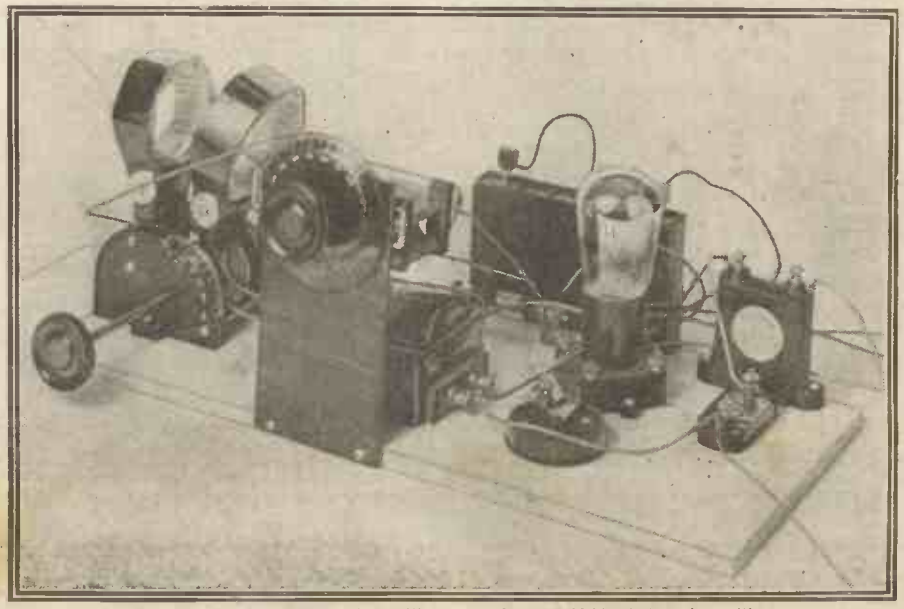


The experimental Hale receiver with valve coils and grid bias battery in position.

ADDING H.F. TO THE HALE.

(Continued from previous page.)

arrangement just referred to the H.T. battery would be shorted to earth. The use of the radio-frequency choke feed, together with a fixed condenser as shown, obviates this trouble.

From a large correspondence it would appear that POPULAR WIRELESS has recently added many readers to its already very large circle, and a number of these have not seen the original Hale circuit, as published last November. In order to carry out my experiments, I have fixed up a very simple single-valve "Hale" on a baseboard, the circuit for which is shown in Fig. 2. Here again we have a coil holder with the aerial directly connected to the grid coil, the reaction coil being placed in the movable socket. The circuit, as readers will see, is the same as that recently published in POPULAR WIRELESS, and as the make-up is of an experimental nature, a board is used with the greatest simplicity.

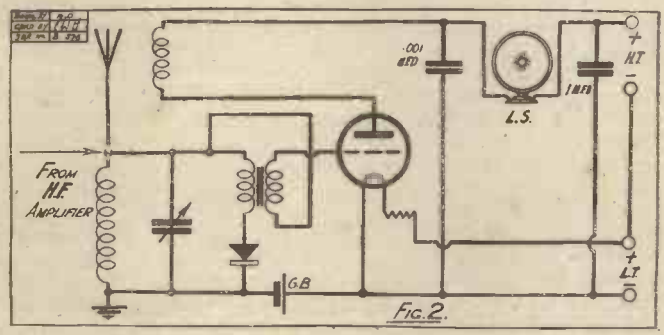


Fig. 2.

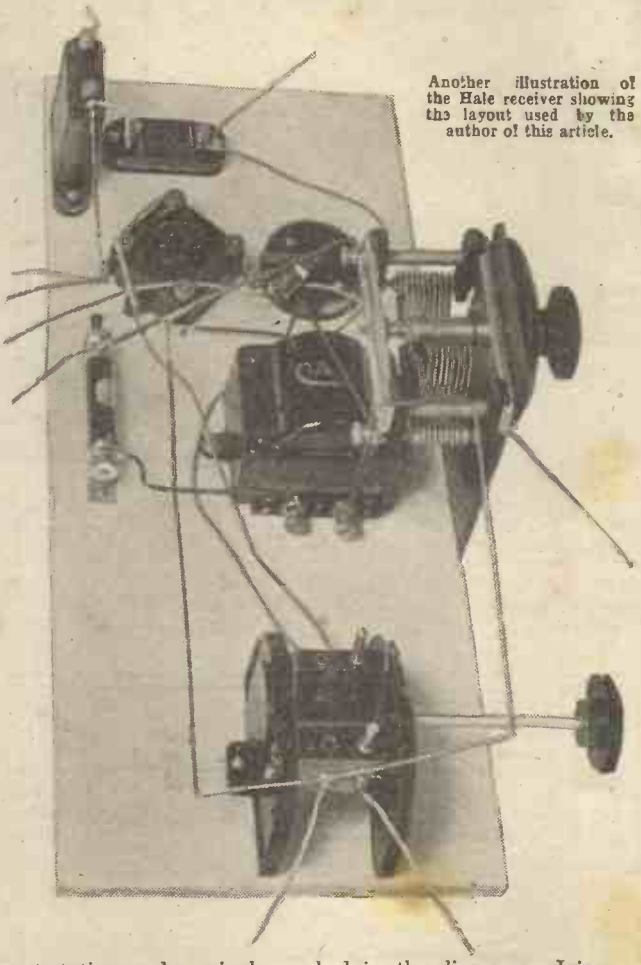
The Hale Connections.

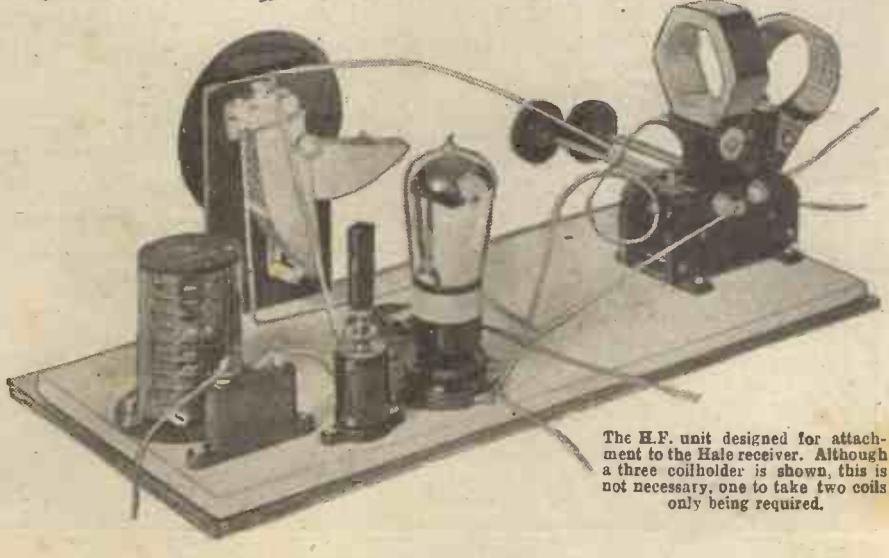
Notice that the L.F. transformer connections are unusual in the Hale circuit, the I.S. being connected to O.P. and to the aerial coil, while I.P. goes to one terminal of the crystal detector, the other terminal of which is joined to earth. A grid-bias battery is interposed between the tuning coil and the filament of the valve, negative being connected to earth and positive to the filament. From the plate terminal of the valve a lead goes to the reaction coil, and from this last to the telephones or loud speaker. A ·001 mfd. fixed condenser is joined from one terminal of the telephones to the negative L.T., the other telephone or loud-speaker terminal being taken to positive H.T., which in its turn is shunted by a 1 mfd. condenser taken from positive H.T. to negative L.T., thus shunting both H.T. and L.T. batteries.

Many readers will already be well acquainted with the operation of the Hale circuit, but for those new readers to whom this is the first introduction, the following practical points will be of interest.

The valve used with the Hale circuit should preferably be of the power-valve type, as the set is capable of giving very strong signals from the nearest station, and unless a suitable valve is used, distortion will occur. A voltage of from 100 to 120 is recommended and I have found best results are given by one of the semi-permanent types of detector, rather than with the cat-whisker type. However, a wide variety of apparatus is possible with this set, and the excellent results with many different components have already been published in this journal.

To operate the Hale circuit, proceed as follows: Open out the reaction coil so that it is well away from the aerial coil (having joined aerial and earth as usual) and join the telephones or loud speaker to the terminals marked in the diagram. Join up your batteries and set the filament resistance to a suitable value for the particular valve you are using. If this is a small power valve with 120 volts on the plate, join up the grid-bias battery with about 4½ or 6 volts, for the time being, and make sure that your two crystals are in contact. Tune in the nearest station in the usual way by means of the variable condenser, and gradually bring up the reaction coil against the aerial coil to see whether the signals increase, as they should do. A point should be reached when the set begins to oscillate, when you will, of course, slack off at once. It is preferable, by the way, to undertake these tests on the test signals which are often given after the normal service has closed down. For example, test signals are regularly sent out every Friday night from 2 L O after "closing-time."


Another illustration of the Hale receiver showing the layout used by the author of this article.


The H.F. unit designed for attachment to the Hale receiver. Although a three coilholder is shown, this is not necessary, one to take two coils only being required.

Careful Crystal Setting.

If you do not succeed in getting oscillation, or if oscillation control is not smooth, try resetting your crystal. A careful setting of the crystal is an important part of the operation of the Hale receiver, and, once a good position has been found, it will be retained for a considerable time. A little practice in setting the crystal of the Hale receiver will soon show you that marvellous results can be obtained with this set, which, incidentally, should work a loud speaker at

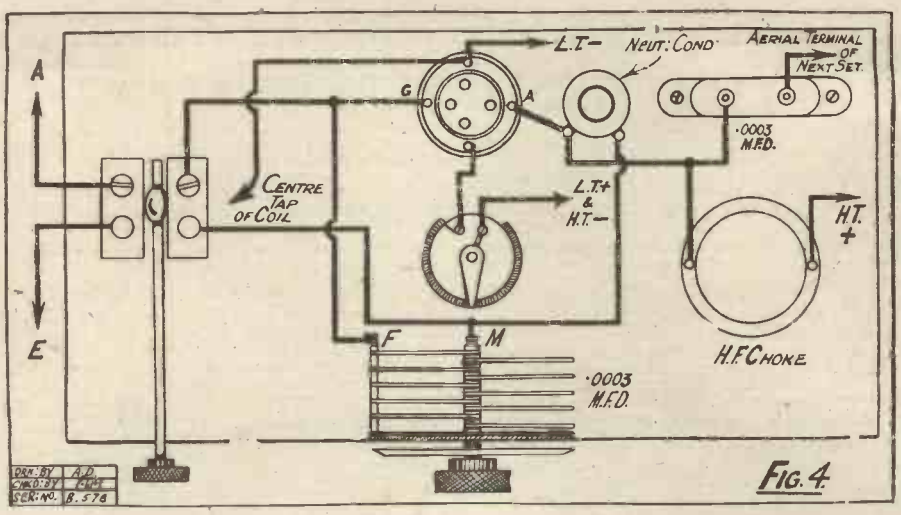
(Continued on next page.)

ADDING H.F. TO THE HALE.

(Continued from previous page.)

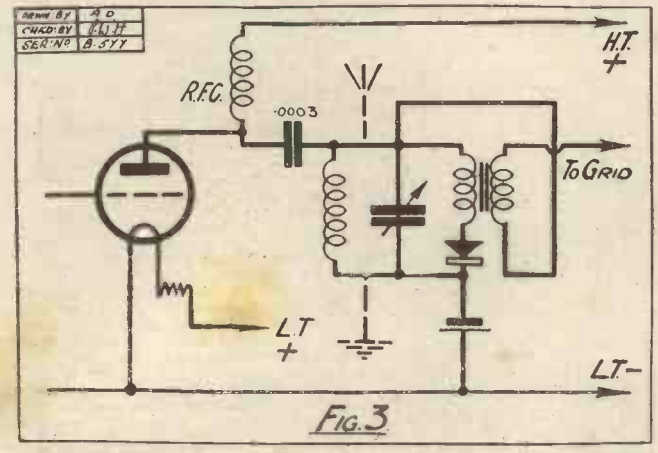
good strength up to quite twenty miles from a main B.B.C. station, using an average aerial.

We will now consider the attachment of the H.F. unit. Having satisfied yourself that the ordinary Hale receiver is working properly, remove the aerial and earth leads from this and connect them to the aerial and earth terminals of the H.F. unit. Take the flexible lead from the fixed condenser of the H.F. unit to the aerial terminal of the Hale, and leave the earth terminal free. It is necessary in this case to use the same accumulator for both sets; the same H.T. battery can also be used.



Connecting the H.F. Unit.

As the aerial and earth are no longer connected to the original Hale receiver, you will have to place a larger coil (say a 60) in the grid-coil socket of the Hale. Set the aerial coil of the H.F. unit fairly close to the grid coil, and by manipulating the tuning condenser again tune in your nearest station. The set will probably be very prone to oscillation, so carefully adjust the neutralising condenser turn by turn until the set becomes stable again. When this neutralising condenser has been properly adjusted the original reaction setting of the Hale set will be the best, and you will get no self-oscillation in the H.F. unit.



My experiments have shown that the ordinary small power valve (not necessarily the H.F. type) works excellently as the H.F. amplifier, and about 80 volts will be found to be suitable for H.T. Remember that the tuning with this combination is exceedingly sharp and that alteration of the coupling between the aerial coil and the grid coil of the H.F. amplifier may cause you to lose a station until you retune.

In Conventional Form.

Most trouble found in adding a stage of H.F. to the Hale receiver has been due to the fact that unless the H.F. unit is of the neutralised type great difficulty is found in getting stability in the Hale, as the grid-coil circuit of the Hale acts as if it were in the plate circuit of the H.F. valve, and when in tune with the grid circuit of this latter valve violent self-oscillation may take place. While the Hale circuit will introduce considerable damping, it is not wise to rely upon this, and it is very difficult indeed to obtain satisfactory working with such an arrangement.

Although for convenience of experimental work the H.F. unit has been made up without a panel, readers will see that a very slight change is necessary in order to make up this set in the conventional form. If such a type of receiver is desired I would suggest that the coil sockets be both fixed in the H.F. amplifier, thus cutting out one adjustment and that the condenser be mounted centrally on the panel in the usual way. The general lay-out of the parts inside the box can be as shown in the present receiver.

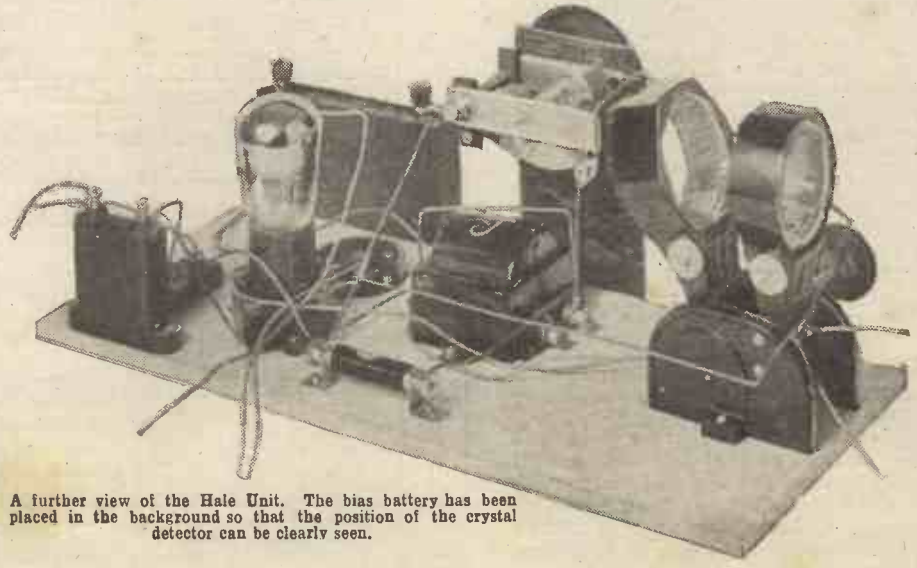
In order to show readers the theoretical connections of the anode circuit of the H.F. valve and the grid circuit of the Hale receiver when they are coupled, I have shown in Fig. 5 the essential parts of these two circuits, from which it will be seen that the path of the H.F. oscillations from the H.F. valve is through the grid coil of the Hale receiver, through the grid-bias battery, and thus back to the common negative filament. This will explain why no earth connection is necessary on the Hale receiver when the H.F. valve is placed in front of it.

Remarkable Increase of Strength.

As previously indicated, this H.F. unit can be placed in front of any existing receiver, providing a common L.T. battery is used, and it will be found to give a very appreciable increase of signal strength on distant stations. When this H.F. stage is added to the Hale, the increase of strength on distant stations is very remarkable. For example, a quick change over showed me that on a night when Madrid was just audible close to the loud speaker with a single-valve Hale on a good aerial, the addition of the H.F. amplifier brought it up to quite reasonable loud-speaker strength for the ordinary room.

For long-distance work the great advantage of the H.F. stage in front of the Hale is that it is not necessary to use much reaction amplification to get these distant stations, and for this reason the quality is greatly improved. When the limit of

(Continued on next page.)



A further view of the Hale Unit. The bias battery has been placed in the background so that the position of the crystal detector can be clearly seen.

CORRESPONDENCE

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

A QUESTION ANSWERED.

The Editor, POPULAR WIRELESS.

Dear Sir,—*Re* Mr. Manly's enquiry in the correspondence columns of your December 18th issue, the station in question is K D K A of the Westinghouse Electric Co., East Pittsburg. This station has been working on 64 metres for some time, and is a very useful help in calibrating a short-wave set, as its wave-length is kept remarkably constant.

Mr. Manly would be well advised to try for 2 X A F of the G.E.C. on 32·7 metres on Saturdays and Tuesdays from 11 p.m., G.M.T., onwards.

This station is remarkably easy to pick up, and considerably louder, generally, than K D K A.

Hoping to see more of "P. W." devoted to short-wave work and amateur research work.

Yours faithfully,
R. MACKLEY.

84, Torrington Street, Grimsby.

RE LECLANCHÉ WET H.T. BATTERIES.

The Editor, POPULAR WIRELESS.

Dear Sir,—Probably a lot of your readers who have constructed "Wet H.T." have found that they get considerable trouble from electrolyte creeping, thereby shorting the battery and, of course, lowering the insulation of the unit. Sugar has been suggested as a remedy, but I have never found this very effective. I therefore suggest that they pour a little THIN lubricating oil on top of the electrolyte. This will be found to stop all creeping.

Only a very thin film of oil is needed.

Trusting this will help many, and wishing "P.W." all good wishes.

Yours faithfully,
CYRIL E. CATER, A.M.I.R.E.

123, Newland Avenue,
Hull, E. Yorks.

SOME COMMON FAULTS.

The Editor, POPULAR WIRELESS.

Dear Sir,—An article which appeared in last Thursday's issue of POPULAR WIRELESS entitled "Some Common Faults" calls, I think, for comment.

The article is apparently intended for new recruits to wireless, to whom it might be somewhat misleading on one to two points.

Your contributor begins by stating that an H.T. dry battery should be tested with a flashlamp, and faulty cells should be shorted. A flashlamp obviously cannot give any useful indication of the state of an H.T. battery for wireless reception, as, although some three-volt tappings may give little or no visible glow in a flashlamp, they may give a perfectly steady current at the rate demanded by a receiving set. I suggest that a voltmeter test would be much more satisfactory, especially if the voltmeter has a fairly high resistance. The really defective cells can be shorted, but I think that the addition of a large Mansbridge condenser across the H.T. battery will sometimes effect a considerable improvement.

He next deals with the accumulator. In this respect I, of course, agree with him, but a clearer way of expressing it would be that the voltmeter will not give a reliable reading unless it is connected across the battery whilst the battery is delivering normal current to the set.

As regards the paragraph dealing with fading, I do not see how this can be caused by geographical conditions, which, I take it, means one's location. One may be in a more or less "blind spot," but I should imagine that only atmospheric conditions affect actual fading.

He advises that valve pins should be scraped, and I suggest that the valve holders occasionally need similar treatment in order to obtain good contact with the valve pins.

The anode voltage of the L.F. valve should, your contributor states, be "100 volts or so." This, I submit, depends upon the type of valve used, and, if there is more than one L.F. stage, also upon its position in the set. Instructions on this point, however, frequently appear in your excellent periodical, of which I am a regular reader.

Other common sources of trouble which I have encountered are the external aerial-earth switch, which at times gets wet and dirty, and should be periodically cleaned; and extension wires, which cause a capacity or leakage to earth, thus throwing the set out of adjustment or causing a drop in volume when plugged in. I have found that a way out of the latter difficulty is to use loose-coupled or aperiodic aerial tuning.

I cannot conclude without saying that the contents of POPULAR WIRELESS are usually of the highest order, and I hope that the progressive policy of "P.W." will be continued.

Yours faithfully,
ERNEST H. J. KEW.

9, Charles Street,
Barnes, S.W.13.

D.C. ELIMINATORS.

The Editor, POPULAR WIRELESS.

Dear Sir,—As your paper has recently given some prominence to H.T. Battery Eliminators, perhaps my experiences with one of these instruments on D.C. Mains may be of interest.

Prior to the installation of the Eliminator, clicks could be heard in the loud speaker every time a house switch was turned on or off.

Since fixing the Eliminator these clicks are slightly louder, but when listening to Daventry the reception is marred by a number of similar noises occurring every few seconds.

My conclusion is that these latter noises are due to the switching on or off of electric lights in the neighbourhood, and that the natural wave-length of the local electric lighting circuit must be approximately 1,600 metres, since the noises are not heard on the lower B.B.C. wave-lengths. This theory is further strengthened by the fact that this evening, before the Daventry transmission commenced, the set was tuned to approximately 1,600 metres, and noises were heard which correspond to those usually caused by an electric motor. Increasing or decreasing the wave-length by means of the variable condenser resulted in a decrease in the volume of the interference.

Have any of your readers had a similar experience, and if so have they found a cure?

Yours faithfully,
"E. LIMINATOR."

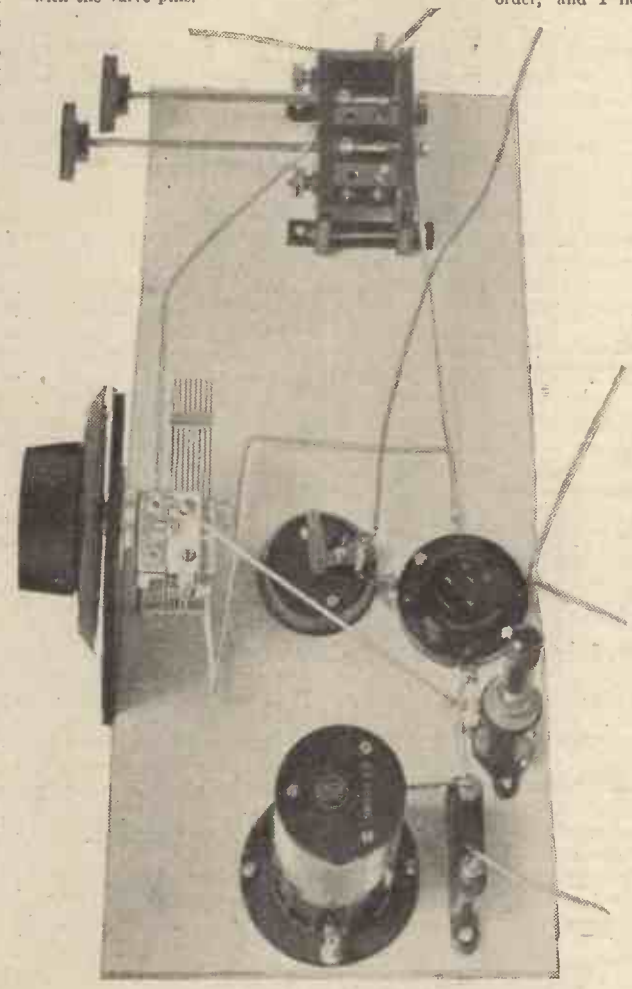
3, Wilmer Drive, Redburn Road,
Shipley, Yorks.

