POPULAR WIRELESS AND WIRELESS REVIEW, October 30th, 1926. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

A FREE GIFT AND A NOVEL PRIZE COMPETITION.

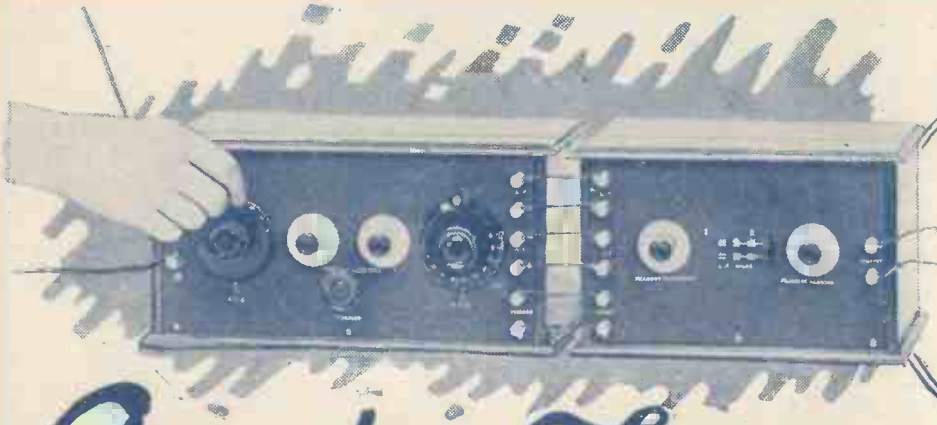
Popular Wireless

Every Thursday PRICE 3d.

No. 230. Vol. X.

Scientific Adviser: SIR OLIVER LODGE, F.R.S.

October 30th, 1926.



72 PAGES Price 3d. as usual

Another Free Gift!

The 3rd "P.W." Constructors Guide

The Radio Constructor.
New Supplement.
Edited by
PERCY W. HARRIS.
Starts in this issue.

£200 in Prizes for "P.W." Readers

Sound, crystal clear, full, mellow as Autumn sunshine fills the room. It is the great concert hall; there stands the singer, world adored; you have but to raise your eyes to see—such is the illusion of the Mellovox—the beautiful medium of wonderful melodies.

THE STERLING MELLOVOX LOUD SPEAKER

Not all singers look beautiful, not all beautiful women sing sweetly. If you want a beautiful thing to admire while you enjoy music of pure mellow beauty, you want the Sterling Mellovox, the newest gift of creative genius. It is made in four colour arrangements of blue, brown, black and purple with gold tracery of flower and leaf. A hinged connection enables the sound to be projected in any desired direction.

45/-

And here are two fine examples of the Sterling Range of Horn-Type Speakers

STERLING 'DINKIE' LOUD SPEAKER

Wonderfully efficient. Renders faithful reproduction and extensive volume. Adjustment lever facilitates micrometer adjustment. Unsurpassed by any instrument of similar class. Height 13 ins. Brown tinted or black and gold finish **£1.10.0**

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Accurate tone quality and elegant appearance. Non-resonant tone channel and horn do not produce any particular frequency at the expense of others. Height 23 ins. Mahogany or walnut finish **£5.5.0**

Ask any wireless dealer for a demonstration or write us for booklet describing the full range of Marconiphone and Sterling Loud Speakers, Receivers, Valves and Components. Marconiphone and Sterling apparatus may be purchased on deferred terms. Particulars on request.

THE MARCONIPHONE COMPANY, LIMITED

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

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

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

At last an Accumulator which can be charged quickly but discharged slowly

AFTER successfully solving the problem of the H.T. Accumulator, Oldham now presents in the new O.V.D. a slow discharge Accumulator incorporating entirely new principles of construction. With the growing popularity of Dull Emitter Valves there has been an incessant demand for a small accumulator suitable for use with two- and three-valve sets, capable of holding its charge over long periods without sulphation. Read below and see how, in the new O.V.D., Oldham has now overcome every previous obstacle.