MORSE INTERFERENCE.

The Editor, POPULAR WIRELESS.

Dear Sir,—Perhaps my locality is rather bad for Morse interference, but it is evident that something must quickly be done to effectively prevent its transmission on 250-400 metres. I possess a powerful

(*Continued on page* 1226.)



Another photograph of the Hale H.F. Unit.

ADDING H.F. TO THE HALE.

(*Continued from previous page.*)

sensitiveness is required, the use of the H.F. stage in front of the Hale with careful reaction setting on the Hale gives remarkable results, and the two-valve combination so produced has distance-getting powers which few people would credit if they have not tried it.

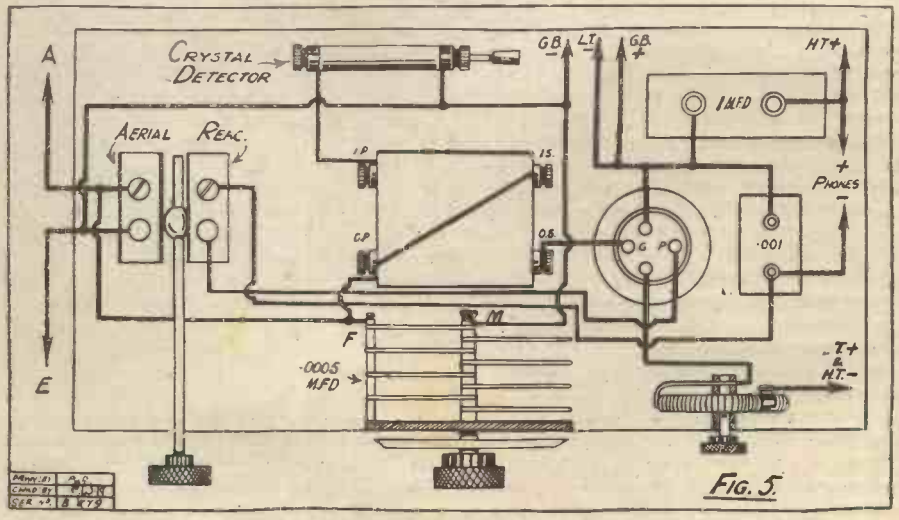
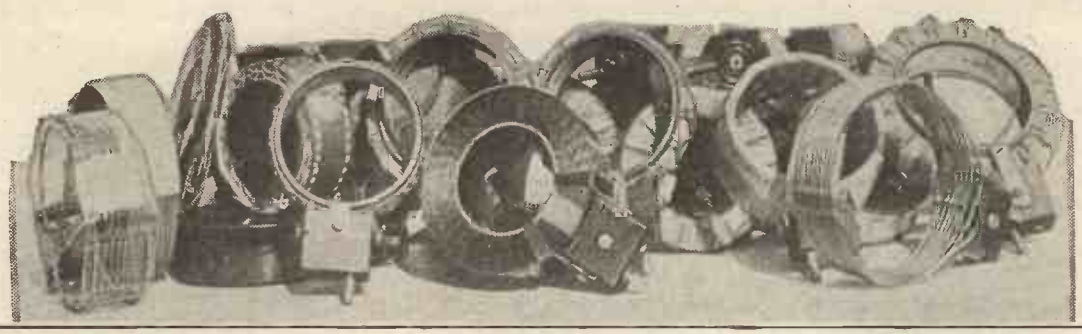


FIG. 5.



An Interesting Reinartz Variation

A modification of one of the most popular wireless receiving circuits.

By J. ENGLISH.

THE reason why circuits employing capacity reaction control have become so popular is chiefly because the use of a variable condenser as the reaction control permits of a very delicate and smooth adjustment of the receiver's sensitivity. This tends to make it all the easier for the amateur to get good DX results.

Of the various circuits perhaps the Reinartz and its modifications have met with most success. This type of circuit in its more simplified form is certainly a fine one for the DX enthusiast who does not wish to bother with H.F. amplification.

Fig. 1 depicts a well-known version of the Reinartz which is quite selective and remarkably efficient. C1 and C2 are respectively the tuning and reaction control condensers, while the two coils are coupled at a fixed distance from one another. In operation, especially when receiving weak signals, it is often found that each adjustment of the reaction condenser necessitates a slight retuning of the grid circuit, L1 C1. Where a large anode coil has to be used to get sufficient reaction, a correspondingly bigger variation in tuning is caused by reaction adjustments.

Now this in itself is not a great disadvantage because, with a suitable reaction coil, the amateur skilled in tuning can bring in station after station quite easily and quickly. However, where it is necessary to use a large reaction coil, and where the operator has not the necessary skill in tuning, especially of weak signals, this variation in tuning is of more importance.

The Ideal Condition.

Thus it would be a decided advantage if some form of reaction control could be introduced into this circuit so that reaction adjustments made no difference to the tuning of the grid circuit. Given such a modified circuit, tuning would obviously be easier, and occupy less time, for, with the receiver just oscillating, we could tune to the silent point of a carrier wave and then decrease reaction until oscillation just ceased. It would then be possible to hang on to a weak station without fear of losing it while making the necessary reaction adjustments. Even the beginner could operate such a receiver successfully, and adjust reaction sufficiently quickly to cause the minimum of interference.

Now in Fig. 1 the reason why reaction adjustments detune the grid circuit is because any alteration in the capacity of C2 changes very slightly the mutual inductance of L1 and L2, so that C1 has to be reset to make up for the decrease or increase of the inductance of L1. Other forms of capacity control upset even more the tuning of the grid circuit.

Obviously the only modification of Fig. 1 which will bring about the desired condition of things is some form of reaction control which does not change either the capacity of C2 or the mutual inductance of the coils.

Before describing this modification let us consider a little more fully the effect of varying degrees of reaction in Fig. 1. Here the full sensitivity of the receiver is only obtained when sufficient reaction is used to counteract, almost but not quite, the fixed damping of the grid circuit. This damping, of course, is due to the H.F. resistance of the aerial system and of the coils and tuning condenser. Therefore, if we substitute for this state of affairs a *fixed* degree of reaction and then vary the damping, we shall obtain just the same control of the receiver's sensitivity, but with one important difference. The damping of the grid circuit can be varied in such a way that no detuning of the grid circuit takes place, whatever the degree of reaction. This will give us the required modification of Fig. 1.

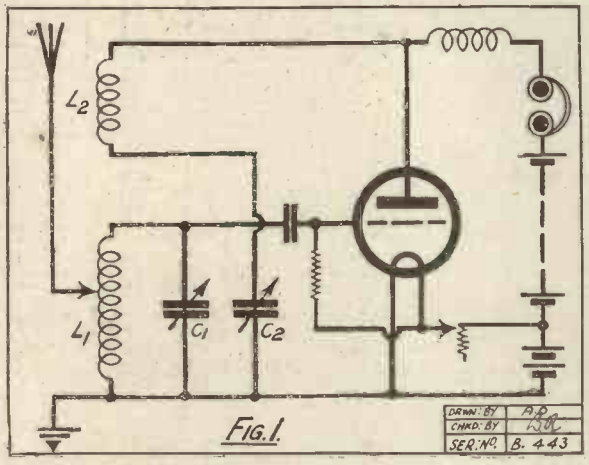


FIG. 1.

Now there are several ways of varying the damping of the grid circuit, but the method which I have found most successful is shown in Fig. 2. Here a resistance R, variable between zero and several thousands of ohms, is inserted in the earth to filament lead, with the reaction coil at the earth end of the tuning coil. Since a properly made variable resistance has negligible inductance and capacity, its use as a reaction control will not detune the grid circuit. Besides this advantage, the circuit of Fig. 2 retains all the good points of the original.

Adding the Resistance.

The fixed reaction condenser C2 (·0002 mfd.) is large enough to make the receiver oscillate at any setting of the tuning condenser with R at maximum and using the coils indicated in Fig. 2. Then, as the resistance of R is reduced, oscillation gradually decreases until the set is just off oscillation, this being the correct adjustment for the loudest signals. Further reduction of R reduces signal strength correspondingly. This wide variation in the degree of reaction causes no detuning of the grid circuit, so that when the set is tuned to the silent point of a carrier wave and then oscillation reduced to "just off," there is no fear of losing the signal, however weak. This modification therefore enables us to obtain the desired results anticipated above, giving a sensitive receiver that is remarkably easy to handle.

Any existing set similar to Fig. 1 can be modified quite easily by inserting a variable resistance in the earth to filament lead as in Fig. 2. The success of this circuit, however, depends entirely upon the choice of the variable resistance, which must be continuously variable from zero to maximum, constant in use and of good design mechanically. A resistance of the graphite type is best, and a very satisfactory component is the Marconiphone variable resistance (0 to 40,000 ohms). I have also used successfully a home-made variable resistance of similar value, details of which wer recently given in "P. W."

Preliminary Adjustments.

In making the preliminary adjustments, R is set at zero and the coupling of L1 and L2 weakened so that the set does not oscillate at any setting of the tuning condenser. Turning R towards maximum

(*Continued on next page.*)

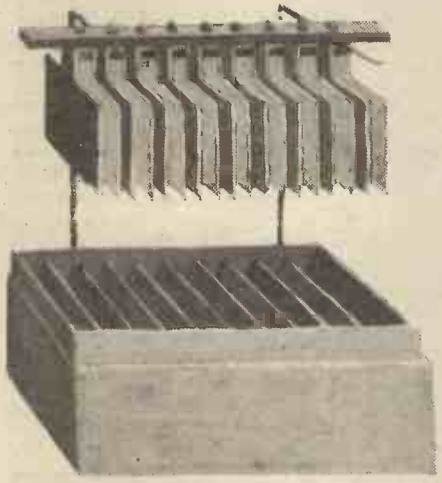
GRID BIAS AND H.T. BATTERIES.

Some Useful Hints upon the Treatment of Dry Batteries.

BY A CORRESPONDENT.

A GRID bias battery is not called upon to supply current. If it were capable of providing a definite voltage value without any current flow whatever, it would still be doing its duty. But no battery can be connected in any complete circuit without some current flowing, although in cases this may be almost negligible.

Now, simply because of this fact, it has become a habit among many amateurs to use otherwise useless batteries for grid bias purposes—old H.T. battery units which have served their purpose, and which



An early form of wet H.T. battery, where the plates have to be removed from the electrolyte when the battery is out of use to prevent unnecessary action taking place.

give just three or four volts where once they were able to record twelve or fifteen, and so on.

But it should be remembered that such a battery as this may fluctuate considerably. One day it may give a three-reading, and another eight or so, or even nothing at all. Needless to say, a grid bias battery that gives no grid biassing voltage is merely a useless resistance in circuit, while one that fluctuates is bound to have a detrimental effect upon reception.

Watch the Bias Battery.

And it should not be forgotten that a dry battery standing on "open circuit," or one that is called upon to deliver negligible current, will still deteriorate. Therefore the practice of connecting up a grid bias battery inside a receiver, and then forgetting about it after its initial adjustment, is strongly to be deprecated. We have even known amateurs to solder "flash-lamp" batteries up inside sets, just as they would solder into circuit a fixed condenser or other component.

As a matter of fact, the health of a grid bias battery is just as important as that of an H.T. battery. A very little thought and study of an average characteristic valve curve will show that a two-volt depreciation in a grid bias battery of nine volts is as serious as a ten-volt or so H.T. battery depreciation.

Grid bias batteries should be as carefully watched as H.T. or L.T. batteries. In the first instance they should be new batteries of sturdy construction, and not derelicts or tiny batteries with infinitesimal capacities; such will rapidly depreciate. In use they should be tested from time to time, and should be replaced when they show the inevitable signs of old age.

H.T. Faults.

When, after a period of successful work, a receiver begins to emit loud crackling noises, such are most frequently due to a faulty H.T. battery. If the noises are due to "atmospherics," they will cease when the aerial and earth leads are removed.

A faulty H.T. battery will cause such a commotion in a loud speaker that broadcasting is practically drowned. It is interesting to test a faulty H.T. battery with a high-resistance low-reading volt-meter. The sections of three or six volts should be tested separately.

Frequently it will be found that it is only one section that is causing the trouble. This section may not give any reading at all, but more often it will give a "shaky" reading. The test should be carried out while the set is working, and it will probably be found that the faulty H.T. battery section (it may be situated between 12 and 15 volts, or any other of the plugs) varies as much as half a volt; and the flicking of the voltmeter needle will indicate how the noises occur.

This section can be shorted out of circuit with a piece of wire, and clear reception once again enjoyed. H.T. batteries with shorted sections sometimes give lengthy extensions of service, whereas with the faulty section in circuit they are perfectly useless.

An H.T. battery should always be tested whilst in operation. It is waste of time to remove it from the set and test it, for such a test will provide no true indication of its condition.

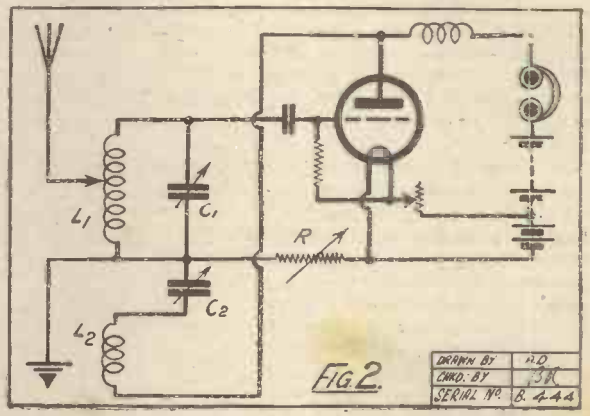
AN INTERESTING REINARTZ VARIATION.

(*Continued from previous page.*)

will then increase reaction smoothly and evenly.

As a matter of fact, this form of resistance control is slightly superior to capacity control as the adjustment of the resistance is not nearly so critical when reaching the point of maximum sensitivity just before oscillation commences. A point worthy of notice is that the resistance in the filament-earth lead does not give rise to howling when one or more L.F. stages are added to the detector valve.

To those who are interested in the theoretical side of reaction control this circuit will seem rather peculiar in its behaviour. On the face of it, the receiver should oscillate with R at zero and reaction decrease as R is increased. Actually, it works in the opposite way, as we have seen above. With R at zero the circuit is just a modification of the Reinartz and the fixed degree of reaction is not strong enough to cause oscillation or even to make the receiver sensitive. But as R is increased, the earth end of the tuning circuit can be considered as being gradually separated from the filament, so that a smaller proportion of the fixed H.F. back coupling is required to make the receiver sensitive. Eventually when R is big enough the receiver oscillates. If R is made infinitely large, that is, removed altogether, the circuit, in a disguised form, becomes our old friend the Ultra-audion. This can easily be seen by re-drawing Fig. 2 without R, and inverting



the coils. In this form the fixed degree of reaction causes full oscillation. This explains why the variation of R controls reaction as it does.

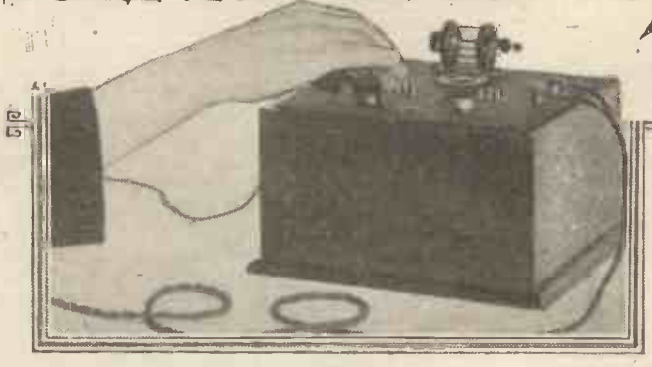
SLATE PANELS

ALTHOUGH widely used in the electrical world for power switch-boards, instrument bases, etc., slate has not found favour in the eyes of the wireless enthusiast. At the present time, when substitutes for the conventional ebonite are being eagerly sought, it is surprising to find that the merits of this most useful material are not given so much as a thought.

Slate is a good insulator, vastly superior to wood; it does not become discoloured, and will not warp. It is, moreover, much cheaper than ebonite or glass. The only disadvantage, which is probably the reason for the lack of enthusiasm, is the difficulty in drilling. A sharp drill and a little oil reduce this considerably.

A steady pressure is essential if the expenditure of energy is to be minimised; but this must not be taken to mean a heavy pressure, which will cause "chipped" holes. To keep the drill sharp, give it a rub on the oil-stone after drilling two or three holes, as it will naturally be slightly blunted.

REACHING OUT WITH THE CRYSTAL



Many reports have reached us from crystal users claiming DX results, and this article should be of interest and value to other crystal enthusiasts wishing to emulate the successes already recorded.

By J. F. CORRIGAN, M.Sc., A.I.C.
(Staff Consultant.)

IT is on occasion remarked that long-distance reception with a crystal set is more a matter of luck and good fortune than one of skilled management. And, in some respects, such a remark is not at all an untrue one, for there is no doubt that a crystal set which suddenly begins to excel itself and to give long-distance results for no apparent reason—as many such receivers sometimes do—is really behaving in a very mysterious manner. As a general rule, a crystal set of good make can be relied upon to provide good and loud reception within a range of ten miles from a main broadcasting station. Beyond this limit the reception qualities of the set begin to get uncertain. For instance, at a range of fifteen miles, such a set might provide good reception one evening, and then on the following night it might probably refuse to give any intelligible result at all.

At twenty miles' range the average crystal set becomes so inefficient that it can no longer be considered to constitute a practical means of receiving radio broadcast. That is, I repeat, as a general rule. But there are, of course, exceptions to this rule.

Results Achieved.

For instance, it is an authenticated fact that reception from the Aberdeen station has been obtained in the London area by means of a crystal set alone. Northern crystal enthusiasts have from time to time reported the reception of Madrid, Paris, Brussels, and other Continental stations. Now, although the re-radiation question may enter into the matter in some instances, it cannot be implied that such long-distance crystal reception is due in every case to the effects of radiation from a neighbouring aerial. Nor are such long-distance results due to the employment of what we may call "stunt" circuits, or out-of-the-way crystal rectifying combinations. The man who gets long distance crystal results generally achieves them through the agency of a thoroughly efficient aerial-earth system, an ordinary crystal set of careful but nevertheless quite straightforward design and construction, and a crystal of the usual cat's-whisker type.

Thus it is that a high degree of all-round efficiency in the receiving set and the aerial-earth system with which it is operated seem to constitute the main factors which make for success in attempts at crystal long-distance work. Of course, we have all had brought to our notice from time to time special circuits which are claimed to give exceptionally good crystal reception over considerable ranges. Some of these stunt circuits may be effective. The majority of them, however, give but disappointing results.

Given any one of the usual types of crystal set of good design and thoroughly efficient construction, the factors which make for success in long-distance reception are the following:

1. Thorough efficiency of the aerial-earth system.
2. The use of a highly sensitive rectifying contact.
3. The employment of suitable 'phones.

Fig. 1. An efficient type of earth plate.

The careful consideration and application of these factors not only enable the town-dweller to reach out with his crystal set, but perhaps what is of greater practical importance, they enable the would-be crystal set user who is situated on the fringe of crystal reception (say, at about fifteen miles distance from the broadcasting station) to *reach in*, as it were, to transmissions from the neighbouring town, and to obtain reliable reception from that source by means of the crystal receiver alone.

Considering the factors of success in long-distance crystal work outlined above, let us begin with the aerial-earth system, and the conditions which make for its utmost efficiency for this type of reception. It has been proved by actual test that for long-distance crystal work the height of the aerial is of more vital importance than its length. Thus, in designing a crystal receiving installation for long-distance work the height of the aerial should never be sacrificed. The higher the aerial, the better.

Importance of Aerial Efficiency.

The aerial, also, must not be subjected to any appreciable screening influences. And still further, the aerial should not pass over the roof of a house or any other building for any great portion of its length. This is not a very well recognised fact, but the reason for it lies in the fact that a crystal receiver works more efficiently at comparatively long distances when its earth is situated directly under the aerial, and thus when the aerial is stretched between two house chimney-pots this requirement respecting the earthing system becomes practically impossible.

The aerial must, of course, be efficiently insulated, not only against direct electrical leakage, but also against capacity leakages. For this latter reason, it is essential to have the aerial down lead as far distant from neighbouring walls as possible. Soot and grime-laden insulators are conducive to current leakages. This fact should also be borne in mind when working a crystal set for long-distance results.

For DX crystal work, earth efficiency is of almost as vital importance as that of the aerial system. For ordinary crystal results almost any type of earth connection to the set will afford suitable reception. In long-distance work, however, much greater care must be given to the earthing of the receiver. Assuming that the aerial runs the length of a garden or neighbouring space, the most efficient earthing system is to be formed by burying a series of galvanised iron plates, edgewise in the ground, directly under the aerial. Each of these plates may conveniently be about four feet long and approximately a foot and a half wide. A plate of this description will be seen in the illustration, Fig. 1.

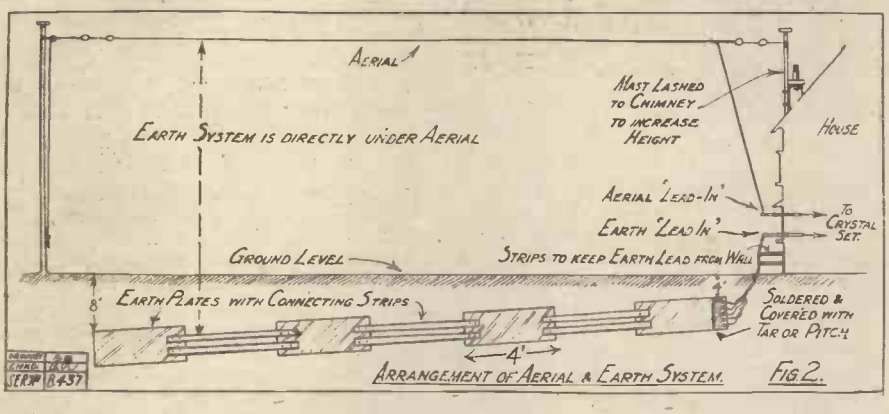
It is best to use a series of four or five of these plates. The plates may be connected together by means of metal strips. There is no necessity to solder the connecting strips to the plates.

(Continued on next page.)

REACHING OUT WITH THE CRYSTAL.

(Continued from previous page.)

Fig. 2 indicates the actual arrangement of the earthing system advised above. Note that the plates are buried edgewise, and on the slope, the plate nearest the earth lead being buried at a depth of four feet, whilst the final plate of the series is below the ground at a depth of seven to eight feet.

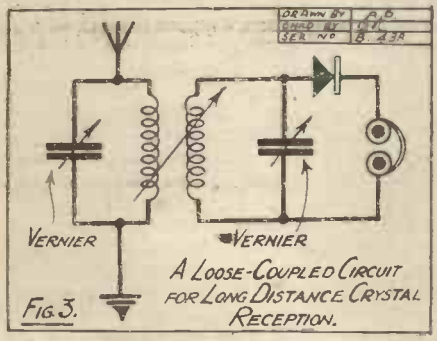


The earth lead to the set should preferably consist of a length of 7/22 *enamelled* wire, each separate strand of which is well soldered to the first earth plate of the series. If the soldered portions are subsequently covered with tar, and also the portion of the earth lead which runs into the ground, no corrosion effects will be set up.

The Best Circuit.

The earth lead, in addition to possessing its enamel insulation, must also be kept well away from neighbouring walls by means of projecting strips in the manner shown in the diagram, Fig. 2.

Turning now to the actual type of set which is best used for long-distance crystal results, it is only possible from an essentially practical point of view to lay down general rules of efficiency, because, given these



efficiency conditions, any set of average design will afford long-distance results when used under the conditions described in this article.

Crystal sets of the so-called low-loss type, with widely spaced air-insulated coils, are necessary for the best results, so far as distance goes. It is not necessary to employ excessively thick wire for the coils or other portions of the set, however. No. 20 wire, well spaced, and not impregnated with insulating varnishes, is quite thick enough a wire to use. Self-capacity in the circuit must be kept down to a minimum by means of avoiding all unnecessary insulative coatings for the coils, and dead-end losses must be guarded against. Naturally, all rubbing surfaces, such as contact arms and rotating spindles, must be efficiently constructed so as to give rise to the minimum possible electrical loss.

Capacity in a crystal set does not make for long-distance reception. Amateurs who are endeavouring to carry out distance work with their crystal sets should do without the use of capacity in their circuits and rely upon inductance tuning only. Such is the general rule, but, on the other hand, in the case of crystal sets employing inductively coupled circuits (which are often of great value for crystal DX work) the employment of small and very definitely controllable amounts of capacity may be advantageous. For instance, in the circuit given at Fig. 3—a circuit which, by the way, is an excellent one for getting distance results—only vernier condensers should be employed to tune the aerial and the detector circuits, the coils themselves being of the widely spaced plug-in variety, the exact number of turns on each coil being a matter for practical experiment.

All-important in the getting of long-distance crystal reception is the precise nature of the rectifying contact. There is no doubt that, despite its one fundamental disadvantage of instability, a rectifying contact consisting of a fine cat's-whisker, carefully adjusted upon the surface of a natural galena crystal of medium coarse grain, is the most productive of long-distance results. Fine grain galena crystals do not seem to be as sensitive in this respect as the coarser grained ones.

A Sensitive Detector.

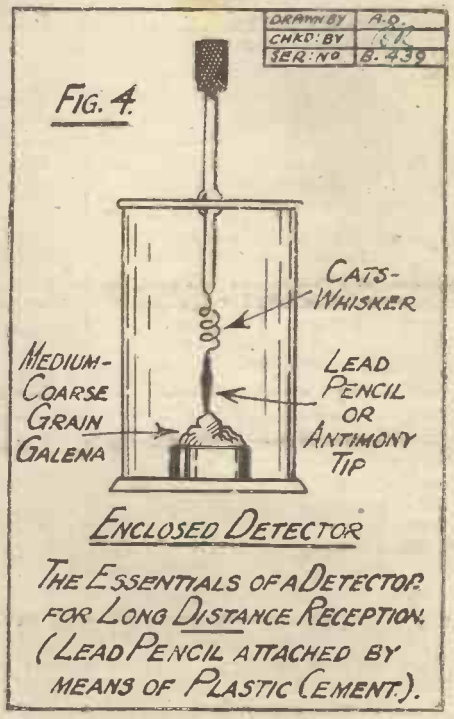
A still more sensitive rectifier may be constructed by attaching a minute fragment of lead pencil (BB grade) on to the end of the cat's-whisker by means of a tiny blob of plastic metallic cement. The contact thus created, whilst being relatively unstable and difficult to adjust, is often extraordinarily sensitive. In a similar manner, very small fragments of metallic antimony, bismuth, and cadmium may be attached to the end of the cat's-whisker. All these contacts are of high sensitivity. So also is a galena-magnesium contact, but its efficiency very rapidly decreases owing to the surface oxidation of the metal. A convenient method of fixing these various contact materials on the end of the cat's-whisker will be seen at Fig. 4. It should be noted, in passing, that the detector in which such contacts are used should be one in which the cat's-whisker is maintained in a vertical position, otherwise the extra weight of the cat's-whisker would tend to disturb the sensitive adjustment of the detector.

Long-distance crystal workers often overlook the undoubted fact that the manner of connecting the detector in the circuit can influence the results obtained. If, therefore, the reception obtained with the detector arranged in the circuit with the crystal directly connected to the 'phones is not satisfactory, experiments should be conducted with the detector arranged the opposite way—i.e, with the cat's-whisker in series with the 'phones. In many cases, a simple rearrangement of this nature will bring surprisingly improved results.

Reed-type 'Phones.

Although long-distance reception with crystal sets may be obtained through the medium of ordinary headphones of the 4,000-ohm type, the employment of reed 'phones greatly facilitates the case of such reception. The reed 'phones, of course, do not affect the intrinsic sensitivity of the set. They merely give louder results when operated by extremely small currents. Hence, 'phones of the reed type have a distinct superiority over those of the ordinary variety when employed for long-range crystal reception.

Finally, let it be said that it is of little use for the crystal-set owner who is situated near to a broadcasting station to attempt to cut out the local transmissions by means of any wave-trap device, and, having done so, to endeavour to bring in more distant signals by means of his crystal receiver. The employment of wave-traps will, of course, have the desired result of cutting out the local station, but these devices usually introduce so much damping into the circuit that it is almost hopeless under such circumstances to pick up the feeble currents from the more distant stations by means of the crystal detector alone.



By the Chief Draughtsman of "Popular Wireless."

7,000 IN four years! That is approximately the number of diagrams completed to the Editor's orders since the first number of POPULAR WIRELESS appeared in 1922.

As may be imagined, there is a considerable difference between the earlier illustrations and those appearing in the current number of the paper.

I do not refer to the actual diagram as a drawing, but to the type and design of instrument or circuit illustrated. For obvious reasons, the earlier numbers of POPULAR WIRELESS dealt more with the elementary principles of wireless reception, much of the information given applying to the theoretical rather than the practical side of wireless telephony. The illustrations were, therefore, correspondingly simple, and the work of the draughtsman comparatively light.

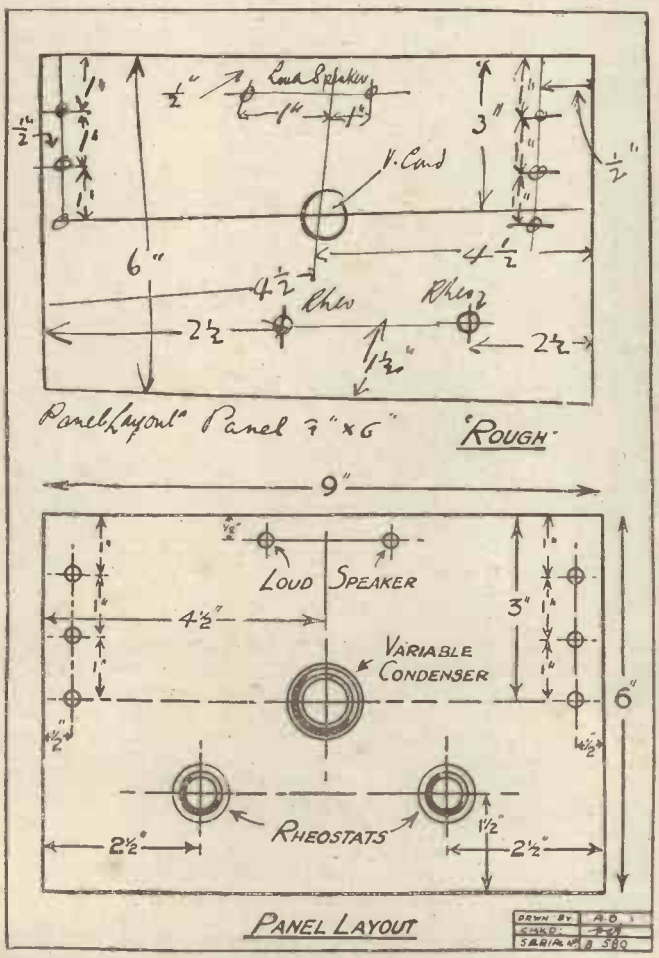
Growth of Wireless.

Publicity, however, quickly led to a better understanding of the science among the thousands of eager enthusiasts who adopted wireless as a hobby, with the inevitable result that from wanting to know "how it was done," readers determined to 'go and do." Constructional articles made their appearance; crystal sets, one-valve receivers, two-valve receivers, reflex receivers, etc., terminating in the neutrodyne and superheterodyne.

This gradual, but easily perceptible, advance naturally resulted in a corresponding increase in the amount of work required from the draughtsmen. This can, perhaps, be better understood by going to the two extremes and comparing the wiring diagram applicable to a simple crystal detector set, and a diagram portraying the layout of a superheterodyne receiver; to draw and check the latter illustration would just about equal the time taken to complete all of the diagrams which appeared in three early numbers of "P.W."

The majority of diagrams appearing in "P.W." fall, of course, between those two extremes, and are generally prepared from "roughs" submitted by contributors with their manuscript.

Unfortunately, certain writers construe the word "rough" too literally, and the crude drawings submitted are practically undecipherable. In some cases of this description the draughtsman completes and checks his drawing from the text of the article, but the liability to error is greater, and the time taken longer, and it is therefore advisable to make sure that all drawings submitted are clear and accurate.



Showing the value of figures on rough diagrams, which should, of course, be as clearly drawn as possible.

This does not imply that good drawing is required, but simply that the "rough" is capable of intelligent interpretation by the draughtsman.

Simple Mistakes.

Where mistakes occur they are usually of a simple kind. The most common error, perhaps, is the connecting of the high tension battery (positive) direct on to the filament of the valves. I refer, of course, to theoretical circuits, and this mistake may be due to the American practice of showing a short thick stroke for the positive sign, and a longer thinner line for the negative. The English method is, of course, the reverse. In theoretical diagrams, also, the iron core in low-frequency transformers is often omitted. This, in most diagrams, makes little difference, the omission being obvious. When it is remembered, however, that the "sign" may then stand for a high-frequency transformer, or even two coils, the necessity for being accurate in compiling theoretical diagrams is apparent. There is, of course, a great deal of difference between diagrams as submitted, some being prepared with meticulous care, and others so bad as to present just a meaningless jumble of lines. It is a fact that the best rough drawings are received from men who are authorities on the science and whose names are known to every wireless enthusiast. In case I should be accused of pointing a moral, I hasten to add that the worst explanatory diagrams I have ever seen have been submitted by their equally eminent confrères. There is also a humorous side, even to an essentially practical thing like a wiring diagram.

In the early days of broadcasting, before 2 L O had "taken the air" with an official programme, I was engaged in answering a voluminous post-bag, from all classes of the community thirsting for wireless knowledge.

One extremely indignant gentleman wrote to say that he had "purchased a wireless from Messrs. ———, which, upon being connected to my aerial and earth will not work the music. Why not?" The letter was accompanied by a drawing showing a well-known loud speaker, one terminal of which was connected to the aerial and the other to a gushing water tap! That particular gentleman is, no doubt, wiser to-day, but at that time many queries of a similar character were being received continually.

Never Built a Set.

I have, personally, drawn some thousands of diagrams for POPULAR WIRELESS, but I have, however, never actually constructed a broadcast receiver, either crystal or valve, and I am fully convinced that should the attempt ever be made the result would approximate very nearly, in appearance, to some of the drawings submitted to me, which represent, in pictorial illustration, the appearance of their particular receivers.

TECHNICAL NOTES.

A Weekly Feature Conducted by

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

VARIOUS attempts have been made to provide safeguards in the shape of fuses in the H.T. and L.T. supply circuits to the valves, but it would seem that only a small percentage of set users take advantage of these safety devices. It is commonly assumed that valves are generally burnt out owing to accidental application of the H.T. voltage to the filament, and, although all kinds of precautions are taken to avoid this, I think it is a mistaken notion that any considerable percentage of valve burn-outs is due to this cause. My own opinion would be that most valves end their days either owing to a gradual deterioration of the filament, with the inevitable result of a burning out at some particular spot, or to the application of too high a voltage from the L.T. battery—not from the H.T. battery at all. It seems, therefore, that a safety device in the L.T. battery circuit is more called for than the corresponding device in the H.T. circuit.

Probably the reason why safety devices for the H.T. circuit are more common than those for the L.T. circuit is because a safety device for the H.T. circuit is a much simpler device to provide. An ordinary pea-lamp will serve the purpose perfectly well, since it has a comparatively low resistance of about 10 to 15 ohms, which is immaterial in the H.T. circuit, and it burns out at a current of about 0·2 to 0·3 of an ampere; furthermore, whilst it is carrying the H.T. current its temperature is very far below the fusing temperature.

In the case of a fuse for the L.T. circuit, however, the fuse has to carry a normal current which is not very much below that at which it is required to fuse, and consequently the margin, so to speak, is very much narrower. When we consider that modern dull-emitter valves frequently operate at a filament current of 0·06 to 0·1 ampere, it will be seen that it is by no means a simple matter to provide a fuse which will have a resistance small compared to the resistance of the filament and yet which will carry a current of 0·06 ampere without fusing, and will fuse if the current goes up to say 0·08 or 0·09 ampere. Many attempts have been made to manufacture such a fuse, but, so far as I am aware, no really satisfactory result has ever been attained.

A New Fuse Unit.

Whilst on the subject of fuses, I see that the Belden Wire Manufacturing Company, of Illinois, U.S.A., have brought out a very useful novelty in this connection. This consists of a double fuse, one for the low tension circuit and the other for the H.T. circuit, these two fuses being enclosed in a small bakelite two-part container which is fitted over the battery cord, the latter being a multiple cable carrying the H.T. and L.T. leads. In the event of either of the fuses being blown it is only necessary to unscrew the two halves of the bakelite cover and draw these apart, when the two fuses attached to the cord are exposed and the spent fuse can readily be replaced. This device strikes me as being a very convenient one, arranged in a very convenient way. I have not actually seen the "Belden Fused Radio Battery Cord," so I cannot say anything with regard to the L.T. fuse which is employed in it.

Doubtful "Revivers."

Battery "revivers" come in for a good deal of criticism in a recent article in one of the American journals. These products do not seem to have been introduced very seriously on the English market, or, if they have been, they have never become popular, although I can recollect having had two or three different types of chemical reviver submitted to me for examination and report during the past couple of years.

Women workers in Radio Research—Miss G. Hazen testing out a new invention at the American Bureau of Standards.

The battery "reviver" usually consists of a carton of a powder soluble in the battery acid. Various claims are made for these powders. One claim which has been made is that as soon as the powder is put into the accumulators the reproduction of the loud speaker is immediately improved. Another claim is that when the battery is run down it can be charged up again in a fraction of the time required when using ordinary battery acid alone. In fact, here is a list of claims which were made in respect of one particular type of reviver: "Keeps your battery always fully charged; preserves and lengthens the life of your battery; removes and prevents sulphation; will recharge any make of battery; prevents corrosion and shedding of plates; prevents plates warping, cracking, and buckling; preserves plates and insulators; prevents muddy and soft positives; gives better reproduction, better ignition, better lighting; gives more power; will not overcharge; will not freeze at any temperature; batteries filled with this reviver need not be stored in winter; will more than double the life of the battery.

A certain business concern communicated with the proprietors of this battery reviver, asking to be enlightened as to how the material could perform apparent violations of some of the laws of electro-chemistry, but received an unconvincing answer.

The product referred to was analysed by a well-known institution and was found to consist essentially of commercial magnesium sulphate (Epsom salts) to which some potassium-aluminium sulphate had been added.

It is hardly necessary to add that on a careful test the claims made were proved to be quite unfounded. In fact, it was found that in some respects the addition of these so-called revivers was actually harmful.

Slip-shod Methods.

It is surprising what a great deal of unnecessary trouble is undertaken by the average experimenter in utilising spare pieces of wire for various connecting purposes. I have often watched amateurs—in a great hurry, owing to their zeal for the experiment in progress—picking up and using anything that comes to hand, hastily baring the ends of large pieces of wire, and in the process getting sharp needles of copper wire embedded in their fingers. It is very much simpler to set aside an hour or so on some suitable occasion to prepare a number of fixed connectors which will be found very handy for a variety of purposes. These may be of various lengths, from 6 in. (for connecting together battery cells) up to perhaps two or three feet. The ends should be carefully cleaned of insulation, and it is much preferable to fit to each end a proper terminal or tag.

Unnecessary Waste of Time.

Although it may seem, perhaps, to some, a little unnecessary or elaborate to prepare a set of fixed connectors in this way, it will be found much more economical and much more satisfactory in the long run to do the job properly. If an experiment is worth doing at all, it is worth doing well, and if you are delayed in the middle of it by having to fiddle with unsuitable pieces of wire, your patience and interest are severely tried and, futhermore, you are apt to introduce elements of uncertainty into the experiment which it is particularly desirable to avoid. If you could estimate the time spent on doing any part of the operations in a shoddy and extemporised fashion, you would find that it was, in fact, considerably longer than the time which you would spend in preparing the parts beforehand.

(*Continued on page* 1228.)

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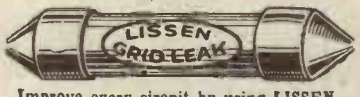

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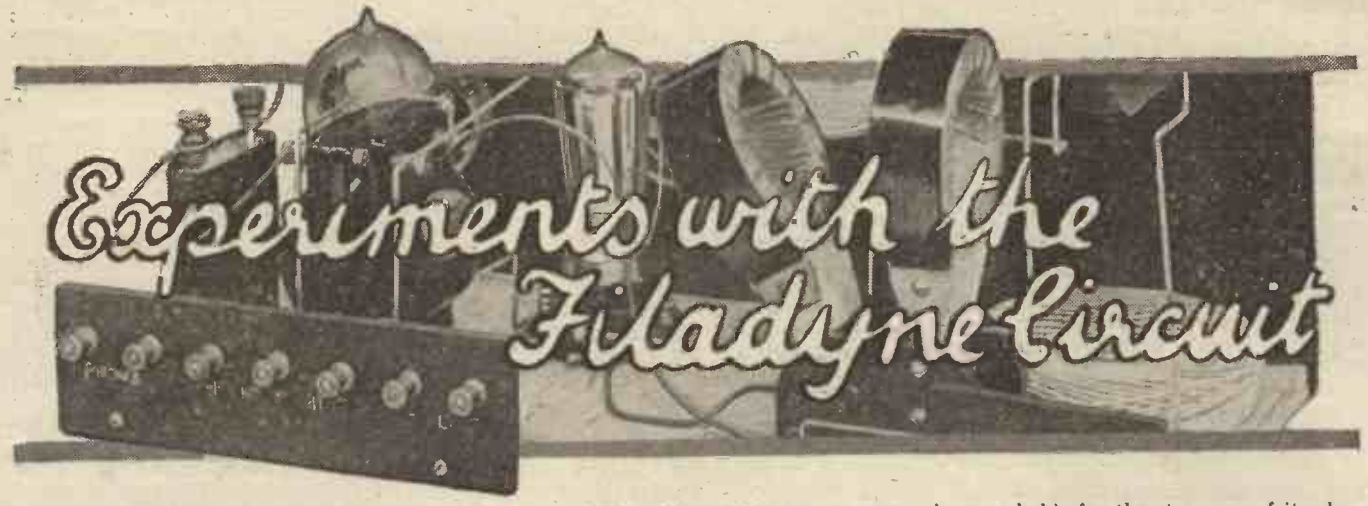


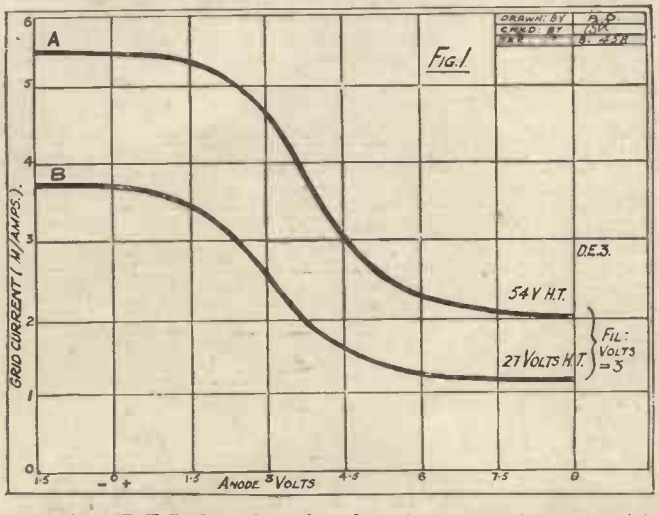
Experiments with the Filadyne Circuit

The first part of an exceedingly interesting and informative article on the Filadyne system of reception recently described in "P.W."

By J. ENGLISH.

WHEN details of the Filadyne circuit were first published I was struck by the distinct originality of the system. A brief trial fully confirmed the results claimed for the circuit, particularly as regards the purity and volume of local reception. In the course of experimenting with various Filadyne "hook-ups" much interesting information was accumulated, revealing in a better light certain obscure facts about this novel system.

An unusual feature of the Filadyne circuit, which must have intrigued those who have tried it out, is that up to the present but one or two types of valves, such as the B.5 and the D.E.R., have been found to give the most satisfactory results. Other valves give either very poor signals or none at all. It would therefore be interesting to know why the Filadyne receiver is so particular about its valve.



Positive Bias.

For instance, using a D.E.3 only very faint sounds could be heard from the powerful local station. A lucky guess led me to try the effect of anode bias, and, when this was adjusted to about 1·5 volts positive, signals came in remarkably strong and clear, quality being extraordinarily good. Several other valves at hand were treated in a similar way to small doses of positive anode bias, and in no case did I fail to get good strong signals, some valves, of course, working better than others. These results seemed to indicate that examination of the effect of anode bias would throw some light on the operation of the valve, whatever its type, and perhaps explain why the B.5 and the D.E.R. work best in the original circuit.

Now the only way to get reliable inside information about a valve is to study its internal workings, that is, its characteristic curves. While it is known that such curves do not portray sufficiently exactly the actual operation of the valve, they do enable us to observe certain facts and, by analogy, to draw conclusions which are very near to the real working conditions.

However, a valve panel was fitted up and a fixed value of H.T. applied to the grid, as in the actual circuit, with a milliammeter in series to indicate the variations in grid current. A bias battery was connected so that the anode could be given a continuously variable negative or positive potential. From the readings of grid current and anode bias voltage curves were plotted for various valves, curve A in Fig. 1 being representative of the D.E.3.

These curves are quite different in form from the normal anode current-grid bias characteristics, but if we turn the valve inside out we must not grumble if our curves are upside down! Other curves both for the D.E.3 and other types of valve showed that increasing either H.T. or filament current shifted the curve upwards with increasing steepness of slope. Curve A is remarkable for the steepness of its slope and the sharp upper and lower bends. These features, in conjunction with the greatly increased "anode" current for quite a moderate H.T. voltage, suggest the remarkable transition of an ordinary general purpose valve into a power valve giving large amplification and good rectification.

To return to the question of anode bias, theory under normal conditions states that we shall get the loudest signals when grid bias is adjusted so that the working point is on or near either of the bends. This is the well-known method of anode-bend rectification. Now, if this theory is to hold good for the Filadyne circuit, the loudest signals will be heard only when anode bias is adjusted at 1·5 or 6 volts positive, using a D.E.3 valve under the conditions of curve A.

Anode-bend Rectification.

Now this is actually the case, other values of anode bias giving either poor results or none at all. Likewise with other valves, the correct anode bias, as ascertained from their new curves, gives in each case the loudest signals. These facts prove almost conclusively that the usual theory of anode-bend rectification does hold good for the Filadyne. There are exceptions, however, of which I shall have more to say later.