ON the introduction of the Dull Emitter Valve, a new problem began to loom on the horizon for the accumulator manufacturer. With the valve-maker producing valves of almost negligible consumption it became increasingly obvious that old ideas had to be swept overboard. The old idea was that an accumulator should last the average valve set anything from a week to a fortnight and should then be recharged. That was alright with bright emitters consuming ·75 amp. each but when consumption was dropped to one tenth of an ampere at 2 volts, a new kind of accumulator became necessary. An accumulator which would hold its charge for weeks on end without the necessity of recharging.

Oldham solves the problem of re-charging

Here, then, was the problem — how should it be solved? One way would be to increase the thickness of the plates. But this introduces another difficulty — the difficulty of recharging. Obviously a thick plate will hold its charge for many weeks. It won't buckle and it is reasonably free from the risk of sulphation. But it cannot easily be recharged. It must be charged slowly and for a long period on end. Compare the thick plate if you like to a thick mass of absorbent material dipped in liquid. It will take a long time for moisture to penetrate to its inmost recesses, but cut it in strips and the liquid can take effect at once. That was exactly what Oldham did. The new Oldham O.V.D. plate is the equivalent of a thick plate made up of laminations. Electrolyte can penetrate completely through the plate and get to work upon its several surfaces. So the new O.V.D., therefore, incorporates every advantage of a thick plate with none of its disadvantages. It can be charged quickly — that is to say, at the normal accumulator charging rate. There is no fear that it can be damaged during charging. And it will readily take up its charge.

Type O.V.D.

2 volts—for use with Dull Emitter Valves. Fitted with the new Laminode Plate. Dimensions 6 ins. by 3 ins. by 2½ ins. 10 amp. hours.

5/6

A plate that cannot buckle or sulphate

The new O.V.D. plate, owing to its exceptionally rigid girder-like construction, cannot buckle. Nor can it sulphate even if left for months without being recharged. Owing to the internal construction of the stout glass cell no separators are necessary.

The new O.V.D. supplied charged ready for use

This new Accumulator is supplied "dry charged." This means that it has already been charged at the factory. Merely add acid and wait for a short while for the cell to get active and it can be used at once. Think how this will benefit you. No long first charge to delay you. The O.V.D can come straight off the dealer's shelf to your home and within an hour can be delivering its stored-up energy.

Every O.V.D. made under the Special Activation Process

The famous Special Activation Process which has made the name Oldham a household word for reliable accumulators is used in the O.V.D. Its Laminode Plates are manufactured under the same conditions as other Oldham plates. As a result the same high standard of efficiency is available At the low price of 5/6 the new O.V.D. offers remarkable value. Its stout clear-glass container—rugged enough to withstand even the hardest knocks—its coloured terminals of generous size—and its non-splash vent cap bespeak the quality product. Ask your Dealer about it to-day.

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Phone: Sloane 2701

Special Activation Process Batteries

OLDHAM

Makers of the Oldham H.T. Accumulator, famous for its expanding bookcase principles of construction.

Gilbert Ad. 6156.

Choose your programme—

these Eureka Ortho-cyclics will find the Station

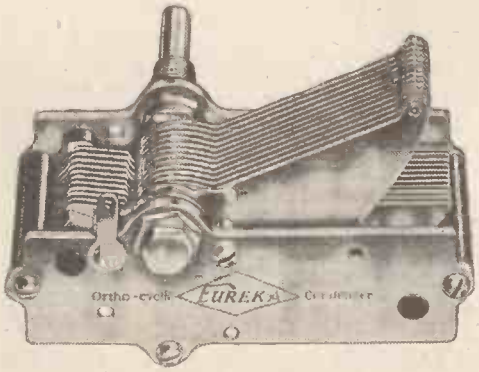
AT last here is a variable Condenser which makes station hunting a pleasure. The Eureka Ortho-cyclic utilises new principles of tuning. The old idea of crowded wavelengths jostling each other at one end of the dial has gone for ever. In the Eureka one degree on its 100° dial covers one Geneva wavelength of 10 kilocycles separation, irrespective of its position. The first fifteen degrees on the dial covers fifteen wavelengths precisely—no more and no less. Whereas this same movement with an ordinary Condenser would cover no less than 51 possible wavelengths. And the second fifteen degrees on the Eureka Ortho-cyclic still covers only fifteen wavelengths—and so on right through the dial one degree equals one wavelength. As evenly, in fact, as the rungs of a ladder.