So far, then, the examination of grid current-anode bias curves has proved that certain definite values of anode bias give the best results, while making it possible to use all available types of valve in the Filadyne circuit. Incidentally, this also

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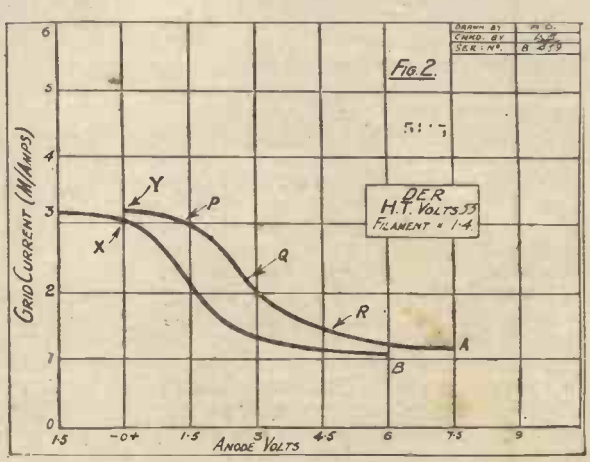


EXPERIMENTS WITH THE FILADYNE CIRCUIT

(Continued from previous page.)

shows that the conclusions drawn from the new curves were not far from the truth.

Now comes the question of polarity of battery connections, analysis of which brings to light several interesting facts. When taking readings of grid current for the curves given above, no apparent difference was made whether the negative H.T. lead reached eventually positive or negative L.T. However, the connection of the negative end of the bias battery has a pronounced effect upon the characteristic curve, and upon the operation of the circuit.

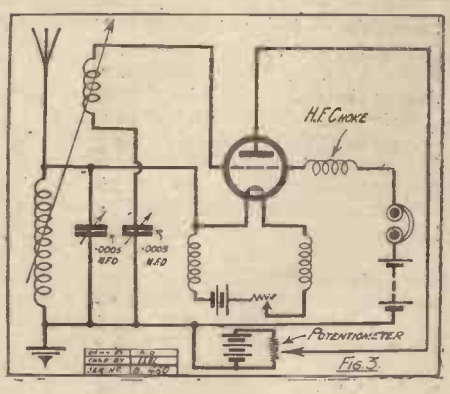


Fig. 3.

Take, for instance, curve A in Fig. 2. This was plotted for a D.E.R. valve with the negative bias lead to earth reaching the negative side of the filament via the tuning coil. On changing the aerial lead to the positive end of the filament, curve B was obtained for the same conditions of H.T. voltage, filament current, etc. Note that B is essentially the same in form as A, but shifted to the *left* by an amount corresponding to an alteration in anode bias of 1·4 volts. This, of course, is the voltage difference across the filament, so that when we connect the negative bias lead to positive filament we are actually starting off with a positive anode bias of 1·4 volts.

Effect of L.T. Connections.

If the connections of the original Filadyne are traced out it will be seen that the anode is really connected to L.T. positive. Now, in curve B, corresponding to no external anode bias and anode to L.T. positive, as in the actual circuit, the working point X is just on the upper bend so that we get strong rectification. On changing L.T. battery connections, the operating point, still without external bias, becomes Y (curve A) on the flat part of curves where no rectification can take place. This explains why reversing the filament connections in the Filadyne results in a loss of signals.

Now, if we apply a positive anode bias of 1·4 volts when the filament connections have been reversed, the working point is shifted back to P on curve A, corresponding to X, so that excellent rectification once more takes place.

We can now see why other valves do not work as well as the D.E.R., since either of the filament connections puts an incorrect bias on the anode for proper rectification. This bias must be such that the working point is adjusted on or near either the upper (X and P) or lower bends.

On the whole, valves having an impedance between 20,000 and 40,000 work best in the Filadyne circuit. Low impedance valves like the P.M.4 and S.P.18 Red Spot give very poor results, their new characteristic curves being rather flat without pronounced upper or lower bends.

We have now sufficient data to understand more fully how the valve works in the Filadyne circuit. It is just a happy coincidence that, with the Osram D.E.R. in the original circuit, the working point is at the right spot on the curve to give such good rectification. Hence the loudspeaker results. All that we have considered above shows us how to get on the same effective spot for any valve and under different conditions of battery connections, etc. Therefore, if you have not a D.E.R. and you want to get good results with the Filadyne, just insert a grid bias battery in the anode lead, carefully adjusting anode bias and filament current until you hear the loudest signals.

Potentiometer Advisable.

A much better method is to use a potentiometer, as in Fig. 3. As the slider is moved from negative to positive you can almost hear the working point slide down the characteristic curve! With the anode just positive, signals are heard increasing gradually as the bend (P) is reached, then decreasing as the working-point gets on to the middle of the curve (Q). Here the circuit oscillates very easily. As the anode becomes more positive, signals get better again and eventually come in loud and strong when the working-point reaches the lower bend (R). More positive anode bias results in no signals, because the working-point is shifted on to the flat part at the bottom of the curve where the valve cannot rectify at all.

At this juncture it may occur to you, that, since the anode has such a good control of the grid current, louder signals would be heard if the tuning coil leads were reversed so that the H.F. signals voltages were applied directly to the anode. Actually this reversal of connections gives strong signals from the local station provided more reaction is used, but the circuit is hardly as efficient or as good for DX work as the correct circuit. Moreover, it does not appear to function in the same way.

Now it is a peculiarity of the Filadyne circuit that, whatever valve is used, with or without anode bias, an increase in filament current beyond a certain critical value results in no signals at all. With the usual one-valve circuit one would expect an increase in signal strength, but not so the Filadyne.

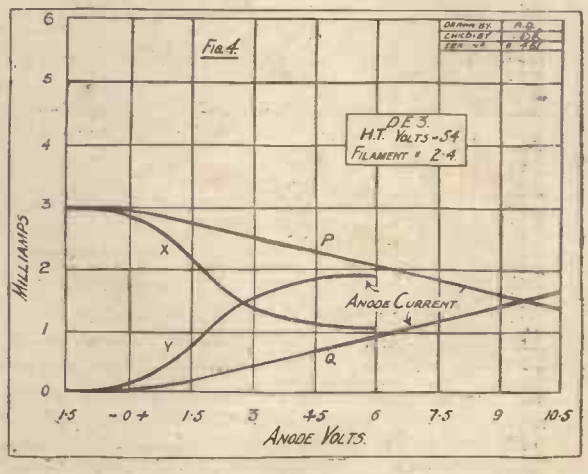
Curves for a D.E.R. valve were plotted for a fixed H.T. voltage and increasing values of filament voltage. Under these conditions signals ceased when the filament voltage reached about 1·6. But the curves both for this and higher voltages are very much the same as the lower ones, complete with nice sharp bends. The curves therefore offer no clue to this mysterious loss of signals, so we can only guess at what happens.

I have a shrewd suspicion, partly confirmed by facts mentioned later, that in the Filadyne circuit the valve functions somewhat like a four-electrode valve. It seems that placing chokes in the filament leads is equivalent to inserting another grid. This phantom grid handles the incoming H.F. energy. The application of positive anode bias makes the valve most sensitive for rectification, while the phantom grid controls the electron stream at its source.

The "Phantom" Grid.

But this imaginary grid, in my opinion, has only a limited control of this electron stream, which overpowers it when the filament current is increased beyond the critical value. Moreover, no juggling of anode bias will bring back the original volume of signals. It may be that beyond this critical value of filament current a space charge of electrons begins to form, thus paralysing the phantom grid. Increasing the H.T. voltage brings back the original strength of signals probably because the greater attraction of the grid once more disperses the space charge.

Now although the hypothesis of an imaginary second grid helps to explain the working of the Filadyne circuit, there is another interesting fact that illustrates the remarkable similarity to an actual four-electrode valve circuit. This is the relation of grid current to anode current. In Fig. 4 a curve is plotted for each current curve, X being similar to A in Fig. 2. Other valves give similar curves. Notice that as the grid current drops the anode current Y rises, X being almost the same as Y turned upside down.



Actually, nearly as loud signals are heard if a pair of 'phones are inserted in the anode circuit instead of the grid circuit! The slight loss in volume is satisfactorily explained by reference to Fig. 4.

The curves P and Q represent grid and anode currents when a pair of 'phones (4,000 ohms) were inserted in the anode lead. This shows the remarkable effect of resistance in the anode circuit flattening the two curves, and thus lowering amplification. Therefore the smaller the resistance of the anode circuit, the sharper the upper and lower bends with corresponding better rectification and louder signals. Adding

(Continued on page 1224.)

CURRENT TOPICS.

BY THE EDITOR.

Sir John Reith—"Science and Miracles"—The Last Forty Years, and the Next—Television—The Heroic Age of Science.

THE honour of Knighthood conferred upon the Director-General of the British Broadcasting Corporation is one which every amateur and listener will learn about with pleasure. Sir J. C. W. Reith is a Scot who hails from Aberdeen, and he is only thirty-seven years of age. He worked as an apprentice at one time at the North British Locomotive Works, and in 1914, when he was twenty-four, he enlisted in the Scottish Rifles, and was wounded at the battle of Loos. In 1915 he went to America to supervise the production of munitions, and had his headquarters at Philadelphia with a staff of six hundred.

He is a Master of Science and so, as well as a great organising ability, he also possesses a technical knowledge of wireless—a fact which is not generally known.

Everybody will wish Sir John Reith continued success in his new position as Director-General of the British Broadcasting Corporation, where his extraordinary organising abilities, together with his forceful personality, will, we feel sure, enhance the great reputation which he has already built for himself, and incidentally, for the B.B.C.

* * *

Mr. J. L. Garvin, the editor of the "Observer," writing in a recent issue of that journal an article entitled "Science and Miracles," takes a very optimistic view of Britain in this scientific age. Mr. Garvin, although somewhat inclined to look upon the coming of television with excessive optimism, writes in a very interesting way about the progress of world telephony. He suggests that before another Imperial Conference assembles, British Prime Ministers will be able to talk direct to any Dominion Premier, or to ring up the Viceroy of India, or speak to them all in turn on the same day.

"This," he says, "is not romancing, but a thing that is surely and rapidly approaching the sphere of practice. With all the cabinets and administrations in immediate touch, the Governments of the new Empire may be carried on as a whole by consent and co-ordination as though an Imperial Conference were in perpetual session. In a decade or so after that statesmen talking to each other across continents and oceans may see each other while they are speaking. When a physical meeting is desired aviation will bring it about in a few days."

Schiller is credited with the somewhat dogmatic statement that: "Alas, the age of miracles is past!" Thomas Carlyle, on the other hand, although possessing all the canny caution of a Scot, once said: "The age of miracles is for ever here." Carlyle's dictum is intensely true these days, for during the last thirty odd years the age of miracles would seem to have been revived, and one may be excused the extravagance of exclaiming: "Nothing is impossible."

Of all the younger sciences, perhaps wireless has made the most rapid progress. Less than forty years ago, science was in something of a stagnant calm, and it was said that civilisation was slowing down, and that the heroic age of discovery was past. It seemed to be the general impression then that no further great advances would startle the world; at least, not for many years to come. That was about 1890; but almost immediately there dawned a new era of scientific progress. The discovery in 1898 of the electron by Sir J. J. Thomson, of X-rays by Sir William Crookes and his experiments with the Crookes tube; the epoch-making deductions of Clerk-Maxwell, followed up by the practical proofs of electro-magnetic waves by Hertz and their application to and working out in radio practice by Sir Oliver Lodge, also their practical application to business and commerce by Senatore Marconi; the development of the motor car, the aeroplane, electrical power—all these things have dawned and developed during the last forty years. What will dawn and develop during the next forty years would stretch the imagination of Jules Verne and H. G. Wells combined; but just as history repeats itself, so does science repeat itself, not in a redundant and futile way, but branching out into new spheres of activity and discovery and enriching civilisation by its labours and researches.

Every reader of POPULAR WIRELESS who is a keen experimenter and who aims at something above building himself new receivers to pick up new and distant stations must realise that wireless still offers illimitable possibilities for those who will devote themselves faithfully and untiringly to the extraction of further secrets from Dame Nature's store.

The case of Mr. J. L. Baird is an excellent one. This young Scotch inventor has devoted himself with untiring energy to the problem of television, and already his researches have borne fruit in the development of this latest wonder in a way which has inclined even the most sceptical of scientists to the opinion that television may now be regarded, definitely, as a practical possibility.

But let us be under no misapprehension about television. There is still a tremendous amount to be done before it can be applied to everyday use as broadcasting is now applied to everyday use. The day when we shall have apparatus which will enable us to see the broadcasting artist as clearly as we can see an artist on a cinema film may be a very long way off, although, on the other hand, developments may follow each other so rapidly that the day will come, perhaps in the next few years. No one can tell. One can only say that at the moment the prospect of further developments of a revolutionary nature is good.

Two of the specially trained telephone girls at the London Trunk Exchange at which English subscribers can be plugged straight through to New York.

* * *

It has always been the dream of many experimenters in wireless work to design a "cold" valve, that is to say, a valve which will require neither L.T. nor H.T. battery.

Many eminent men are working on this problem to-day, and students of physics and chemistry realise that, theoretically at least, such a valve is possible.

It is, indeed, a revival of the heroic age of science which we are now experiencing, and, as we have already pointed out in our columns, it is a source of gratification to know that many of the greatest scientific pioneers of the age are still with us. It cannot but be a source of inspiration to the young inventor and to the young research worker to know that men like Edison, Fleming, Lodge, Thomson and others, are still working and still helping in that great work of furthering and benefiting the progress of scientific research and, incidentally, modern civilisation.

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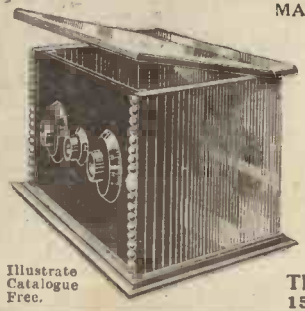

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IS "PUSH-PULL" WORTH WHILE?

A great deal of nonsense has been written about this method of L.F. amplification, especially in certain journals which fill some of their columns with wireless matters, supposedly for the interest of their motoring readers, but in this special article the subject is dealt with in a sane and really unbiased manner.

By G. P. KENDALL, B.Sc.

(*Assistant Technical Editor.*)

IT is rather strange that, although perfect quality of reproduction does not appear to have been sought after with any special enthusiasm by the average American experimenter until fairly recently, yet there is a type of L.F. circuit expressly designed to achieve that end which has been far more extensively exploited across the Atlantic than in this country.

When the "Push-Pull" L.F. amplifying circuit first appeared, it at once achieved quite a vogue in the States, and there have been signs of late that it has gained a certain degree of popularity over here. There appears to be some uncertainty as to the exact purpose of this type of circuit and its real capabilities, and there is a risk of disappointment if it is blindly used as a specific for all the distortion troubles which most of us now spend so much time trying to eliminate from our note-magnifiers.

How It Is Done.

At this point it will be well to refer to the skeleton diagram of a push-pull amplifying circuit reproduced on this page, and gain an idea of the working of the arrangement. It will be seen that three valves are shown here, and of these V_1 is the detector valve of the set, while V_2 and V_3 are two L.F. valves wired up in the special parallel scheme which is the essential feature of the circuit.

This latter is the whole point of the push-pull arrangement, since it does *not* merely consist in the placing of two valves in parallel, but in so dividing the signals applied to them that one half goes to each, is amplified separately, and then, after amplification, is recombined with the other magnified half in a special output circuit before being passed to the loud speaker.

Just how it is done can be followed from the circuit diagram. In the anode circuit of the detector valve is the primary of a special L.F. transformer, T_1, T_2, and it will be seen that the secondary of this transformer is provided with a centre tap which is connected to the filament circuit *via* a grid-bias battery. The ends of the secondary go to the grids of the two L.F. valves, and it will be understood that in this way just half the signal is applied to each.

Re-Combining the Impulses.

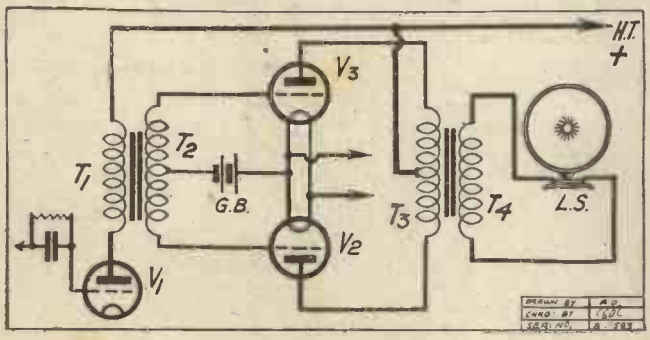
Furthermore, the halves so produced are of opposite sign—i.e. at any given instant the grid of V_2 may be made positive and the grid of V_3 negative, and a moment later conditions will be reversed. Thus, when the anode current of V_2 is increasing, that of V_3 is decreasing, and so on; hence the name, "push-pull."

Since the two amplified halves of the signal are of opposite sign, it is evident that they must be combined in a special manner before being passed to the loud speaker.

The Main Claim.

This is done by means of another transformer with a centre-tapped winding, this time the primary. This is the output transformer, T_3 T_4, and the diagram shows how the signals are fed in opposite directions through the two halves of the primary. Since they are of opposite sign at any given instant, the fact that they pass in opposite directions through the primary means that they will induce voltages in the *same* direction in the secondary, and thus will be properly added together before being applied to the terminals of the loud speaker.

Possessing now a fairly clear idea of how the push-pull system works, we are in a position to decide whether it possesses so many advantages as popular opinion is inclined to attribute to it, and whether



those advantages outweigh its obvious drawbacks. The main claim made for the system is purity of reproduction, and its possibilities in this direction are principally due to the fact that only half the voltage of the signals is applied to each valve. Since they thus are called upon to deal with relatively small voltages, the risk of distortion being produced by overloading is practically eliminated, and this risk was a very real one at the time of the introduction of the push-pull circuit.

Now Out-of-date.

Overloading, as applied to valves, is perhaps a term requiring explanation. What we mean by saying that an L.F. valve is overloaded is simply that the voltage swings produced by the signals across its grid and filament are too large to be accommodated on the available straight portion of the characteristic curve of that particular valve. When this happens, of course, distortion is bound to take place, and there is no doubt it *did* occur quite frequently at the time of the introduction of the push-pull circuit, because the correct characteristics for a last-stage valve were not clearly understood by the average experimenter, and all sorts of really unsuitable "tubes" were used, especially since valves of the right type were few in number, were expensive, and often required very high anode voltages.

The remedy for such overloading is now known to most people to lie in the use of a power or super-power valve having a very long straight portion upon its characteristic curve, and the number of such valves on the market is now very large. They are no longer unduly costly, and all the later ones work well with anode voltages of the order of 120 volts. Provided that proper grid bias is used, there is very little risk of overloading such valves when reproducing signals of adequate volume for any normal domestic purpose.

Not Worth While.

Since there is no longer the same urgent need to reduce the load on the last valve by dividing it between two, it would seem that the only real justification for the push-pull circuit is gone. It is sometimes argued, however, that it is still worth using by experimenters who have a large stock of the older L.F. valves and *small* power valves on hand which they wish to use up. This seems to me to be false reasoning, however, because to use the circuit two special transformers must be bought, and it is surely cheaper to buy *one* special valve!

Just one sound argument in favour of the push-pull circuit remains, and this should receive due consideration before reaching our final conclusion. The types of valve capable of handling really strong signals without risk of overloading are necessarily valves with a rather low amplification factor, and thus one does not obtain quite so much magnification from a "super-power" stage as from a push-pull stage employing two valves, each separately capable of handling only moderate signals, but of higher amplification factor. Against this, however, must be set the corresponding drawback that for *one* stage of push-pull *two* valves are needed, with their attendant adjuncts and filament current. This does not seem to me a sufficiently weighty advantage to justify the unquestionable complication and expense of the circuit.

NEXT WEEK:

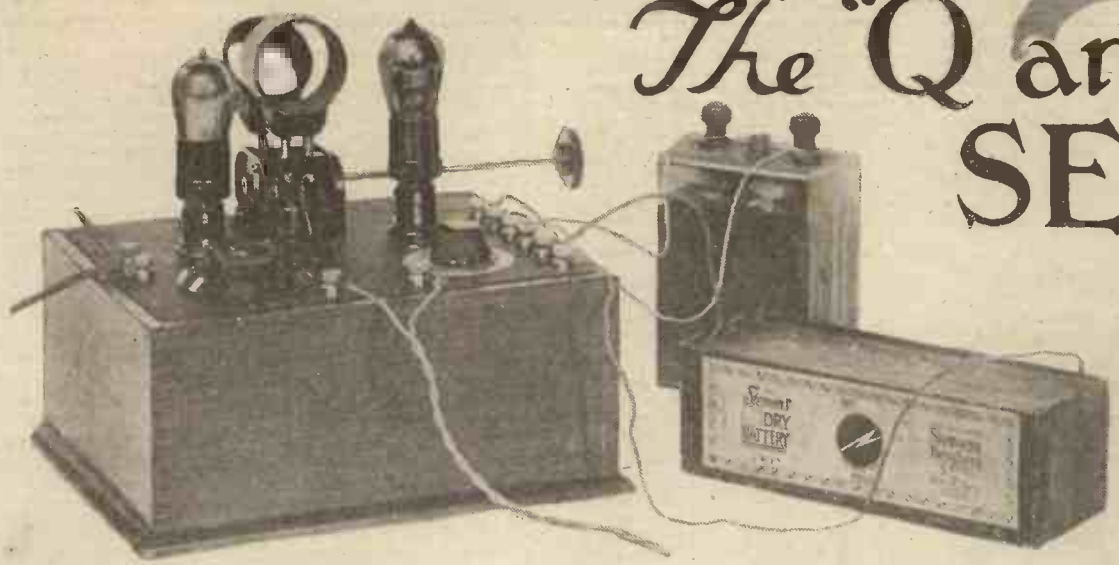
"Modernising the P.W. Continental"

By Percy W. Harris, M.I.R.E.

Order Your Copy of P.W. NOW.

Captain Eckersley Runs Another "Howler" to Earth.

The "Q and A" SET



Designed and described by a member of the "P.W." Queries Staff.

A straightforward chat about set building, discussing the various needs of the average listener and fully describing the construction of a general purpose 2-valve receiver.

Q. I am going to have a shot at building a wireless set. How should I set about it?

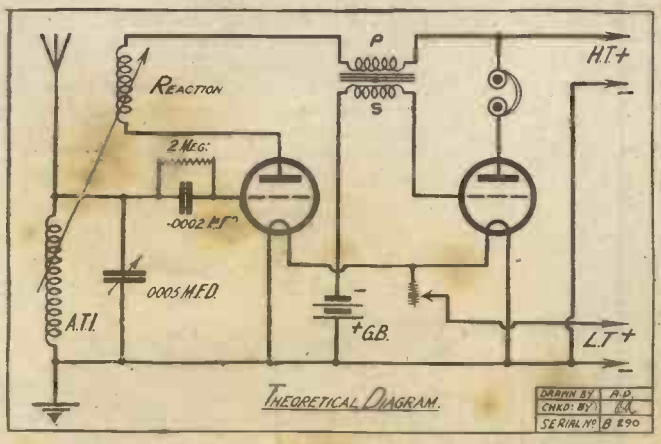
A. Have you made up your mind whether you will listen on 'phones or loud speaker?

Q. Well, I am about eight miles from 2 L O, and I would like to work a loud speaker from there, and from Daventry. If possible, I should like to tune in other stations sometimes, but it's really the local station and 5 X X that I shall depend on. I don't want the set to be too expensive, though; say, up to three pounds, without the valves, coils, 'phones, and batteries.

A. It need not cost more than that, and you should get excellent results on two valves from 2 L O, and quite fair volume from 5 X X.

Q. What parts shall I need?

A. Well, I have here a set of the kind you require, and we will look over it together. Suppose you make a note of the prices as I take the various components. As you will see, you'll want a box not less than 4½ in. deep, big enough to take an ebonite panel measuring 10 by 8 in.



Q. Would it be possible to make the box at home, or would it be just as cheap to purchase one ready-made?

A. If you are skilled at that sort of thing, you can certainly make it for yourself, but otherwise it is hardly worth while.

Q. By the way, I presume the components you are now mentioning are those that have to be bought, and cannot be substituted by anything else or cut down in number?

A. Yes, all these are necessary, though, of course, you need not buy exactly the same makes provided you get components which answer the same purpose as those I have here. Let's take those on the panel first. There is a one two-way coil holder (Lotus), two valve holders (Lissen), one variable condenser (·0005 mfd.), one filament resistance (30 ohms), and ten terminals.

Q. What about the foreign stations? Should I stand any chance of getting them occasionally?

A. Oh, yes, when you have attained a little skill in handling it, the set I have in mind would probably bring in quite a nice sprinkling of foreigners as well. But that is only when conditions are good, and if you put up a decent aerial.

Q. Out-of-doors aerial, I suppose?

A. Yes, out of doors. The higher it is, the better; and I am assuming it would not be shut in too badly by surrounding houses, trees, etc.

The Necessary Components.

Q. Well, I can put up a 30-ft. pole, and my garden backs on to another garden, so I suppose it's an average sort of situation?

A. That should be all right, I think.

Q. What sort of set would be suitable?

A. A "straight" two-valver, in which the first valve is a detector and the second valve the L.F. amplifier. As you haven't built a set before, I should recommend an easy-to-make flat-panel set.

Suitable Transformer.

Q. I notice the coil holder has an exceptionally long handle. Is this a necessity?

A. No; but the long handle is a great convenience, as you will find that if your hand is approached too close to the set it affects the tuning.

Q. What extra components are on the reverse of the panel?

A. The chief one is the Lissen L.F. transformer.

Q. A friend of mine has offered me a transformer of another make. Could I use this instead?

A. Oh, yes, providing it is of suitable ratio, and is designed for coupling a *first stage* of L.F.

Q. Good! What else shall I need?

A. Besides the transformer, you will require a grid leak and condenser, some stiff wire of about No. 16 gauge, and about a couple of feet of flexible wire for the coil connections.

Q. I suppose I shall need a few odd screws for fixing the components to the panel?

A. Yes; the screws for the coil holder are supplied with it, and, in addition, you will require about half-a-dozen counter-sinking bolts and nuts (4 B.A. gauge) of half-inch and three-quarter sizes.

Q. As I cannot carry accurately in my mind the way you have arranged the parts in your set, can you give me a sketch showing where the various components should be placed?

A. Here is one that shows all the essential measurements, which you can vary slightly if the components you finally decide upon are not exactly the same size as those I have used. *(See drilling layout.)*

Inexpensive Receiver.

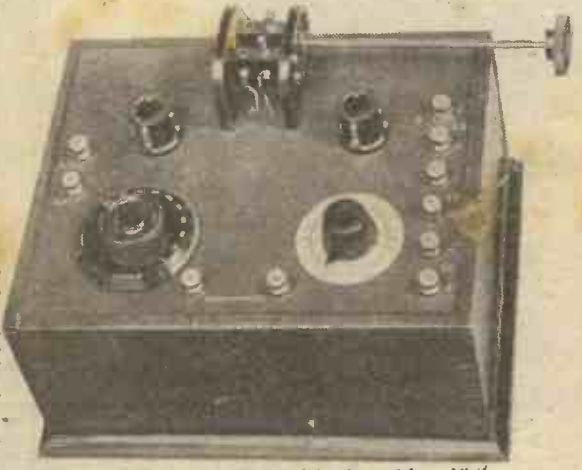
Q. What are the approximate costs of the parts? I don't believe you mentioned them.

A. I bought the panel and cabinet together at an inclusive cost of 12s. 6d.; the L.F. transformer costs only 8s. 6d.; the coil holder is 8s.; and the variable condenser is retailed at 10s. 6d. The other components are quite inexpensive, the rheostat costing 5s., the grid leak and condenser, complete, 2s.; the terminals, 1s. 3d.; the valve holders, 2s. Odd screws and wire will cost you about 1s. 6d.

Q. Having got all the parts, is there any special procedure I should adopt for building the set? I mean, can the components be mounted in any order, or should some be put on before the others?

A. First of all, you should mark the panel for drilling. The sketch I have given you indicates the positions of the various components. The exact location of the coil holder holes can be found from

(Continued on next page.)

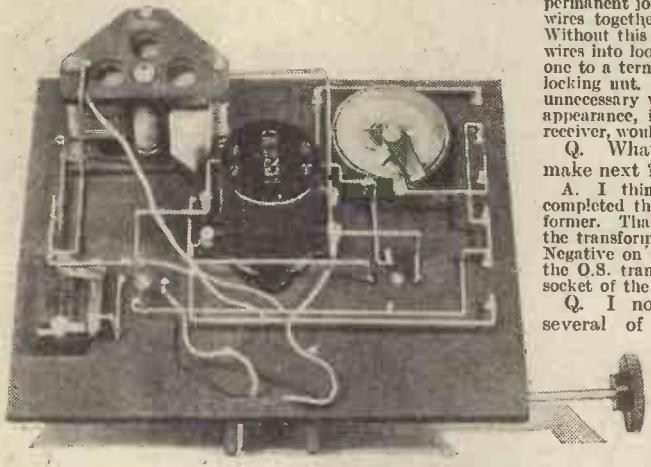


The two-valve receiver discussed in the article. All the components are mounted either above or below the panel.

THE "Q AND A" SET.

(Continued from previous page.)

the template which is supplied with that component. The valve-leg spacing must be very accurate, so I should advise you to use a template. The particular valve holders which I have used have a template supplied with them, but if ordinary valve holders or valve sockets are employed the spacing can be accurately found by one of the little metal templates obtainable from your dealer.



Together with the other under-panel photographs, this illustration should be of assistance during the wiring-up process.

Q. I presume that all the components should be mounted before I commence wiring up? Or should I wire up some of them (for instance, those wires nearest the panel) before putting on the larger components, such as the transformer?

A. The best method is to mount the terminals first, and file the ends ready for soldering. Then mount the rest of the components, and you will be ready to commence the wiring.

Q. Where shall I start on the wiring?

A. The usual plan is to wire the filament circuit first, and I think I had better give you a sketch of the wiring (*see wiring diagram*). You will notice that the wire joining the grid bias plus and L.T. negative terminals to the filaments of the two valves is low down close to the panel. Having put on this wire, join the remaining filament connections of the valve holders together and connect them to one side of the rheostat. The remaining rheostat terminal is joined to the L.T. plus terminal, and then the filament wiring is complete.

Q. I notice that other wires join those you have mentioned. Should these be taken next?

A. Yes; though with a little ingenuity I could have continued the wire that joins L.T. negative and G.B. plus to the H.T. negative terminal as well. The exact order of wiring up and the exact position of the various wires is not very particular providing you follow the sketch in its essentials, and leave adequate space between those wires that are not connected together.

Concerning the Wiring.

Q. I notice that all the wires on your set have right-angle bends in them. Is this an essential feature, or would it be better to take them direct to the various points they have to reach?

A. The idea of bending them at right-angles is to keep them as well-spaced from each other as possible and, at the same time, give the set a neat appearance. As regards the next wires that you put on, I should take the following in the order I mention them: One joining the aerial terminal to one side of the grid leak and condenser, and to the fixed plates of the variable condenser; one from the earth terminal to the moving plates and to the filament wire coming from the L.T. minus and G.B. plus; then the lead connecting the remaining side of the condenser and leak to the grid socket of the right-hand valve holder (looking at the back of panel all the time, of course, with the variable condenser and rheostat towards you).

Q. Should the flexible leads, which come through the panel from the coil holder and are connected to the leads from aerial and earth terminals, be fixed in position now?

A. No; I think it would be best to leave those until a later stage, though you might fix the flexible lead from the plate of the first valve to the socket of the moving section of the coil holder in position. The other terminal on that portion of the coil holder can be connected by a flexible lead to the terminal marked O.P on the transformer. The terminal marked I.P. should then be connected by a piece of stiff wire to the left-hand telephone terminal and the terminal marked H.T. plus.

Q. I notice, in your set, that all the connections are soldered. Is that an essential feature, or could I do away with the necessity of soldering?

A. It is much better to solder the connections if you possibly can, as this makes for a much more permanent job and enables you to connect wires together at any points you wish. Without this you would have to bend the wires into loops at the ends and take each one to a terminal, fixing it by means of a locking nut. In this way a great deal of unnecessary wire would be used, and the appearance, if not the efficiency of the receiver, would be impaired.

Q. What connections should I make next?

A. I think it would be best if you completed those going to the L.F. transformer. That is, join the I.S. terminal on the transformer to that marked Grid Bias Negative on the left of the panel, and join the O.S. transformer terminal to the grid socket of the second valve holder.

Q. I notice that at this stage several of the wires seem to be running close together. Should they be kept any definite distance apart, or is that immaterial?

A. There is no definite distance at which they should be kept apart, but they should not be allowed to go too close, or slight bending of the wires might cause them to touch, which would certainly prevent the set from working properly, and might possibly damage your valves if the voltage from the high-tension battery, by any chance, was placed across the filament circuit. There are very few wires now to be put on, viz., the one from the right-hand 'phone terminal to the plate socket of the second valve holder, and those two flexible leads from the fixed portion of the coil holder through the panel that you mentioned before, one going from the plug of the coil holder to the lead attached to the earth terminal and the other one from the socket of the coil holder to the wire joining the fixed vanes of the variable condenser to the aerial terminal.

The Accessories.

Q. Now that the set is wired up, I conclude it is ready for testing?

A. Before connecting up, you had better check over the connections.

Q. What shall I need in the way of accessories before the set will be ready to use?

A. Apart from the aerial and earth leads you will require the L.T. battery, H.T. battery, and grid bias battery. Also a pair of 'phones or loud speaker, the two valves, and a set of coils.

Q. Is there any special size or voltage of accumulator that will be required, or is this immaterial?

A. Your requirements in this direction are entirely governed by the valves chosen. Whatever kind of valves you decide upon, you will find that the makers recommend a suitable L.T. and H.T. battery and grid bias values, and if you keep within the limits recommended by the valve maker you can be sure of obtaining the best results from them.

Q. I understand that the valves can be divided roughly into three classes according to the voltage they require. Is any one class more suitable for my use than another?

A. No, they are equally suitable, except for the fact that if you choose two-volt valves the L.T. battery is smaller than with the other types and, consequently, the problem of recharging it is simplified.

Choosing the Valves.

Q. I presume the efficiency of the various classes is about the same, but as there are so many valves from which to choose, I should be glad if you would give me some idea of what I shall require, as it is a difficult matter for a novice to make a choice from all the valves at his disposal.

A. I should recommend you to use valves with a low current consumption, so that your accumulator will need recharging at infrequent intervals only. We shall have to mention figures here for a moment, I am afraid, but as they are very easily understood I think you will follow exactly what I mean.

The current consumed by any valve is measured in amps., and the lowest current consumption you can obtain will be with valves taking ·06 amp. There is another class taking ·1 amp. others taking ·25 amp., and so on. Either of these would give excellent service, and really there is very little to choose between them.

Q. I suppose if I take the middle course I shall not be going far wrong, but I am told that the number of times I have to have my accumulator recharged will depend on the size of the accumulator as well as on the valves I use. Is that correct?

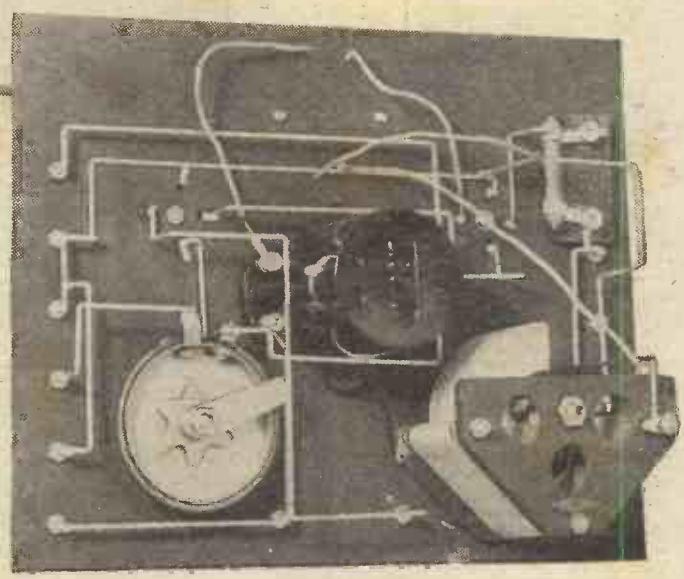
A. Yes. If you choose the ·1 valves the total current consumption of the set will be ·2 amp. This total consumption will have to be divided into the actual ampere-hour capacity of your accumulator, to find out how many hours it will last before it needs recharging.

Suppose, for instance, you purchase a twenty actual ampere-hour accumulator. Divide this twenty by the ·2 which is the total current consumption of the set, and the answer is 100—that is, you can use your set for about 100 hours before the accumulator will need recharging.

Q. If I exceed this number of hours, will any damage be done to the set or will it merely cease to work? In any case, if I should lose count of the number of hours, is there any indication which would tell me when the battery wants recharging?

A. It is particularly important that the battery should not run right down for the first two or three

(*Continued on page* 1205.)



This illustration gives a clear idea of the disposition of the components and wiring. The grid condenser and leak on the right are supported by the wiring alone.

THE NEED FOR A BETTER BATTERY IS FILLED

There was a need for a better battery for loud speaker work—long programmes imposing a tremendous strain on batteries proved that the ordinary H.T. Battery could not stand it as well as was desirable. Deterioration in reproduction during every long programme took place, but so gradually did it occur that the ear almost got accustomed to the change, but that did not mean that the reproduction was not as good as it could be.

The unique new process and chemical combination employed in the making of the LISSEN new process battery has introduced a new power smoothness into the loud speaker reproduction. The tones are more natural than has ever been known before. Volume is clearer and bigger, and the LISSEN battery will keep this up hour after hour, never varying, never altering throughout the longest evening.

All who are using it are finding a new delight in their loud speakers because of a new and better battery utterance.

A LISSEN battery is always fresh, always brimful of new energy when you get it.

It is not dear, for the LISSEN new direct-to-dealer policy of distribution cuts out all the wholesale profits for your benefit. Your dealer sells this LISSEN battery. Ask him for LISSEN new process and take no other. Rated at 60 volts but goes considerably over. If any difficulty send to factory—no postage charged, but please mention dealer's name and address.

10/6

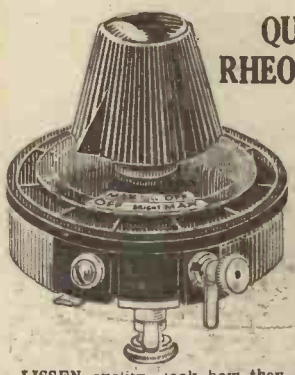
(Price would have been 13/- but for new policy.)

Hear your LISSENOLA working off this LISSEN battery to know what a good loud speaker and a good battery can do together.

LISSEN LTD., 8-16, FRIARS LANE, RICHMOND, SURREY.

Managing Director: Thomas N. Cole.

QUALITY RHEOSTATS



Previously 4/- NOW **2/6**

LISSEN quality—look how they are made—the wires cannot move and short circuit—the contact brush rides firmly yet smoothly—the heat-resisting former cannot soften—there are accessible terminals—and the combined knob and pointer will fit flush with the neat photo-engraved dial when mounted. Lastly, note the irresistible appeal of the price, made possible by our big production programme backed by our new direct-to-dealer distribution policy which cuts out all wholesale profits.

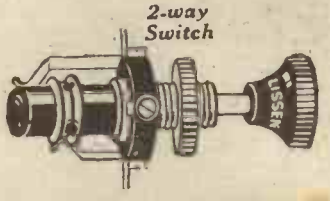
	Previously	NOW
LISSEN 7 ohms rheostat, patented	4/-	2/6
„ 35 „ „ „	4/-	2/6
„ Dual „ „	6/-	4/6
„ Potentiometer, 400 ohms	4/6	2/6

Every One LISSEN One-Hole Fixing, of Course.

Baseboard mounting type same prices as above.

QUICK TO FIX AND HANDY TO USE

2-way Switch



There is a LISSEN switch for everything you want a switch to do. Ask your dealer for the appropriate LISSEN switch, and you will get a real radio switch. LISSEN one-hole fixing explains itself.

	Previously	NOW
LISSEN 2-way	2/9	1/6
Series-parallel	3/9	2/6
Double Pole, Double Throw	4/-	2/6
Key Switch	2/6	1/6

A VALVE HOLDER FOR CLEARER, BETTER SIGNALS

Because of its low loss and low capacity qualities, the LISSEN Valve Holder plays its part in getting clearer, louder signals. Sent out ready for baseboard mounting, as shown, it can also be used for panel mounting by bending the springs straight.

LISSEN VALVE HOLDER
(Patented)
Previously 1/8 **NOW 1/- Each**

L.199

THE "Q AND A" SET.

(*Continued from page 1202.*)

charges, so if I were you I should take it to be recharged after it has had about a fortnight's use, for the first four or five times. After this, you will find that it you leave the battery too long before taking it to the charging station it will give out in use and your results will more or less suddenly fade away. This is when the battery is fully discharged, and in such a condition it should be taken to the charging station as soon as possible for recharging.

You can obtain a good idea of the condition of the battery from its voltage, which is measured by an instrument called the voltmeter. When the battery has been recharged, you will find its voltage is just over 2, and by the time it has run completely down this will only measure about 1·8 volts. The decline in voltage is fairly steady, so that this forms a good indication of the condition of the battery.

Q. The H.T. battery, I understand, is of a different type and cannot be recharged. How long should this last and how big should it be?

A. For two valves, one of the ordinary size 66 volt H.T. accumulators will probably meet the requirements of the valve maker, and this should last you several months before needing a renewal.

Q. What coils shall I need?

A. For London you will need a 40 and 50 coil, and for Daventry a 150 and 200. Probably the smaller coil will go best in the fixed holder, and the larger one in the moving, though you might try experimenting with these by changing them over to see if better results are obtained the other way.

Hints on Operation.

Q. I assume that in connecting up I put the aerial lead on the aerial terminal, and earth lead on the earth terminal; that leaves me with six more terminals to connect up. What are the correct connections for these?

A. The drilling layout is marked to show how the respective batteries should be connected, and you must be very careful with the leads, or you may do some damage either to the batteries themselves, or to the valves. If I were you I should connect the leads to the set itself *first*, and then, making sure that they are the right leads, connect each pair to its battery as marked.

Q. I understand that reaction is employed in this set and that when mishandled this is liable to upset neighbouring receivers. How can I guard against this?

A. By never bringing the reaction coil too near to the aerial coil. The important thing to remember is that too much reaction spoils your own signals as well as other people's, whilst too little reaction has no detrimental effect whatever except that signals are not quite as strong as they might be. This will hardly affect the reception of London and Daventry, but when you are conversant with the receiver and try for foreign stations you will have to get skilful enough in the use of reaction to use it as much as possible without carrying it to excess.

Q. When varying the distance between the coils, how shall I know when I am causing interference by using too much reaction?

A. Too much reaction causes a set to oscillate, and a good method of finding out how this happens is the following. By the way, this method should be tried outside broadcasting hours, preferably early in the morning, when no one is trying to listen to distant stations. You proceed as follows: Put on the 'phones or listen caretully with the loud speaker, and then gradually bring the reaction coil towards the aerial coil. Whilst you are doing this, wet your finger, and tap the aerial terminal with it. With each tap you will hear a click, and these clicks will probably get louder and louder when the coil is at an angle of about 45 degrees from the aerial coil. At first the increase is not very noticeable, but at a certain point it suddenly gets very much louder, and this is often accompanied by a slight hissing or breathing sound, or else by a whistle.

The very loud clicks or the whistle are due to oscillation, so it is before this point that the correct reaction position is found. With a little practice you will soon discover a position where reaction is making the clicks louder than before, but the set is just *not* oscillating. This is the position for maximum reaction, when the set is in its most sensitive condition.

Picking Up Distant Stations.

Q. You mentioned just now that I might have to change the coil over. Will the size of coil have an effect on the oscillating powers of the set?

A. Yes, the larger the coil the greater the reaction effect (within limits). By the way, I forgot to mention that sometimes it happens that when trying to increase reaction it is found that apparently the opposite effect is being obtained. Signals do not get stronger as the coils get closer together, and they may indeed get weaker.

Q. What should I do then?

A. All that is necessary is to reverse the two leads to the reaction coil. It is partly for this reason that flexible leads are being used, as they enable the relative positions of the coil wiring to be altered easily.

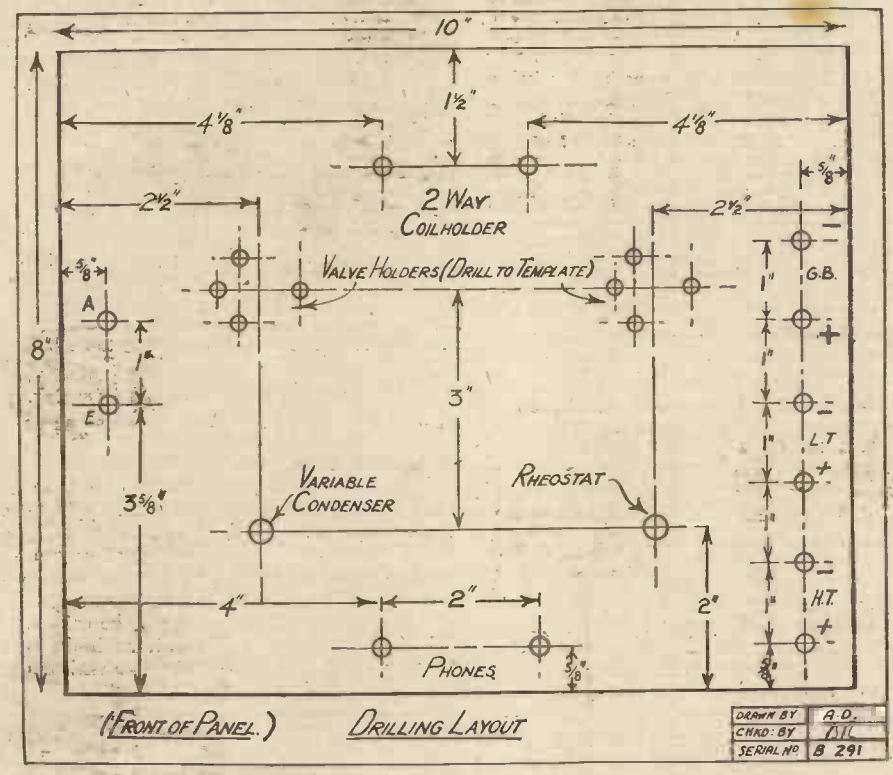
Q. I have been told that best results are obtained from what are known as power valves. Are these expensive to run, and should I be able to use them?