This is the kind of tuning you have always longed for. Now you can get razor sharp selectivity at small cost. The new Geneva wavelength plan makes ortho-cyclic principles of tuning essential. The ether is being divided into wavelengths of 10 kilo-cycles separation. That is to say, using a Eureka Ortho-cyclic Condenser there can never be more than one station to any degree on the dial. It will be impossible with a sensitive Set equipped with Eureka Ortho-cyclics to hear two stations at the same time.

See this all-metal, low loss, Condenser at your Dealer's to-day—you will be amazed at its low price for such a beautifully constructed instrument.

Six exclusive Eureka features:

1. Compact design permits a panel depth of only 2 inches.
2. Ball bearings throughout ensure velvet-smooth action.
3. One-hole or three-hole mounting as desired.
4. Electrical losses so low as to be negligible.
5. Earthed rotor ensures stable reception.
6. Permanent contact guarantees continuous silent performance.



Prices:

·0005 mfd. - 15/6

·0003 mfd. - 14/6

SLOW MOTION DIAL

Engraved 0 to 100, right to left, for kilo-cycles, and 0 to 100, left to right, for wave-lengths. Beautifully constructed in metal throughout to fit all Condensers, including the Eureka Ortho-cyclic, with ¼-inch shafts. Easily fixed to set. Price 4/6

EUREKA ORTHO-CYCLIC CONDENSER

Advt. Portable Utilities Co., Ltd., Fisher St., W.C.1

Gilbert Ad. 6150.

The "Cosmos" Rheostat.

The "Cosmos" Permacon.

The "Cosmos" Coupling Unit and spring valve holder.

Ask your dealer for these attractive folders on "Cosmos" Valves, Sets and Components.

Cosmos
RADIO COMPONENTS

ensure reliable sets.

Constructors who desire smooth working and efficient sets use "Cosmos" Precision components.

The "Cosmos" Rheostat. The principal features of the "Cosmos" Filament Rheostat are its sturdy construction and reliable, smooth movement. The contact arm cannot easily be damaged, having its movement on the inner side of a porcelain bobbin which carries the windings. Other pleasing features of this Precision Rheostat are the handsome knob and dial, ONE HOLE fixing, and the small space it occupies.

Made in four types, two of which are double-wound for DULL or BRIGHT Valves and one a Potentiometer.

Description	Ohms.	Currents	Price
			s. d.
Single Wound	6·0	1·0 amp.	4 6
Double ,,	20	·4 ,,	5 0
,, ,,	34	·2 ,,	5 0
Potentiometer	300	—	6 0

The "Cosmos" Permacon is an ideal fixed condenser, being light in weight, of guaranteed accurate capacity, and having the lowest possible losses.
The dielectric is mica, and each condenser is tested at 500 volts during inspection. Nickel-plated cases give them a particularly neat appearance.

·0001 mfd.	1/6	·001 mfd.	1/8
·0002 ,, ...	1/6	·002 ,, ...	1/10
·0005 ,, ...	1/6	·005 ,, ...	2/8
·0003 ,, (with clips for grid leak)	1/8	·01 ,, ...	3/9

The "Cosmos" Coupling Unit. Real purity of reproduction can only be obtained with resistance capacity coupling. The "Cosmos" coupling unit with a suitable valve is as effective as an ordinary transformer-coupled stage. It avoids all distortion and effects considerable economies in first and operating cost.
Designed primarily for use with the "Cosmos" S.P. Blue Spot Valves, it can be used successfully with any valve having an amplification factor of 30 or more.

Type "O," the Unit alone 8/6
Type "V," the Unit incorporating spring valve holder *(as illustrated)* 10/6
Suitable valves for use with this unit are "Cosmos" S.P. 18/B at 14/- and "Cosmos" S.P. 55/B at 18/6.

METRO-VICK SUPPLIES LTD.