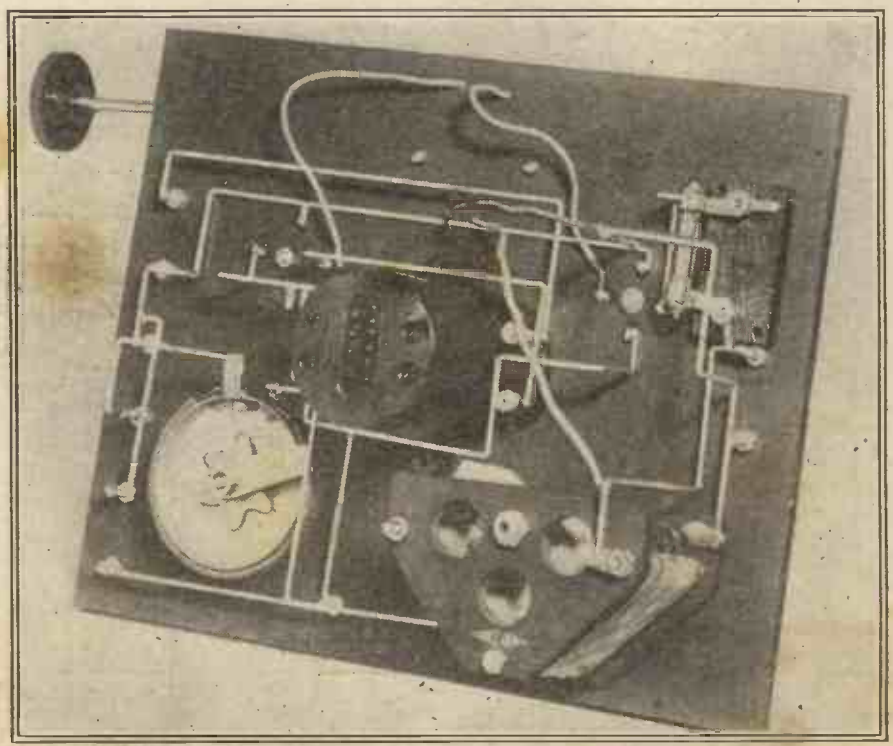
A. They are a little more expensive, both in first cost and upkeep, but, as a matter of fact, their performance is generally greatly in advance of the ordinary valves, and if you can do so I should certainly purchase those of the power type. Alternatively, one power valve in the last stage would give better results than two of the ordinary valves.

Q. What is the best procedure for tuning in a station?

A. Simply rotate the aerial condenser until maximum signals are received, with the reaction coil well out. Later on, when picking up distant stations, this coil will have to be advanced closer to the aerial coil, as already explained, but just at first you will be well advised not to attempt long-distance reception.

(*Continued on next page.*)





The connections made by the flexible leads are clearly indicated in the above photograph.

THE "Q AND A" SET.

(Continued from previous page.)

Q. There is one other query I should like to raise now, and that is as to whether it will be possible to use the set away from the window through which the lead-in will be taken, or whether it must be placed in that part of the room ?

A. That all depends how far away from the window you want to have the set. A few feet will not matter, but we do not advise you to let your lead-in wander all round the room before reaching the receiver, as this will entail serious losses and a corresponding decrease in efficiency.

Q. Supposing I place the set in a corner of the room about six feet away from the window, shall I need to take any special precautions with regard to the lead-in wire ?

A. In that case you should keep your aerial well away from the wall and run it as direct to the set as possible. Under no circumstances must the aerial and earth leads be made of twisted flex, or even allowed to run close to each other, if you want to get the best from your set.

Q. Well, that reminds me that I shall want to run a lead upstairs sometimes, so that one can listen in the bedroom on 'phones. Will there be any need for precautions with the lead in this case, as it will be rather difficult to keep it right away from the walls and floor ?

A. No. Provided well-insulated wire is used, a couple of leads from the 'phone terminals of the set can be run anywhere in the house and can be placed quite close together. Under these circumstances, it would be better to place a ·003 or ·005 fixed condenser across the 'phone terminals, so that extension leads shall not have any marked effect upon the tuning.

Q. Shall I build the fixed condenser into the set, or would you test the set without it first ?

A. You might just as well build it into the set while you are about it, as in any case it will tend to improve the tone of your reception, especially if a loud speaker is used at any time.

Q. As there are several types of loud speakers, would you mind telling me which is most likely to be satisfactory on a small set of this kind ?

A. It is rather difficult to advise any particular make of loud speaker, because so much depends upon the individual taste of the listener. I would advise you to hear several makes at some demonstration before finally deciding, but in any case I do not think that one of the horniess type, having a large composition diaphragm, would be suitable for your purpose. As a rule these take rather a little more energy than some of the smaller models, and I doubt whether your set would be capable of operating them so as to give sufficient volume for your purpose. Something about the order of three guineas, and a well-known make, should meet your requirements. This should have an ohmic resistance of about 2,000 ohms, as you will be using an average-type power valve in the L.F. stage.

Q. I presume that sometimes wireless receivers go wrong, and if mine fails to function at any time, what is the best way of finding out what the trouble is likely to be ?

A. Probably any wireless enthusiast you may happen to know who possesses sufficient knowledge will be glad to give you a hand with the set, or advise as to what is wrong with it. But remembering the wide differences in sets, I think your safest plan in the event of difficulty is to write to the "P.W." Technical Queries Dept. The full rules governing the answering of queries are given in the Radiotorial columns of POPULAR WIRELESS every week, and this dept. will be only too glad to put you right.

TWO IMPROVISED CONNECTORS.

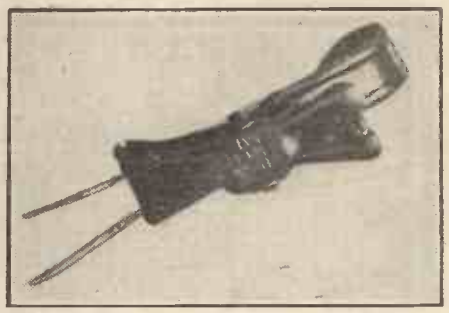
By J. F. C.

IT is often very convenient to be able to make use of some very temporary means of connecting two or more wires together, and with the least possible loss of time and expenditure of trouble.

Naturally, one can make temporary connections by holding the two wires together, or by tying them together. Such connections are not satisfactory, however, because it is always difficult to obtain efficient electrical contact by such means.

For making wire connections of a purely temporary nature there is no implement more useful than an ordinary paper clip, or, alternatively, one of the small clips which are used by shopkeepers for hanging up showcards in their windows.

Both these varieties of clips generally possess steel jaws which are made to come



Making use of a tie-clip for connecting two wires.

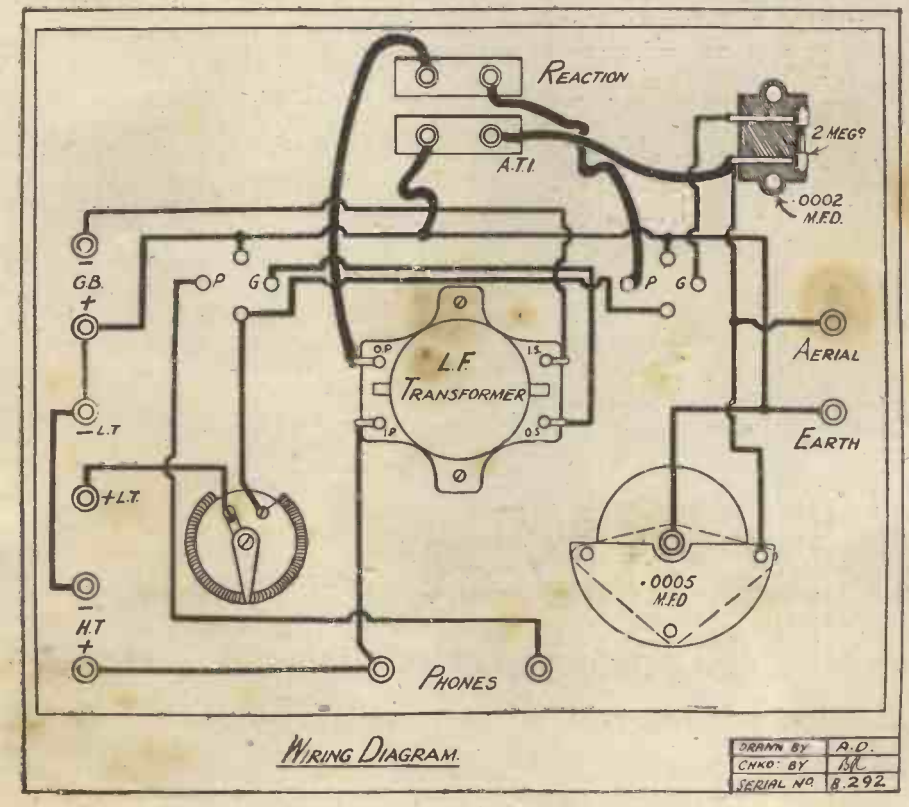
together firmly by means of a strong spring. A number of such articles can be of great use to the busy wireless amateur. If wires are placed between their jaws, the former will be held tightly, provided, of course, that the two wires are of the same approximate diameter.

It is necessary to make sure, of course, that the gripping portions of the jaws of the clip are perfectly clean and free from rust, otherwise bad contact areas would be set up.

The accompanying illustrations indicate the manner in which the above two varieties

A supply of small paper-clips often greatly assists when rapid changing of connections has to be carried out.

of clips may be used. Needless to say, this mode of making wire connections is not an elegant one, but it is decidedly convenient, and on that account it will recommend itself as a good practical tip to the radio worker whose time is not unlimited.



WIRING DIAGRAM.

30 PER CENT MORE ELECTRICITY PRODUCING MATERIAL

Improvement on top of improvement has been the history of COLUMBIA Radio Batteries. Here, in the radically different COLUMBIA Layerbilt, is the H.T. Battery which tops them all. The ability of this battery to give unrivalled service and economy is due to its unique internal design. Instead of the usual assembly of round cells, it is built of flat layers of current-producing materials pressed firmly together. This construction makes use of the spaces now wasted between the round-type cells and avoids the usual soldered wire connections. COLUMBIA Layerbilt is every inch a battery. This exclusive COLUMBIA development packs more active chemicals in a given space, produces more current from them and gives longer life.

HIGH TENSION

The ordinary H.T. Battery is composed of cylindrical cells. The new COLUMBIA Layerbilt H.T. Battery is made of flat layers of electricity-producing material. In this way every available cubic inch produces power. This not only means greater efficiency but longer life.

BATTERY No. 4486

The illustration shows the unique internal construction of the Layerbilt Battery. This exclusive feature makes it the most economical of all H.T. Batteries. It will be available after JANUARY 1, 1927, from any good dealer.

"Layerbilt"

Columbia Radio Batteries

they last longer.

Manufactured and guaranteed by:
NATIONAL CARBON CO.
⊙ ⊙ ⊙
Scotland:
John T. Cartwright,
3, Cadogan Street,
Glasgow.

For full particulars apply to:
J. R. MORRIS,
Imperial House,
Kingsway, W.C.
Telephone: Gerrard 3038.
Telegrams: "Colcarprod, London."

M 834 A

BROADCAST NOTES.

By OUR BROADCASTING CORRESPONDENTS.

"Menace of the Leisured Woman."—"Peer Gynt" from Liverpool—An O.U.D.S. Broadcast—The A.A. Talks—Flotsam and Jetsam—The Extra Money—The Governors at Work—Sir John Reith—B.B.C. Publicity—Long Plays Preferred—The Danger of Dignity.

"Menace of the Leisured Woman."

THE debate on this subject at the Kingsway Hall on January 22nd is likely to be broadcast from London and Daventry. Mr. George Bernard Shaw is to preside, and the principal speakers are to be Lady Rhondda and Mr. G. K. Chesterton. This should be of exceptional interest to most listeners.

"Peer Gynt" from Liverpool.

It is definitely "one-up" to the Liverpool Station that their recent local performance of "Peer Gynt" was so successful that they are to repeat it for the benefit of London and Daventry listeners. The date has not yet been fixed, but will probably be early in February.

An O.U.D.S. Broadcast.

Arrangements are being made for the broadcasting of an excerpt from the O. U. D. S. performance of "King Lear" on February 15th.

The A.A. Talks.

A violent controversy is raging round the A.A. Talks, broadcast regularly. Mr. Stenson Cooke, the popular and able executive chief of the A.A., does the talks in his own inimitable direct and incisive manner. One section of opinion at Savoy Hill takes the view that in their present form these talks do no good either to the A.A. or the B.B.C. But the other view is still prevailing, to the general advantage of the programmes. Those who are in a position to gauge public opinion are agreed that there should be more talks of the kind given by Mr. Stenson Cooke. They point out that dignity and platitude do not compensate for dullness and lack of personal appeal.

The interesting test of dropping a number of valves out of an aeroplane was recently carried out by Messrs. Cossors. This photograph shows the valves being handed to the pilot.

Flotsam and Jetsam.

It will be welcome news to all radio fans that Flotsam and Jetsam are to appear for three separate but whole weeks during 1927. They will appear in the weeks commencing February 7th, June 6th, and October 3rd. Next only to George Grossmith's special "My Programme" in December, Flotsam and Jetsam's broadcast week in November last year was quite the most popular and successful broadcast of the year. Some Press commentators in surveying broadcasting for 1926 put the national concerts and the chamber concerts at the head of the list. This was perhaps true of the minority; but for the overwhelming majority, G.G.'s programme was first, Flotsam and Jetsam second, Harry Lauder third, and Kitesh fourth. It is to be hoped that the engagement of Flotsam and Jetsam for the three periods is indicative of a new and more decisive policy in dealing with features whose merit and popularity are proved.

The Extra Money.

There is some speculation as to the distribution of the additional funds which the B.B.C. will have this year. It is presumed that programmes and engineering will get the whole of it. The old B.B.C had established its administrative charges as long ago as June, 1925, and the proportion of revenue allotted thereto is understood to have remained stabilised during the past eighteen months. The salaries and expenses of the new Board will cost an item of about £7,000. But the introduction of the new system of distribution, accompanied by a reduction of staff, should see at least an equivalent saving on salaries. Thus the Corporation is in the fortunate position of being able to devote all its extra money to programmes and technical improvements.

The Governors at Work.

The extreme pressure on the available space at Savoy Hill makes it impossible for each of the new Governors to have an office, at least for the present. As to the actual detail of how the new Board will work, no final decision has been taken. It is understood, however, that for the first few weeks they will content themselves with examining carefully what is being done. Subsequently they will signify their approval or disapproval of general methods, and will then split up the work of supervising between them. Thus each Governor will accept responsibility for the working of one or more department, as is done in many successful businesses. In the event of the adoption of this scheme, each Departmental Chief at Savoy Hill will be attached to a Governor whose office normally would adjoin his. It will be interesting to see if this plan is adopted, and, if so, how it will work.

Sir John Reith.

This honour is so long overdue that it has been taken for granted. It is perhaps typical of the attitude of a section of the "official mind" towards Broadcasting that it should have received only a knighthood. If the matter had been left to the twelve million listeners throughout the country they would have spontaneously given Mr. Reith the choice between a high title and the Order of Merit. Nor will they be satisfied until due reparation has been made.

B.B.C. Publicity.

No step has been taken as yet to apply the proposal to demobilise the B.B.C. publicity machine, and "farm-out" their publications either to a publisher or to a new concessionnaire company. It is understood that this is one of the early problems for the attention of the Governors. Apparently, however, there is less desire now at the Post Office to be rid of the B.B.C. publicists.

Long Plays Preferred.

Up until recently it was generally assumed even at Savoy Hill that with one main set of programmes available, listeners would prefer short plays to long ones. It has now been discovered, however, that the longer plays are actually more popular. This indicates two things—first of all, that the B.B.C. dramatic work is vastly improved; and secondly, that sustained listening is becoming more customary. Now that the error of the previous view is recognised, it is certain that the dramatic side of broadcasting will be more encouraged by the Corporation than it was by the Company.

The Danger of Dignity.

Just as the new B.B.C. has more power, independence, and resources, so it will be subject to correspondingly more acute and exacting criticism. And one of the first points likely to be criticised is the new-found dignity of our Broadcasting service arising from the fact of the Royal Charter and new status generally.

Unless the greatest care is taken, it will not be to the advantage of the programmes that Broadcasting is at last regarded as thoroughly respectable, and as one of the normal institutions of British life. Recognition and dignity are of value only to the extent in which they open up new fields of programme material. They will be a positive hindrance if their chief manifestation is in red tape and bumbledom.

If the executive people at Savoy Hill are really wise they will omit no opportunity to show that there is not to be any intrusion, however slight and innocuous, of the "Departmental manner."

THE "POPULAR WIRELESS" VALVE GUIDE—*continued.*

2-VOLT L.F. VALVES—*continued.*

Make of Valve	Type	Fil. Volts	Fil. Amp.	Anode Volts	Grid Bias	Impedance	Amp. Fac.	Price	Remarks
								s. d.	
NELSON.—									
Nelson Electric Ltd., 138, Kingston Rd., S.W.19	Multi D.E.2	1·8–2·0	0·7	80–120	1·5–6	16,000	9	11 0	Power valve — Two filaments
	G.220	2·0	0·2	40–100	0–6	20,000	7	11 0	General purpose; Non-phonic
NEUTRON.—									
Neutron Ltd., Sentinel House, Southampton Row, W.C.1	L.220	1·8–2·0	0·2	30–100	0–6	15,000	8·0	12 6	Average L.F., also choke coupling
OCTRON.—									
H. S. Electric Ltd., 32, Charlotte St., Birmingham.	L.210	1·8	0·1	60–100	2–6	16,000	7·5	12 6	Average L.F. or det.
	H.R.210	1·8	0·1	80–120	—	50,000	1·8	12 6	Res. L.F., det. and neutrodyned H.F.
	L.P.240	1·8	0·1	60–120	4–8	9,000	5	15 0	Power valve
OSRAM.—									
The G. E. Co., Ltd., Magnet House, Kingsway, W.C.2.	D.E.2 H.F.	1·8	0·12	40–120	0–4·5	45,000	12·0	14 0	Res. or choke coupl., also H.F.
	D.E.2 L.F.	1·8	0·12	20–80	0–6	22,000	7·0	14 0	Average L.F. valve
	D.E.6	1·8–2·0	0·5	60–120	4·5–12	10,000	5·5	18 6	Last stage power
	D.E.P. 215	2	0·15	60–120	1·5–9	6,250	6·25	18 6	Last stage power
	D.E.R.	1·8	0·35	30–80	0–4·5	32,000	9·0	14 0	G.P. 1st stage L.F.
	D.E.7	1·8	0·4	6–15	—	20,000–8,000	4·5	22 6	Four-electrode valve
QUIKKO.—									
J. W. Pickavant, Quikko Works, Lombard St., Birmingham.	D.E.25 L.F.	2·0	0·25	100	6–7½	18,500	5·25	5 9	Average L.F. valve
	D.E.25 H.F.	2·0	0·25	100–120	1½–4½	58,000	17	5 9	Res. or choke L.F.
	P.4	2·0	0·4	80–120	0–12	10,000	5·75	9 0	Power
RADION.—									
Radion Works, Bollington, nr. Macclesfield	D.E.34 L.F.	1·8	0·34	60–120	3–9	19,000	5·9	10 6	L.F. and general purpose
	D.E.34 H.F.	1·8	0·34	40–150	0–4·5	60,000	16·8	10 6	Resist. coupling and H.F.
	V.L.S.2	1·8	0·4	40–120	3–12	12,700	6	10 6	L.F. and power valve
RADIO MICRO.—									
H. D. Zealander & Co., 124–7, Minories, E.1.	Bivolt	1·8	0·2	40–80	—	—	—	5 3	General purpose
	K.	1·8–2·0	0·2	30–100	—	—	—	5 3	General purpose
	D.E.2V.	1·8–2·0	0·06	30–100	—	—	—	5 3	General purpose
RADVACO.—									
Blitz Bros., 3, Lynton Rd., W.3	S.B.6	1·8	0·15	30–100	0–4·5	—	—	—	General purpose
	S.B.8	1·0	0·06	30–100	0–4·5	—	—	—	General purpose
	S.B.9	1·0	0·2	50–150	1·5–9	—	—	—	Power valves
	S.B.10	1·8	0·2	50–150	1·5–9	—	—	—	Power valves
RATRACO.—									
Blitz Bros., 3, Lynton Rd., Horn Lane, Acton, W.3	206	1·8	0·15	—	—	—	—	4 6	General purpose
	203	1·0	0·06	—	—	—	—	7 6	For portable sets
SIX-SIXTY.—									
Electron Co., Triumph House, Regent St., W.1	S.S.2A L.F.	1·8	0·1	50–100	1·5–4·5	18,000	8·5	14 0	Average L.F., also det. (with less H.T.
	S.S.2H.F.	2·0	0·3	50–300	0–20	60,000	17·0	14 0	Res. L.F., also H.F.
	S.S.10	1·4–1·8	0·1	50–100	4–10	7,700	5·0	18 6	Power last stage
S.T.—									
S.T. Ltd., Melbourne Place, W.C.2.	S.T.22	1·8	0·1	60–120	3–4·5	16,000	10	14 0	L.F.
	S.T.23	1·8	0·15	80–120	9–12	6,000	6	18 6	Power valve
STANDARD.—									
Standard Telephones Ltd., Connaught Hse., Aldwych, W.C.2.	Weco (orange spot)	0·85–1·1	0·25	30–60	0–45	25,000	5–6·5	14 0	General purpose
TELA RADIO.—									
Monowatt Lamp Co. ...	—	—	—	—	—	—	—	—	——
TRIOTRON.—									
Electric Lamp Service Co., 6, Red Lion Yard, High Holborn, W.C.1	D.E.	1·8–2·0	0·2	20–100	0–6	18,000	—	5 0	General purpose
"TWO GRID".—									
Anclov Products, Eton Works, E. Dulwich, S.E.22.	L.F.	2·0	0·34	20–40	—	—	—	—	Four-electrode valve inner grid volts, 10–15 2nd stage
VITA.—									
Peter Curtis Ltd. ..									
VOLTRON.—									
Voltron Co., 75, City Rd., E.C.1	202	1·8–2·0	0·22	30–100	—	13,000	—	—	General purpose
	L.C.2	1·8–2·0	0·06	30–80	—	15,000	—	—	——
	202 (green star)	1·8–2·0	0·22	30–100	—	8,000	—	—	——
	L.S.2	1·5–2·0	0·35	60–120	—	11,000	—	—	——

4-VOLT H.F. VALVES.

Make of Valve	Type	Fil. Volts	Fil. Amp.	Anode Volts	Grid Bias	Impedance	Amp. Fac.	Price	Remarks
								s. d.	
AMPLION.—									
A. Graham & Co., 25, Savile Row, W.1.	—	—	—	—	—	—	—	—	——
ARA.—									
Stephens & Weill, 55, Gt. Eastern St., London, E.C.2.	1	3·8–4·0	0·35	50–150	—	—	13	—	Amplifier
	Det. No. 1	3·8–4·0	0·6	30–80	—	—	13	—	General purpose
	7A	3·5–4·0	0·06	40–120	—	12,500	13	—	——
	16	2·7–3·0	0·06	40–120	—	30,000	8	—	——
BEAM.—									
Lester & Marquis, 15–16, Thavies Inn, E.C.1.	D.E.·06	3·0–4·0	0·06	20–90	—	—	—	9 6	General purpose
BENJAMIN.—									
Benjamin Electric Ltd., Brantwood Works, Tottenham, N.17.	—	—	—	—	—	—	—	—	——
B.T.H.—									
British, Thomson-Houston Co., Ltd., Crown Hse, Aldwych, W.C.2.	R.	4·0	0·7	40–100	—	27,000	7·5	8 0	General-purpose
	B.5	2·8	0·06	20–80	—	17,000	7·0	14 0	General purpose
	B.5 H.	2·8	0·06	40–120	—	55,000	17·5	14 0	Tuned anode, also Det. and L.F. with a high-res. or low ratio transformer
B.S.A.—									
B.S.A. Co., Ltd., Small Heath, Birmingham.	—	—	—	—	—	—	—	—	——
BURNDEPT.—									
Burndept Wireless Ltd., Bedford St., W.C.2.	H.310	3·0	0·1	40–60	Neg. L.T.	55,000	17	14 0	H.F. valve
	H.L.310	3·0	0·1	30–45	Neg. L.T.	20,000	6 5	14 0	General purpose
	H.L.425	4·0	0·25	30–45	Neg. L.T.	10,000	9·0	18 6	General purpose, also power,
C.A.C.—									
C.A.C. Valve Distrib. Co., Ltd., 10, Rangoon St., E.C.3.	B.E.H.F.	3·5	0·5	40–80	—	52,000	18·0	6 0	H.F. valve, also det.
CLEARTRON.—									
Cleartron Radio Ltd., 1, Charing Cross, W.C.	C.T.·08	3·0	0·08	30–60	—	18,000	7·5	14 0	General purpose
COSMOS.—									
Metro-Vick Supplies, 155, Charing Cross, Rd., W.C.2	—	—	—	—	—	—	—	—	——
COSSOR.—									
A. C. Cossor Ltd., Aberdeen Works, Highbury Grove, N.	W.R.2	1·6–6·0	0·3	30–100	3 over 100	30,000	10·0	16 0	H.F.
CUNNINGHAM U.S.A.—									
Rothermel Corp. Ltd., 24/26, Maddox St., W.	C.299	3·0	0·06	—	—	—	—	10 0	——
	C.X.299	3·0	0·06	—	—	—	—	10 0	——
DEXTRAUDION.—									
E. E. Co., Ltd., Fitzroy Sq., W.1.	306	2·8–3·0	0·06	40–75	—	20,000	—	12 6	General purpose
	406	3·8–4·0	0·06	40–75	—	21,000	—	12 6	General purpose
EDISWAN.—									
Edison Swan Electric Ltd., Queen Victoria St., E.C.2.	A.R.·06 H.F.	2·5–3·0	0·06	20–100	—	35,000	10·0	14 0	H.F.
	G.P.4	3·5–4·0	0·15	60–120	—	22,000	12·0	14 0	General purpose
	A.R.H.F.	4·0	0·75	30–80	—	30,000	10·0	8 0	H.F.
	R.	4·0	0·75	20–100	—	25,000	7·5	8 0	General purpose
ELKA.—									
L. Kremner, 49a, Shudehill, Manchester.	D.	3·5–4·0	0·15	20–100	—	—	—	—	General purpose

To be continued.

Apparatus Tested

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

A NEW COSSOR "STENTOR."

WE are rather surprised that Messrs. Cossor did not follow up their undoubted success with the now well-known little Stentor Two with a power valve or two of the six-volt type. It was our impression that the order of popularity was 2-6-4, with the four-volters a rather bad third. However, it is possible that by the time these words are in print we will have some six-volt Cossors on the market. Such would undoubtedly be welcomed very heartily.

Perhaps the Stentor Four, samples of which were recently sent us, is merely the precursor of a wider Cossor range. Anyway, it is a really good valve and a worthy member of the Stentor fraternity. Operating at 3·8 volts and taking the low current of ·1 amps., it is a power valve in the strictest sense of the word. It hasn't double the "punch" of its smaller brother, for unfortunately amplification is not proportional to filament volts, but, in its class, it is just as successful and can handle pretty large inputs very capably.

Cossor enthusiasts will find this new Stentor all that they would expect it to be.

A WELL DESIGNED L.F. TRANSFORMER.

We recently received a "Puradyne" L.F. transformer from the manufacturers, The Puradyne Manufacturing Company, 27, Elgin Road, Seven Kings, Essex. It embodies several novel features. For instance, the terminal bars, of which there are two each carrying two terminals, are moulded integrally with the bobbin, and the terminal screws have hexagonal heads which fit into specially shaped slots in the terminal bars. Therefore the terminals cannot possibly turn and break their connections.

The transformer is very heavily built, and its many core laminations are held together securely without screws passing through them. An earthing tag is provided on the metal frame.

On test the "Puradyne" gave very good results—results that place it immediately out of and above the so-called "cheap" class. Three ratios are available, viz. 1–27; 1–4 and 1–6, all at the standard price of 13s.

A DISTANT CONTROL SWITCH.

Messrs. Electradix Radios recently submitted one of their Electradix control switches to us for test. It is a very substantial piece of apparatus, and operates in a very definite manner. Placed in series with a small dry battery and a "button" switch, it controls the filament circuit by "making" and "breaking" it as desired. It embodies a novel clockwork mechanism, and this provides it with the power to operate very heavy contact points. One winding will suffice for 350 switchings. It is a control switch which we should hardly think could fail to work, and in our opinion it is decidedly cheap at 15s.

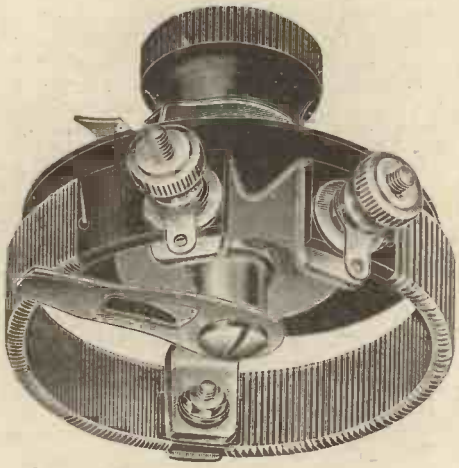
NEW AMPLION LOUD SPEAKER.

In producing their new "Cabinette" loud speaker, the Amplion people state that they are endeavouring to meet a demand from listeners who do not approve of the horn type instrument, and at the same time are not prepared to invest in one of the rather more expensive "Radiolux" models. But although the "Cabinette" costs but £3 3s., it has not a

(*Continued on page* 1214.)

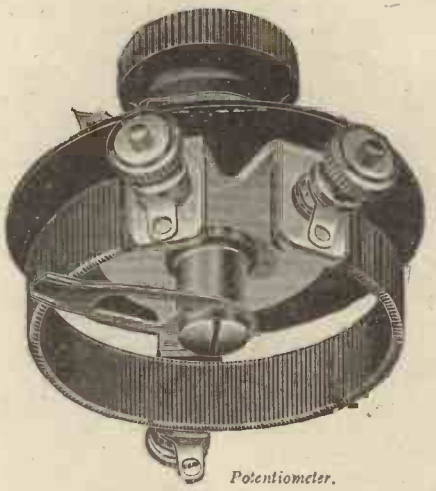
EASY MOUNTING—SMOOTH WORKING

Ormond Filament Rheostats



Dual Rheostat.

ORMOND would not trouble your attention with a component unless they could make it better than others on the market. Here, for instance, are rheostats and a potentiometer in which, if you examine them at your dealers, you will notice several real improvements. The two main results are silent, silky-smooth movement and a rigid, reliable contact.

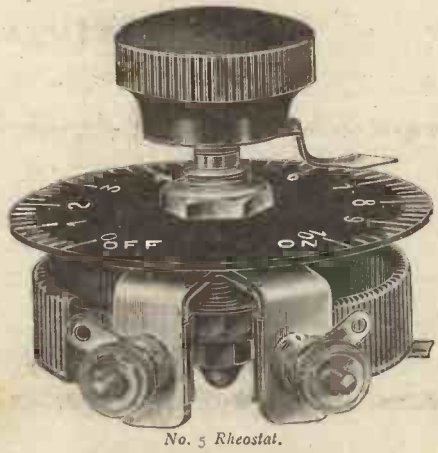


Potentiometer.

These rheostats and potentiometer are of the open type. The resistance wire is wound on an insulating former, supported on a metal frame, well ventilated.

The movement of the contact arm is smooth and silent, giving a firm, sure electrical contact.

The Dual Rheostat is wound in two sections with different-gauged wire continuously variable from maximum to zero. It may be used for Bright or Dull-Emitter valves.



No. 5 Rheostat.

The 6 ohm and Dual Rheostats may be used as Master Rheostats; they will control three bright emitters without undue heating.

"ONE HOLE" FIXING.

For Baseboard mounting an additional bracket is supplied. Complete with Knob, Pointer, and suitably engraved dial.

PRICES :—

No. 5 Rheostat, 6-15-30 ohms	2/-
Dual Rheostat, 5-30 ohms ...	2/6
Potentiometer, 400 ohms ...	2/6

ENGINEERING — ORMOND — COMPANY LTD.

Registered *Trade Mark.*

199-205, PENTONVILLE ROAD, KING'S CROSS, LONDON, N.1

Telephone : CLERKENWELL 9344-5-6. *Telegrams : "ORMONDENGI, KINCROSS."*

Factories: WHISKIN STREET AND HARDWICK STREET, CLERKENWELL, E.C.1

Continental Agents : Messrs. PETTIGREW & MERRIMAN, LTD., "Phonos House," 2 & 4, Bucknall Street, New Oxford Street. W.C.1

APPARATUS TESTED.

(Continued from page 1212.)

"cheap" appearance, in fact, it looks quite an expensive instrument.

It is finished in dark Jacobean oak, and is of a handsome design and is very nicely made. And this speaker gives good results, too; reproduction is full and mellow, and the projection factor of the instrument is very high. A hinged door at one end provides access to the unit and its adjustment screw. This new Amplion model should prove to be one of the most popular of all speakers this year.

A MICROPHONE AMPLIFIER.

We have had a Wilson Microphone Bar Amplifier on test for some few weeks in different localities and under varying conditions. The device is manufactured by the New Wilson Electric Manufacturing Co., of 18, Fitzroy Street, Fitzroy Square, London, W.1. Through the medium of our advertising columns most of our readers will be familiar with the appearance of this instrument and will know that it operates on the usual microphone amplifier principle, although the application of this is decidedly a novel one.

The Wilson amplifier is a very neat little instrument, and is carefully made and assembled. Two small dry cells are all that is required in the way of a local energy supply. The current consumption is of a markedly low order.

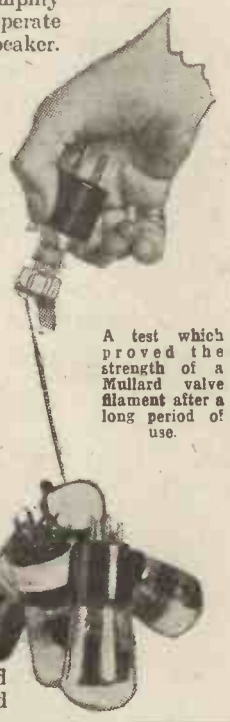
It gives good results, too, and is less affected by external vibration than most other instruments of the same nature. It is perfectly stable in operation, and once adjusted (a very simple operation) it functions for very long periods without the slightest attention.

Reproduction is good, and the sensitivity of the amplifier deserves special commendation in the circumstances. When fairly strong 'phone signals are receivable on a crystal set it will amplify them sufficiently to operate a medium-sized loud speaker.

The price of the instrument is 38s. complete. Crystal enthusiasts desirous of operating a speaker and not wanting to use valves should endeavour to hear one of these amplifiers at work.

A USEFUL FITTING.

Messrs. A. F. Bulgin & Co., of Cursitor Street, London, E.C.4, seem to specialise in novel and useful gadgets. Their latest is the "Deckorem" wall mounting telephone extension or loud speaker socket. It bears resemblance to an ordinary ceiling rose, and it can be supplied with covers finished in oxidized silver, nickel plate, or oxidized copper to match existing room fittings. The wooden bases can also be obtained in various finishes. The socket will take standard telephone plugs, or by means of special terminals fitted inside, ordinary wire. Types suitable for either series or parallel wiring. The price of this handy little article is 3s. 9d.



A test which proved the strength of a Mullard valve filament after a long period of use.

A D.C. MAINS UNIT.

We recently received a Micromain Super D.C. unit for test from the Micromain Unit Service, 46, Artillery Lane, London, E.1. It is a very neat little instrument; one of the most compact we have seen, and is enclosed in a solid, polished aluminium case. By means of conventional sockets the unit enables ten voltages of H.T. to be obtained, these ranging from approximately 12 to 154 volts on 220 volt mains.

This Micromain Unit was tested in three different localities in one of which the supply is notoriously "rough." In all cases the device operated well, although in two, "hum" was experienced. This "hum" was not noticeable during the reception of music and speech of normal intensity, but could be discerned during quiet passages. Practically all traces of "hum" could be eliminated by using an additional choke-condenser smoothing attachment.

On the whole, the "Micromain" is well up to the average D.C. unit, as it is found that but few will function with complete "silence" without employing additional smoothing devices.

The price of the "Micromain" Super, complete with plugs, flex and standard adapter, is £2 8s. 6d.

RADIOTORIAL

All Editorial Communications to be addressed to The Editor POPULAR WIRELESS, The Fleetway House, Farringdon Street, London, E.C.4.

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

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

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

TECHNICAL QUERIES.

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

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

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

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

Details of the "P.W." BLUEPRINTS are published fortnightly in the advertisement pages of "P.W."

BACK OF PANEL DIAGRAMS can be specially drawn up to suit the requirements of individual readers at the following rates: Crystal Sets, 6d.; One-Valve Sets, 6d.; One-Valve and Crystal (Reflex), 1s. Two-Valve and Crystal (Reflex), 1s.; Two-Valve Sets, 1s.; Three-Valve Sets, 1s.; Three-Valve and Crystal (Reflex), 1s. 6d.; Four-Valve Sets, 1s. 6d.; Multi-Valve Sets (straight Circuits), 1s. 6d. Except SUPER-HETERODYNE DIAGRAMS, all of which, irrespective of number of Valves used, are 2s. 6d.

If a panel lay-out or list of point-to-point connections is required an additional fee of 1s. must be enclosed. Wiring diagrams of commercial apparatus, such as sets of any particular manufacture, etc., cannot be supplied. (Such particulars can only be obtained from the makers.) Readers may submit their own diagrams, etc., for correction or for criticism. The fee is 1s. per diagram, and these should be large, and as clear as possible.

No questions can be answered by 'phone.

Remittances should be in the form of Postal Orders.

Questions and Answers

ON-OFF SWITCH.

"PUSH-PULL" (Camberley, Surrey).—What is the best position in the circuit to insert one of those little make-and-break push-pull switches, for putting the battery on and off? It is a straight one-valve set, with H.T. negative and L.T. negative joined together.

You cannot put *both* batteries on or off with a one-pole make-and-break switch. If you have a rheostat, this will make or break the filament circuit, and the new switch, when inserted between H.T. negative and L.T. negative, will break the H.T. battery lead, thus safeguarding the valves against an accidental short.

If, however, the control must be worked by someone unaccustomed to a set, you can insert

(*Continued on page* 1218.)

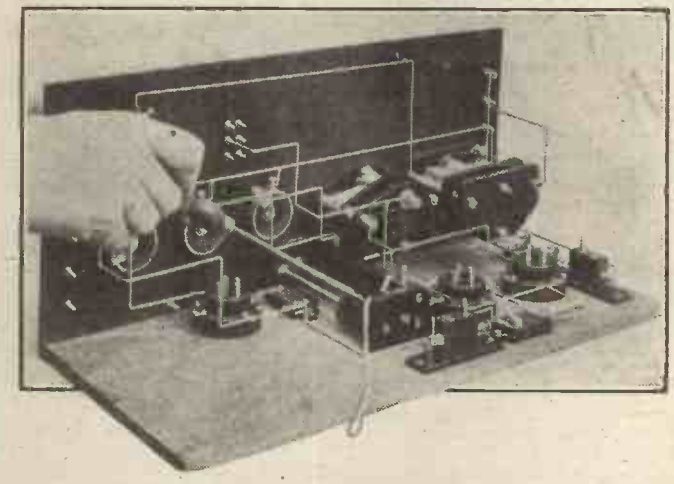
RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page* 1216.)

the on-off switch in series with the rheostat, and then the set can be brought into action by the push-pull switch only. In this case, however, H.T. negative has to be left connected to the L.T. lead.

WIRING UP.

F. W. B. (St. Leonards-on-Sea).—When making up a set, from a "How to Make" article, I have found that some of the wiring



is best carried out before all the components are mounted. Ought everything to be in position first, or is it a good plan to leave large components unmounted until their own wiring is ready to go on?

It is essential in wiring up multi-valve sets, without explicit bit-by-bit instructions, to mount all the components first, and mentally plan how the various wires will run. When it has been ascertained that all the positions are O.K., the larger components are then best removed from the baseboard, to leave as much room as possible, whilst the first part of the wiring is carried out.

The accompanying photograph shows a set being constructed, and it will be noted that L.F. transformers, etc., have all been removed and put aside until the H.F. portion of the set is wired up.

THE SAVOY THREE.

D. K. (Portsmouth).—I have built the "Savoy Three" (using 2 Cosmos resistance-coupling units), and, though it is giving very good results, I am puzzled by the wiring diagram, which shows G.B.+ joined to the rheostat lead from L.T.+. Would it be an advantage to take the G.B.+ lead to L.T. neg.?

Theoretically, the G.B.+ lead should be connected to the L.T. neg. lead, but, if desired, the wiring can be shortened by connecting it to L.T.+. In practice it will be found that this procedure means that when adjusting grid bias a little more negative bias is required than would be the case if G.B. + were connected to L.T. neg.

If the wiring diagram has been followed exactly, and it appears that a little more negative grid bias than the G.B. battery gives would be beneficial, the lead can easily be changed over. The only modification to the wiring diagram (page 1103) is that the flexible lead from G.B.+ should be disconnected from the rheostat lead, and taken instead to a point on the wire that joins the aerial coil and condenser to the earth terminal and L.T. neg.

(*Continued on page* 1221.)

IMPORTANT NOTICE.

WIRELESS VALVES.

Injunction and Damages

On the 9th December, 1926, in the High Court of Justice Chancery Division in the case of Marconi's Wireless Telegraph Company Limited against Midland Valves Limited the Defendants having paid agreed sums for damages and costs amounting to £75 consented to an order for an Injunction restraining them from infringing Letters Patent 184,446 and for delivery up to the Plaintiffs of all ·06 Ampere Valves in their possession or power.

WARNING
to
DEALERS *and* USERS

NOTICE IS HEREBY GIVEN by Marconi's Wireless Telegraph Company Limited, both on their own behalf and on behalf of the British Thomson Houston Company Limited and the General Electric Company Limited, that legal proceedings will be taken against any Company firm or person selling or using valves which infringe any patents owned or controlled by them.

M.W.035.

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from page 1218.)

Will Mr. Arnold, who wrote to the Queries Department regarding a portable super-heterodyne receiver, send his address in full as soon as possible ? (The reply sent to him in his own stamped, addressed envelope has been returned undelivered by the G.P.O.)

When sending inquiries to the Technical Queries Department, readers can expedite the replies by carefully observing the rules of the department (as set out under the heading "Radiotorial").

* * *

Remember it is essential to send a stamped, addressed envelope.

* * *

Write your name in block letters.

* * *

If, for any reason, reference is made to a previous communication from the Query Department, the letter in question must be returned for reference.

DISCONNECTING H.T. & L.T.

M. J. D. (Llwydcoed).—I have constructed a 3-valve loud-speaker set from your Blue Print series No. 20 which works very satisfactorily. I am anxious to insert a switch so that I can cut out both H.T. and L.T. to save disconnecting the leads. Will you give me the wiring for a switch suitable for fixing on side of cabinet ?

To completely disconnect both the batteries, a make-and-break switch, having two poles, is required. The L.T. neg. terminal is connected direct to one pole, and the H.T. neg. terminal direct to the other. The rheostat lead goes to the switch contact corresponding to L.T. neg., and when the switch is in the "on" position the connections are completed exactly as shown in the Blue Print. When the switch is "off," the negative leads of the two batteries are joined only to their respective switch contacts.

SCREENING.

C. W. R. (East Ham, London, E.).—How do metal screens prevent interference ?

Interference is caused by electro-magnetic fields, such as exist around conductors carrying current. This interference occurs in concentrated form around inductive apparatus such as motors, generators, transformers, or choke coils.

In the case of a transformer, for instance, its electro-magnetic field may extend over a considerable distance, setting up interference in neighbouring conductors.

If, however, the transformer is completely enclosed in an iron box, no interference from it will be experienced outside this box, because the transformers' external varying field dissipates its energy in setting up eddy currents in the iron.

Similarly, if a tuning coil is to have complete protection from stray electro-magnetic fields, all that is necessary is to place it inside a suitable metal screen, which then automatically excludes all external fields that could set up interference in it.

SET'S FAILURE TO WORK.

"INEXPERIENCED" (Halesworth, Suffolk). My 1-valve set suddenly ceased to work, apparently without cause. Where should I look for the fault ?"

You will get no signals if the aerial or the earth lead becomes disconnected, or if the lead-in wire gets caught upon the roof, iron gutter-pipe, etc.

If H.T., L.T., or 'phones are not connected correctly the same trouble will occur, and a faulty connection at one of the plug-in contacts (valve or coil, for instance) may account for the failure to hear anything.

Apart from the external leads and the accessories, any break in the wiring of the set itself, or in one of the components, would cause the trouble you complain of.

A GOOD STRAIGHT 3-VALVER.

J. W. N. (Stansted, Essex).—Please give the circuit for a straight 3-valve set, with simple switching, so that the valves light up when the

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS

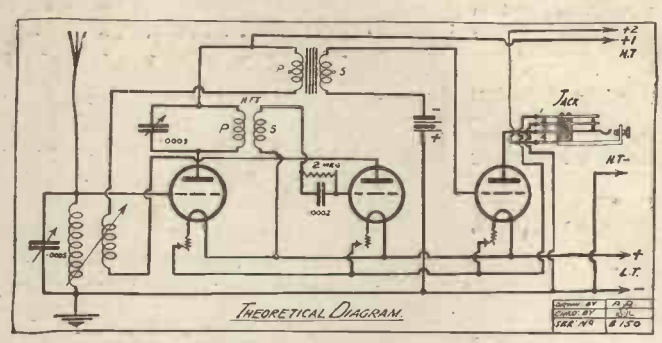
(Continued from previous page.)

loud speaker is plugged in. I have the following components on hand—1 H.F. and 1 L.F. transformer, 3 rheostats, grid leak and condenser, and ·0005 variable condenser. What others will be required ?

A set of this kind was fully described in "P.W." No. 226. The circuit is given herewith, and is perfectly straightforward.

If your L.F. transformer does not incorporate a fixed condenser across its primary winding, this may be added as a separate component to assist smooth reaction (·001 is the usual capacity).

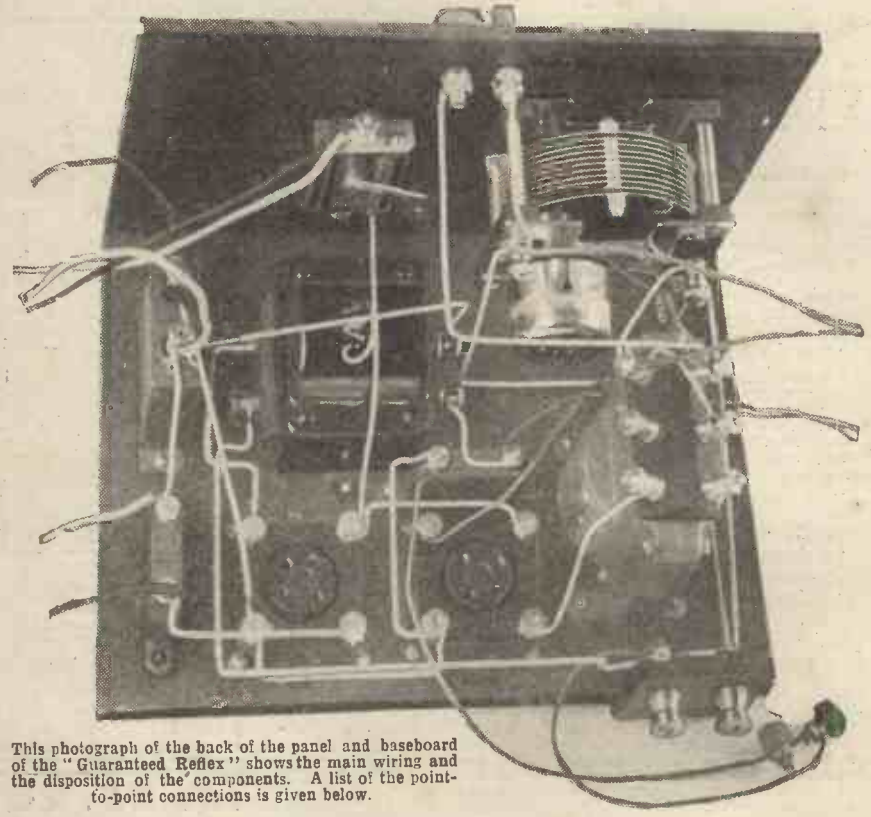
The additional components required are: 1 panel, 16 ins. by 8 ins., with cabinet to fit; 1 ·0003 variable condenser; 1 2-way coil-holder; 3 valve-holders; single filament jack and plug (Bowyer Lowe, 239 type); terminals, strips, wire transfers, etc.