(Proprietors : Metropolitan-Vickers Electrical Co., Ltd.)
METRO-VICK HOUSE,
155, CHARING CROSS ROAD, LONDON, W.C.2

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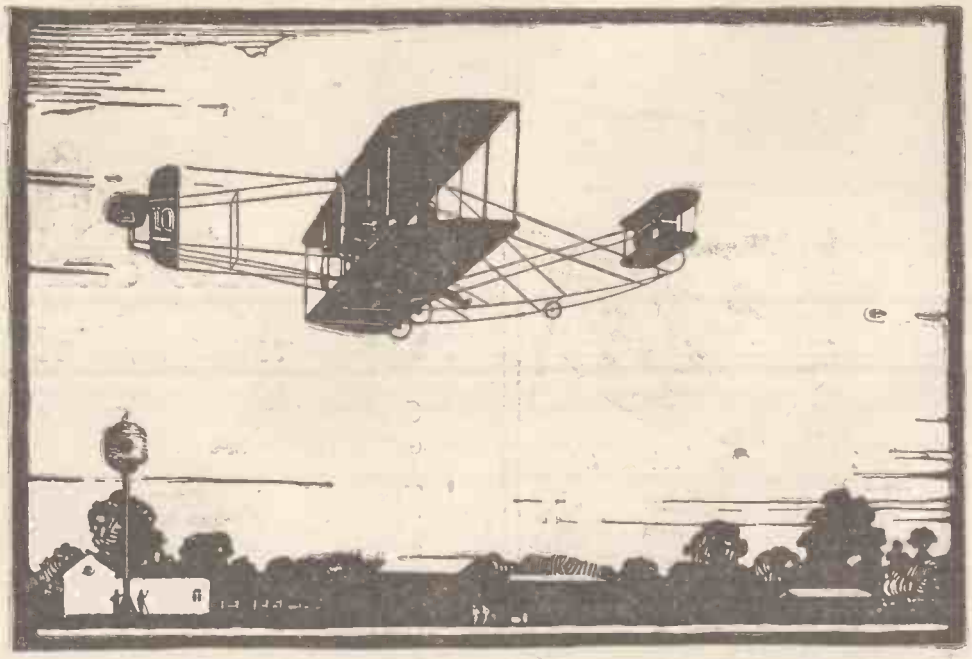
P54



In 1910

In 1910 arose the problem of designing condensers for aircraft wireless sets.

The glass Leyden jars of those days were too bulky and too fragile, and there was no other suitable condenser made.

Thus it was that William Dubilier turned his attention to the subject and commenced his pioneer experiments. He immediately realised that to design a condenser which should be compact, unbreakable, and at the same time efficient under the high frequencies and voltages of wireless circuits would call for much specialised research.

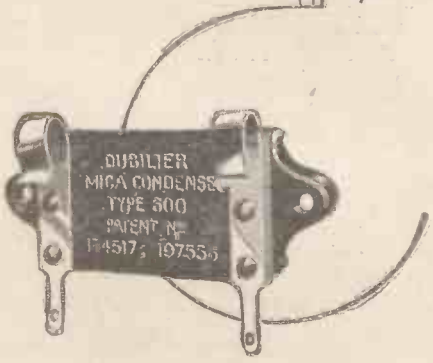
He was successful in that same year in producing the first condenser to meet these requirements. Its dielectric was Mica.

Three years later, encouraged by the War Office, he commenced upon the manufacture of condensers on a large scale, and the Dubilier Condenser Company at once assumed the leadership which it holds to this day.

For sixteen years we have specialized in the manufacture of wireless condensers, and for all products bearing our name we have continuously insisted upon that high standard of efficiency which we as Radio Engineers know to be so essential.

Naturally this high standard implies a slightly increased selling price, but it undoubtedly results in the production of condensers in which you *can* have complete confidence.

And the possession of such condensers is essential to good results whether you build a crystal set or conduct laboratory research.



Specify—

DUBILIER

ADVERT. OF THE DUBILIER CONDENSER CO. (1925) LTD.,
DUCON WORKS, VICTORIA ROAD, NORTH ACTON, W.3.
TELEPHONE: CHISWICK 2241-2-3.

E.P.S. 220

The New H3Q Loud Speaker

The latest example of Brown craftsmanship. Unequalled in the quality of its reproduction. 2,000 ohms. PRICE £3 5s.

With a Watchmaker's eye for accuracy and precision

THE proverbial accuracy of the old Swiss watch is attributable to one fact—the minutely precise attention to detail by the master who made it. Only a craftsman loving his work could produce such marvellous examples of precision.