THE GUARANTEED REFLEX.

As large numbers of readers have asked for the layout of the "Guaranteed Reflex" (Hale circuit, with additional L.F. amplifier), the back-of-panel photograph of the receiver is reproduced herewith, together with a list of the point-to-point connections.

(The theoretical diagram was published in "P.W." No. 232.)



This photograph of the back of the panel and baseboard of the "Guaranteed Reflex" shows the main wiring and the disposition of the components. A list of the point-to-point connections is given below.

Aerial terminal to fixed vanes of condenser, to ·0001 fixed condenser, and to S.O. and P1 of R.I. transformer. Attach flexible lead to S.O.

Earth terminal to moving plates of condenser crystal, and flexible lead for coil-holder; also flexible lead for G.B. negative and stiff wire to I.S. of second transformer.

S2 to grid of first valve. Join one filament terminal of both valve sockets to bottom of filament rheostat. Join other filament terminal of both sockets to one terminal of Mansbridge condenser and to one terminal of ·0003 fixed condenser. Join flexible lead for G.B.+ to this last point.

Join flexible leads of L.T.+, H.T.− to top terminal of filament rheostat. Take flexible leads for coil-holder from anode of first valve and from terminal of ·0003 fixed condenser. Join same terminal to I.P. of second transformer. Join O.P. to Mansbridge terminal. Join crystal to P2 of first transformer and to ·0001 fixed condenser.

H.T. flexible leads to Mansbridge. L.T. negative flexible lead to other Mansbridge terminal. Join ·002 fixed condenser to Mansbridge. Other terminal of ·002 condenser to anode of second valve-holder. Grid of second holder to O.S. of second transformer. Flexible leads for loud speaker taken from terminals of ·002 condenser. Thread coil-holder leads through holes in side of cabinet.

CRYSTAL AND 2 L.F.

E. J. N. (Wellingboro', Northants).—I have two good L.F. transformers on hand, and should like to use these in conjunction with a crystal for loud-speaker work. Please recommend a suitable circuit for a set to be used about 11 miles from the Birmingham station, on a good outdoor aerial.

Only the local and Daventry stations' programmes are required, so I should like a "straight" set instead of one using a reflex or similar circuit.

Switching for 1 or 2 valves would be an advantage, as sometimes only one loud speaker (or even 'phones) may be required. Would such a set be difficult to build ?

For your purpose the best circuit is undoubtedly one in which the valves act as straightforward L.F. amplifiers, to increase the volume given by the crystal detector.

(Continued on page 1224.)

RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page* 1222.)

A circuit of this kind is given on the "P.W." Blue Print No. 17, which is obtainable from the Query Dept. for 6d., and a stamped addressed envelope. Suitable switching is incorporated, and by means of one S.P.D.T. and one D.P.D.T. switch it is possible to listen on crystal only, crystal and one L.F., or on crystal and two L.F.

The set is equally suitable for 5 X X or for 5 I T, and is shown arranged on a flat panel. (If desired, it could easily be built in the totally enclosed form, as pictorial and theoretical diagrams are given upon the blue print.)

A CORRECTION.

We regret that, owing to a printer's error, the price of a Brunet transformer was given incorrectly on page 1169 of "P.W." No. 240 (Jan. 8th issue).

Instead of 2/9 as shown, the price should have been 7/9.

IF there is anything in this or any other issue of "Popular Wireless" that you *do not like*, please let us know what it is when you write.

EXPERIMENTS WITH THE FILADYNE CIRCUIT.

(*Continued from page* 1194.)

together the value of X and Y for any particular value of bias gives a constant figure which is the saturation current for the particular grid and filament voltages used.

This interesting relation between grid and anode current suggests other possibilities of the Filadyne circuit. This has led to the development of other circuits, which will be described in the second part of this article.

Grid Circuit Resistance.

Resistance in the grid circuit also affects the operation of the Filadyne valve. When the 'phones are shorted, this resistance is low and grid current then increases to abnormal figures. For instance, using a D.E.R., grid current reaches 15 milliamperes for normal filament current and 50 volts H.T.! This is more than twelve times the value of anode current when the valve is used normally with the same H.T. voltage. Accordingly better results are obtained by using lower resistance 'phones, but there does not seem to be much advantage in using 'phones of less than 2,000 ohms resistance.

So far I have considered chiefly the purely theoretical side of the Filadyne circuit, but in the next article I shall show how this knowledge may be used to obtain even greater efficiency from an already highly efficient circuit. The circuit of Fig. 4 is certainly a fine one both for local and long-distance work on the one-valve. Careful adjustment of anode bias brings in distant stations at excellent strength. This circuit also embodies capacity reaction control, the advantages of which are too well known to need further description.

CORRESPONDENCE

(*Continued from page 1184.*)

4-valver, and if I wish to use it, I am compelled to tolerate a hubbub of Morse as a background. I quite realise that Morse is a necessity, but it must be confined to a definite wave-band. My set is quite useless five days out of seven, and my sympathies go with those who have struggled, perhaps a little beyond their means, to purchase a decent receiver, and have been sorely disappointed with this disgusting bugbear.

I was demonstrating my set last week to a musician who was considering purchasing a set. When his enquiry of the reason of the continual tap-tap-tap was answered, he decided to stick to his gramophone, and thanked me for the warning.

Yours truly,
JOHN W. COLLINS.

P.S.—My tuning is sharp, and I find the worst interference is on about 350 metres.

"Lea Hurst," Esplanade Gardens,
Westcliff-on-Sea.

IMPROVISED LOUD SPEAKER.

The Editor, POPULAR WIRELESS.

With reference to your article on an improvised loud speaker, I think you may be interested in one that will cost—nothing. Simply unscrew the cap off one of the headphone earpieces and bring the magnets into contact with the clean bottom of a tin similar to a Cerebos salt container. The results are remarkable in a small room. The tin bottom is the diaphragm, and, if the headphone is any good, it will hang on by its own magnetism.

Yours sincerely,
W. N. MAWBY.

The Cottage, Quernborough Lodge,
Syston, Leicestershire.

THE "RANGE" OF A CRYSTAL SET.

The Editor, POPULAR WIRELESS.

Dear Sir,—I can hear London (80 miles) on a crystal set at any time, including when Daventry is doing another programme, thus proving it to be 2 L O.

I hear Birmingham (50 miles) at any time and have heard Hamburg several times.

London, on my 30-foot-high aerial, is faint, but on a friend's aerial (50 feet high) it is at comfortable strength.

On this latter aerial I have heard Hamburg at 3.30 p.m. I know German and identified the station from the published programme.

In this district it is extremely unlikely that any valve user would be listening to a long German talk at such a time; all would be at work.

In any case, re-radiation must be ruled out as regards 2 L O. It is impossible to believe that someone or other is always listening to London at all the times I have tried it.

I can generally hear Nottingham (38 miles), only a relay, and have occasionally heard Bournemouth; all the above on a crystal set.

Yours faithfully,
CHAS. D. ROCHESTER.

4, High Street, Rothwell,
Kettering.

SPARK JAMMING.

The Editor, POPULAR WIRELESS.

Sir,—May I, if I am not too late, make one or two comments on Mr. J. L. Maitland's letter in your issue of December 4th, in which he puts forward the sea-going operator's point of view on spark jamming.

Firstly, as regards broad tuning: Granting that it would not be desirable or even practicable to carry on commercial work with razor-sharp tuning or strict adherence to the 600-metre wave for ordinary work, particularly when traffic is heavy, there still remains the fact that "there's measure in all things made," and when one finds the whole band of wave-lengths from 250 metres upwards freely used by shipping, there *does* seem legitimate cause for grumbling.

May I remind Mr. Maitland of a fact which so many operators seem to forget, and that is that even with the old type of 1½ kw. and 5 kw. sets, which probably cause a large percentage of the interference, reasonably sharp tuning may be obtained with a loose aerial coupling; and that a coupling which may be justifiable and necessary when well clear of the land and great range is required is both unnecessary and undesirable when in wireless company with, say, the Channel shipping. Imagine a dinner-party where everyone used "full power and a tight coupling" when speaking! Conversation would not be easier.

Secondly. Is not the distress signal plea rather overdone? There are two ends to a signal, to put it crudely, and receiving gear, so far as I am aware, has not yet reached such a state of selectivity that a reasonably sharply tuned transmission will not be picked up even if slightly off the expected wave-length.

Do not think that this is a flippant treatment of a serious argument, as having been at sea for over 20 years myself, I know how urgent a distress signal may be.

Another small point—almost trivial—the "selfish minority" referred to at the end of Mr. Maitland's "Point 2": IS it a minority? If it *is* now (with

(*Continued on next page.*)

CORRESPONDENCE

(Continued from previous page.)

which I do not agree), this state of affairs would soon be altered, given reasonable freedom from interference round the coast.

Finally, may I say that I entirely agree with Mr. Maitland in the third "Point" of his letter, and wholeheartedly sympathise with those who have to receive signals through the pandemonium which exists at present. I suggest again that the situation could be eased for all by the more frequent use of a loose coupling in narrow waters—though how those who begin the good work will ever get their signals through the shoutings of the remainder, goodness only knows!

Yours etc.,
"Home Croft," E. G. HALLEWELL.
Mullion, Cornwall.

3-VALVE DX RESULTS.

The Editor, POPULAR WIRELESS.

Sir,—On seeing some of the results of POPULAR WIRELESS readers, I thought I would write and let you know of my list of Main Stations and Amateurs received on a 3-valve—detector and 2 L F. Those stations in heavier type I require addresses. Could any readers oblige me with same?

AMATEURS.

2 Q R, 2 P L, 2 M B, 6 A H, 2 N R, 2 A D, 2 R U, 2 P S, 2 Y S, 2 H X, 2 A D E, 2 S Y, 2 R Y, 2 P B, 2 O W, 2 B P, 2 Y N, 2 W B, 6 H U, 5 N U, 2 I S, 2 Y X, 2 W D, 2 Q I, 5 Z X, 2 K D, 2 Y Z, 2 W S, 5 C K, P Q R, 2 K O, 5 Y S, 5 L K, 2 N K, 2 W X, 2 K R, 2 R F, 5 R I, 2 P D, 2 S E, 2 N Y, 2 D U, 2 A R F, 6 M K, 5 W O, 2 M D, 2 F R, 6 Y Z, 2 L S, 2 B M M 2 O P, 2 H F, 2 X E, 2 S K, 2 A E, 2 O Q, I X, 5 K D, 2 A K, 2 N U, 2 P I, 2 Y I, 2 V I, 2 F I, 5 I Y, 5 M D, 2 H S, 2 V R, 6 M J, 2 Y C, K A R G (Germany), 6 I D, 6 K R G, 5 K D, 2 B P P, 2 A X R, 2 A K I, 2 A F T, 5 Y X I (4 A F (New Zealand), 5 F I, 3 3 A Z, 1 J W, 6 U U, 2 Y D, 6 F U, 6 F F W, 2 B B P, 6 R E, 6 S W, 2 B P M, 2 R E, 2 X I, 2 B F, 2 S T, 6 H W, 6 H T, 3 T C K, 2 Y V, 1 J W (Italy), 2 B S L, 2 B S O, 6 U C, 5 E W, 6 F R, 6 S R, 3 B M V, 3 B M P, K I G (Germany), 6 V D, 6 C Y, 6 C I, 5 I Y, 6 E Y, 2 M Z, 5 K Y, 5 J I, 6 X Q, 6 R S, 5 P X, 2 B K, 6 N A, 5 A J, 2 O J, 6 N T, 5 A D K, 6 S L, 5 S X, 2 A R E, 6 P C, 5 P H.

MAIN B.B.C. STATIONS—London, Birmingham, Bournemouth, Glasgow, Newcastle, Liverpool, Cardiff, Aberdeen, Manchester, Edinburgh, Dublin, Daventry, Nottingham, Stoke, Plymouth, E A J I.

FOREIGN.—Paris C F R, Paris F P T T, Paris P T T, Riga, Hilversum, Vienna, Lyons La Doua, Barcelona, Prague, Seville, Brussels, Belgrade, Berne, Toulouse, Munster, Draz, Hamburg, Madrid E A J 6, Madrid E A J 7, Oslo, Copenhagen, San Sebastian, Breslau.

New York, America. Rugby, England.

I have just made the 2-valve Hale receiver, which has proved of great satisfaction. It is a "wonderful receiver." I get 2 L O, 5 I T, 5 X X, Rugby, New York, on loud speaker.

Some foreigners are just audible in the loud speaker. Signals from Rugby can be heard at full loud-speaker strength. On Sunday I can hear the conversation between Rugby and New York very loud in the 'phones. On this set I am using a P.M. Mullard P.M.6 dull-emitter power valve, followed by a P.M.5 Mullard dull emitter valve, using 120 volts H.T. and 1½ volts grid bias and R.I. transformer, first stage, followed by a Telsen second stage.

I must congratulate POPULAR WIRELESS on such a fine, sensitive, selective, long-distance receiver.

Hoping this will interest you and POPULAR WIRELESS readers.

Yours faithfully,
ALBERT HORTON.

270, Rookery Road,
Handsworth, Birmingham.

WET H.T. BATTERIES.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have just read the letter of Mr. Alfred Timson in "P.W." and as he appears to have experienced some trouble with the zinc sheet in his wet H.T., I thought perhaps the following hint might possibly help him. It may possibly help other readers as well.

In place of sheet zinc he should obtain some commercial Leclanché zincs and cut them into 1½ in. lengths and use these, and as they are very solid they will last for years. I have had some in use for over eighteen months and have had no trouble yet. They can be soldered to the carbons with a short strip of bare copper wire (about 22-gauge), and the joints smeared with either oil or vaseline to prevent salts creeping. I feel certain your reader will then get his battery to work O.K. May I just add that I am a regular reader of P.W., and have tried a good many of your circuits, the latest being the Hale 2-valver, and I must say I am truly surprised at this circuit as the stations fall over each other to get to the 'phones, the only drawback being its lack of selectivity.

Wishing you and "P.W." every success in the future.

Yours faithfully,
H. C. BUTTER.

Myrtle House,
North Brink, Wisbech.

TECHNICAL NOTES

(Continued from page 1190.)

This applies in quite a general way to experimental work, and you will always find that the most successful experimenters in any branch of science adopt a tidy and business-like method in their manipulations.

A Necessary Accessory.

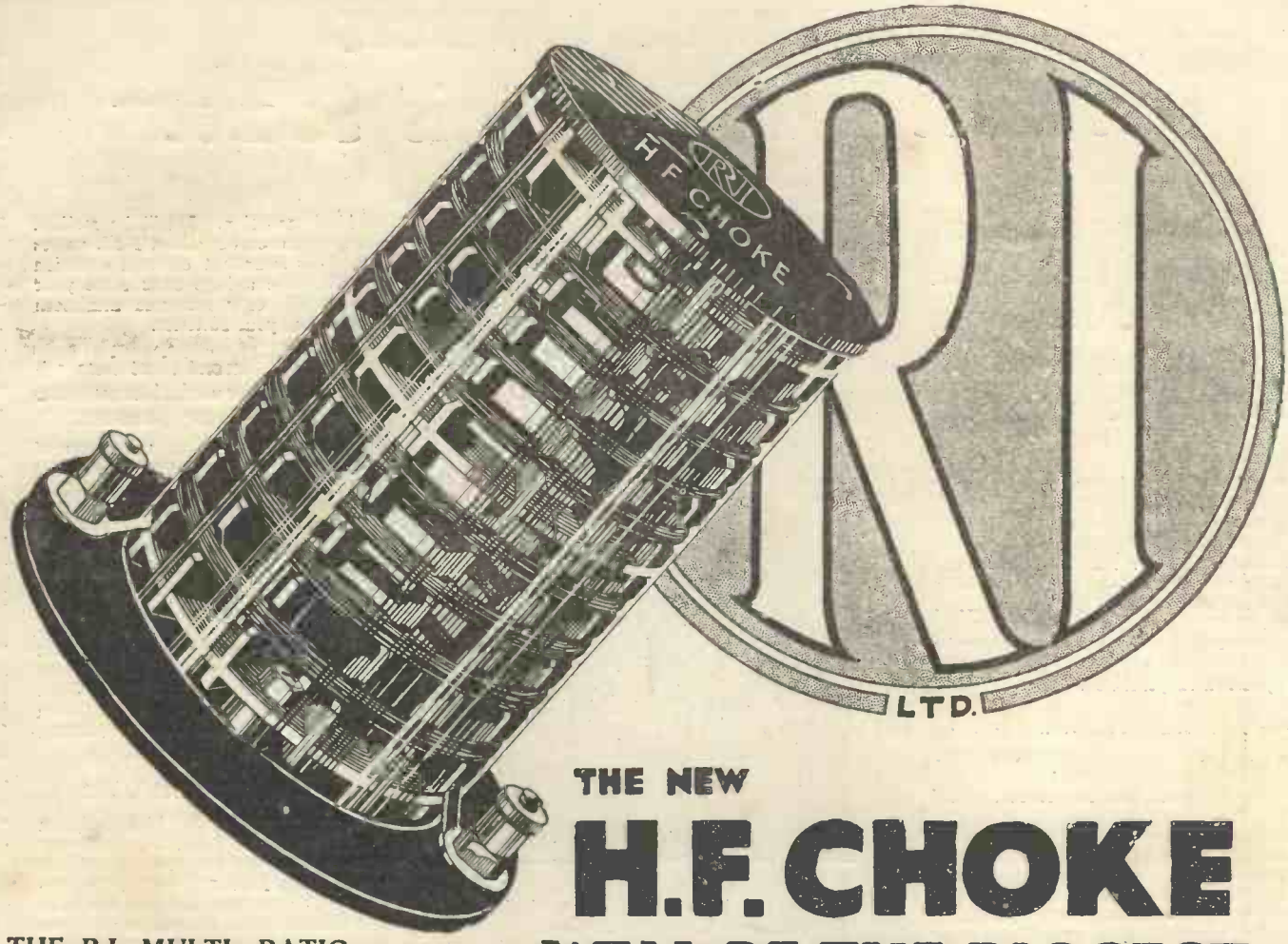
Talking about experimental work, I wonder how many readers, when carrying out experiments, take the trouble to keep what migh tbe called a "laboratory notebook," and to write down all their observations at the moment that they are made. This I place as one of the most important of all factors to success in scientific investigations. You may feel it a little bothersome to have to write down patiently your various observations as they are made, and you may feel that your memory is quite sufficiently trustworthy. But after you have made a few observations you will very quickly find that they have become hopelessly confused if carried only in the memory, and the net result will be that there will be, at the least, a degree of uncertainty as to what it was you have really found out. The moment there is any degree of uncertainty whatsoever as to the results of your observations, you may as well forget the matter and start all over again and do the thing right. Thus it is easy to see that time and trouble would, in fact, have been economised had the work been done properly in the first instance.

Always keep a written record of any observations which you make when carrying out experimental work and, as soon as you have finished an experiment, sit down and consider very carefully the interpretation which is to be placed upon the observations which you have made. Do not, for example, leave the records until the next day, but consider them whilst the whole matter is fresh in your mind, as such consideration will indicate to you the direction which the next day's experiments should take.

"THE Wireless Trader' Year Book & Diary" for 1927 (published by the proprietors of "The Wireless Trader," 139–140, Fleet Street, E.C.4), contains nearly 400 pages of trade facts and information, readily supplying answers to the innumerable problems met with by Wireless Traders in the course of business.

Revised and thoroughly up to date, the new edition, beside providing a useful interleaved Diary, contains an Alphabetical List of Trade and Professional Addresses of Manufacturers, Agents, Associations, and Publishers; a comprehensive Guide to Goods Supplied and Services Rendered; a List of Factors (arranged territorially); an Alphabetical List of Proprietary Names of Wireless Sets and Components; data on Technical and Broadcasting matters, and a wealth of other trade information. The price is 5s. 6d. (7s. 6d. Overseas).

R/R



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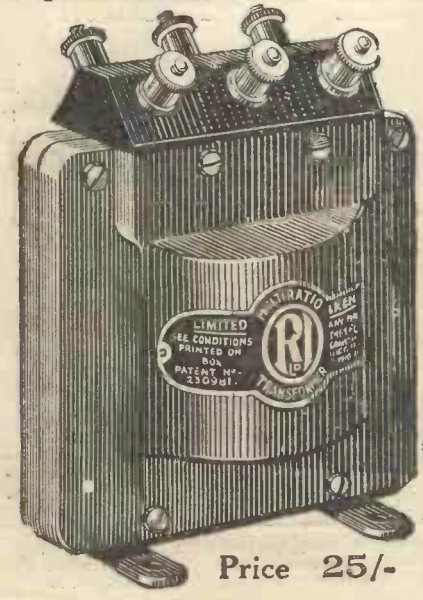

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"How copious is the emission given by the filaments of your valves over a range of filament temperatures?"

IT may seem strange to you that the emission of a valve filament can make a marked difference in the way your receiver operates and in the cost of its upkeep.
If, for example, your set is "all out" when receiving a station, say 100 miles away, you have small hope of securing weaker distant stations as your friends may do, moreover, your battery consumption is naturally at its highest under these conditions.

Why—great emission makes all the difference

When a valve filament gives a copious and sustained emission at the correct filament temperature, a rich field of power is placed under your control which enables the best conditions to be secured to deal with the incoming signals, so that your

receiver is adjusted to suit the particular circumstances existing at the time.
The local station may be tuned in purely and strongly with the minimum of energy expended because valves that possess a huge emission are able to function perfectly at considerably less than their full capacity.
Then, as you reach out for more-distant stations or weaker signals, you are able to adjust the operating energy of your high emission valves, particularly in the detector stage, to suit the exact demands for ideal reception. It will be realised that by the use of Mullard P.M. valves with their abundant electron emission you will save upkeep costs since your receiver will only consume minimum energy from your batteries.

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Convincing proof of the high emission of the wonderful P.M. Filament was recently given by the 1000 hours' test report of the National Physical Laboratory. This proved that the emission of Mullard P.M. Filaments was so abundant and consistent that an 18/6 Mullard P.M. Valve was still worth 18/- after 1000 hours' continuous life test, equivalent to a year's broadcasting service.
Bring your radio receiver up to the highest pitch of efficiency by installing Mullard P.M. Valves with the wonderful P.M. Filament and remember they consume absolutely minimum current.
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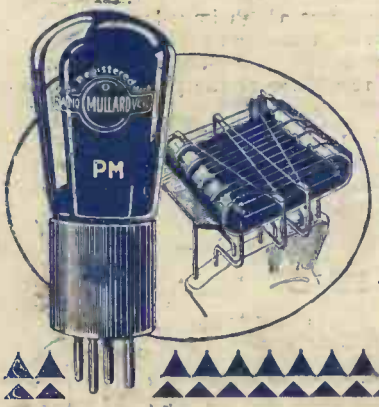

Sectional view of P.M.5 showing generous proportions of P.M. Filament

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R/R