The same conscientious workmanship, the same eye for detail is strikingly evident to-day in the most modern example of instrument making—the manufacture of Brown Loud Speakers and Headphones. To this scrupulous carrying out of the unique principles of design, which are the basis of each individual instrument, is attributable the success and the world-wide fame which Brown Loud Speakers and Headphones enjoy.

First in the field among Loud Speakers in England, the Brown has never looked back. The high standard of workmanship and the discriminating selection of only the finest materials never wavers; for only by such rigid principles can instruments be produced which are to be unfailingly relied upon to interpret in a faithful manner *every* phase of the Broadcast, now, and in years to come. Your Dealer will demonstrate any model—call in to-day and ask him!

The Brown Disc Loud Speaker.
2,000 ohms. resistance.
Oxydised Silver **£8 : 8 : 0**
Black and Gold **£7 : 7 : 0**

Brown

S. G. BROWN, LTD., Western Avenue, North Acton, W. 3.

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

A lesson from the chain

A warning whistle—a "Stand Clear!" and the steel Goliath swings its burden, dangling on the end of an iron chain, through space. The old adage says, "A chain is no stronger than its weakest link." The constant lifting of heavy weights imposes a severe strain on a chain. The molecular structure of its metal becomes changed. To use a technical term, it becomes crystallised or brittle. And a brittle chain would be a danger because it might readily snap. But engineers have a remedy. At regular intervals the chain is annealed and the displaced and distorted molecules are permitted to resume their normal positions.

You may not be interested in cranes, but as a wireless enthusiast you are certainly concerned with the molecular structure of metal. Take, for example, the filament of an ordinary valve. It becomes incandescent in use—the intense heat slowly alters its molecular structure and makes it brittle. That is why it fractures so readily. It has lost its pliability through excessive heat.

An entirely new kind of filament has now been produced, however, which operates practically without heat. It is only to be found in Cossor Dull Emitters. This Kalenised filament can *never become crystallised* or brittle because it functions without visible glow. But long life is not the only advantage to be derived from the Kalenised filament. Its low specific resistance permits an exceptional length being used. Obviously a long filament will give off more electrons than a short one. And the efficiency of a valve is measured by its electron emission.

Co-Axial Mounting, too, ensures that this long filament is mounted in absolute alignment with the grid and anode. The whole structure is permanently interlocked by means of a seonite insulator at its head. Even the hardest shock cannot displace either the filament, the grid or the anode. As a result, lifelong uniformity of characteristics is assured.

The combined use of Co-Axial Mounting with the new Kalenised filament will give you greater sensitivity, complete freedom from microphonic noises, superior tone and greatly increased length of life, while current consumption has been reduced to one-tenth of an ampere at 1·8 volts. Your dealer has these remarkable valves in stock.

TYPES AND PRICES

Red Band. Pre-eminent among H.F. valves. Consumption ·1 amp at 1·8 volts **14/-**

Black Band. An ideal super-sensitive Detector. Consumption ·1 amp. at 1·8 volts **14/-**

The New Cossor Stentor Two

Green Band. For Power Valve use—ideal for Super Sets. Consumption ·15 amp. at 1·8 volts **18/6**

The new Cossor Point One

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

Gilbert Ad. 6145.

Popular Wireless

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RADIO NOTES AND NEWS.

The Mars 14-Valve Set—B.B.C.'s Birthday Week—Home Secretary to Broadcast—Who is Pronto?—Aerial Slashing.

The Mars 14-Valve Set.

MARS will be receding from the earth again by the time these lines are in print, and no doubt the daily papers will have given the latest news of "P.W.'s" attempt to pick up signals from the mystery planet. At the time of writing the tests of the 14-valve set—specially constructed for Mars—have been carried out, and have given proof that it is one of the world's wonder sets. In "Current Topics" this week will be found further details of this remarkable radio receiver.

A Public Display.

LONDON listeners will be interested to know that arrangements are being made whereby they will have an opportunity of seeing the 14-valve set. It will be on view in the Oxford Street window of Selfridge & Co., Ltd., as soon as possible after the Mars tests have been completed.

It has been suggested that a demonstration of the set might be given, but Mr. Selfridge informs me that reception of distant stations is almost impossible in the great steel building. Placed right in the shadow of 2 L O, which transmits from the roof above, even an 8-valve super-het. cannot pick up other stations. But, of course, there is no knowing what the wonder set would do, even under such conditions.

Home Secretary to Broadcast.

THE Home Secretary is due to broadcast on Tuesday next, November 2nd. On this date he will be speaking from the Mansion House, London, in connection with the Wireless for Hospitals Fund.

New Set Like a Stage.

ONE of the cutest ideas that I've heard of for a long time is that adopted by an American competitor, in a set-building contest in New York. So as to make the programmes sound realistic, he concealed his loud speaker inside a miniature theatre upon the top of the set. When the set is switched on the curtain rises, and the loud speaker's voice comes from behind the footlights!

B.B.C.'s Birthday Week.

THE special B.B.C. Birthday Week broadcasts will open with a Huguenot service, from the crypt of Canterbury Cathedral, on November 7th. This will be followed by a performance of "The Messiah," conducted by Sir Henry Coward, who is bringing a strong chorus to London from Sheffield.

Capt. Orlinski, the famous Polish airman who flew from Warsaw to Tokio and back, broadcasting a flying talk.

On Thursday, Nov. 11th, special Armistice Day programmes will be broadcast, morning, afternoon and evening.

"P.W." READERS' QUERIES ANSWERED at SELFRIDGE'S.

On [illegible]MBER 28th and 29th, in Selfridge's Wireless Demonstration Lounge, Oxford Street, Mr. PERCY W. HARRIS will be present between the hours of 1 and 3 p.m. to meet and discuss radio problems with amateurs who carry with them current copies of "P.W."

Readers of "P.W." will thus have an opportunity of meeting the Editor of the "Radio Constructor" in person.

Who is Pronto?

AS several readers have claimed that they have picked up the Pronto station, I think it's about time somebody came along and pricked this Pronto bubble, good and hard. For if you sit up all night and listen to every programme that's in the ether you won't get Pronto, 'cos there's no such place.

As a matter of fact, I think that the station that keeps saying "Pronto" is Naples, Pronto being a word much used in Italian tests. Anyhow, if it isn't Naples, it certainly isn't Pronto.

Killed by Radio.

A FEW months ago I chronicled the accidental death of an American announcer, killed through touching a live wire at the broadcasting station. Now I am sorry to have to record a similar fatality at the Rugby station, the first accident of the kind in Great Britain. The victim was Ralph Leary Oldfield, an electrician whose home was at Folkestone. He was in charge of the power-house at the time, and nobody was aware of the tragedy until his dead body was found, with the hand burned through coming into contact with a wire carrying 3,000 volts. The proper entrance to this part of the building is by a gate that automatically switches off the current when opened, but for some reason he appears to have climbed into the enclosure by means of a ladder, and thus deprived himself of the usual safeguard.

The Falling Off of 5 X X.

RECENTLY I had a grouch about the strength of Daventry, which during the past few months has fallen off badly, leaving many listeners right in the lurch. Ever since I have been hoping for a marked improvement, but it seems a long time coming. Many correspondents complain that 5 X X is no better than some of the German stations; and it is a fact that while Daventry has been going down the hill, the Germans have been practising the

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

"Excelsior" stunt, and have climbed steadily. What's the matter with the British Long-wave-fellow ?

"My Programme."

THE third of the special programmes selected for the B.B.C. by famous people is to be given on Saturday next, October 30th. On this occasion the Rt. Hon. J. R. Clynes, M.P., will give us his idea of a good evening's entertainment, the items he has selected starting at 8 p.m. and concluding at 10.15 p.m.

It was Mr. Clynes who, as Lord Privy Seal in the Labour Government, first introduced the microphone to Downing Street, by permitting the broadcasting of a reception held at No. 11.

Aerial Slashing.

A NORWOOD reader tells me that there has been an epidemic of aerial-slashing in Upper Norwood. Apparently a gang of half-witted hobbledehoys, with receding chins and a crude sense of humour, think they are being funny when they succeed in cutting a wire or two, and bringing down receiving aerials. They ought to be exterminated, like any other wretched wireworms.

National Wireless Week: NOVEMBER 7th—13th, "Let your Friends Listen."

The Coal Question.

"WHO is responsible for all this *same*-ness about the programmes ?" writes a critical correspondent. "All I can hear on my set is coal, and what the coal-miners are doing, the price of coal, the coal-owners' views, and conferences on coal, and a daily musical interlude by Mr. Maurice Cole."

So I've written and told him the fault's not "mine"!

New Broadcasting Authority.

MRS. PHILIP SNOWDEN is being mentioned as one of the Commissioners who will be appointed to help Lord Clarendon on the new British Broadcasting Corporation.

The Corporation will take over from the B.B.C. on January 1st, and although time is getting short, there is great official reticence about the new concern that in future will control broadcasting. Lord Clarendon's appointment, first forecast in this journal, is now generally accepted as a fact, but apparently we must wait for the full official announcements until the P.M.G. makes a statement in the House next month.

Always and Always.

"THE great contralto arranged her Lady Duff Gordon gown with infinite care. She touched her hair daintily so that each strand was meticulously in place. She bowed her lips and powdered her nose with infinite care. The great audience was waiting——

"'Ladies and gentlemen,' spoke the radio announcer, 'Madame Jupre will now sing "Always."'"—"Radio Digest."

The Hofmann Recital.

INTERVIEWED upon his arrival in England, Josef Hofmann, the world-famous pianist, declared he was going to play Liszt's Rhapsody No. 2 to the microphone, because a wireless fan asked him to do so ! The enthusiast in question was an emigration official who seemed suspicious of the great pianist until he was shown the B.B.C. contract. Immediately the word "wireless" was mentioned all his doubts vanished, and the atmosphere became so friendly that the official asked Mr. Hofmann to oblige with the Second Rhapsody, and obtained the promise !

TECHNICAL TERMS ILLUSTRATED.

THERE was a stout lady dispenser,
So fat that she thought she'd commence a
Reduction of diet.
She started to try it—
But nothing on earth could —|—

Short-Wave Programmes.

A WILLESDEN reader tells me that using the detector portion only of the Simonds Short-wave set, he gets a strange foreign station, transmitting music, etc., late in the evenings. The wave-length is a little below Königswusterhausen's, and the power and quality apparently too good for an amateur. Can anyone identify these transmissions ?

SHORT WAVES.

Lord Clarendon's appointment suggests a variation of the Gilbertian lines :

"I listened to my two-valve set so carefully
That now I am the ruler of the B.B.C."
("Daily News.")

* * *

It is a well-known saying that : "Children should be seen and not heard." But if they want to make good radio artistes, surely they should be heard and not seen !

* * *

"On Short Waves to Australia" was a recent headline in the "Daily Telegraph." A passenger to that country, when reading this, was heard to remark that she wished the waves she went over on had been a lot shorter.

* * *

We understand that one of the aunties who has recently been married says she will broadcast just as she did before. Great relief has been expressed that it will be no worse.

* * *

"He swore terribly at me in a broadcasting voice," said a man at Mansfield Police Court.
("Daily Mirror.")

An announcer, perhaps.

* * *

Enquiries were recently made as to why the wireless music always seems so loud in the lounge of a certain well-known hotel. One suggestion is that it is to drown the groans of the visitors paying their bills.

* * *

"A discussion followed on whether the society should have a permanent transmitter, but this was dropped when it was stated that if they did so on a wave-length of 150 to 200 metres, it would cause interference with listeners round about." ("Sheffield Independent.")

Surely the set could have been dismantled and the parts used for another set, without dropping it ?

* * *

A correspondent from Glasgow asks how long wireless receivers should be used.
(Suburban Paper.)

In the same way as short ones, surely ?

* * *

An inventor claims to have made a four-valve set that is so sensitive that it can pick up last week's programmes. But wouldn't it be much better to bury the past—and bury it deep, too ?

Valves Given Away.

AT every meeting of the Bristol and District Radio Society, the assembled members ballot for a valve ! Readers living in the vicinity who fancy their luck should join up and have a go for one of these buckshee bulbs. The secretary's address is Mr. J. R. Houghton, 2, Elm Lane, Redland, Bristol.

Britain's S.B. Scheme.

ON or about November 1st, the B.B.C.'s new line-repeater station at Gloucester will be ready for service. Designed to improve simultaneous broadcasting, and to provide a better land-line link between London and the West, it will do for the West Country stations what the Leeds repeater is already doing for the northern stations. In future Plymouth or Cardiff will be able to tap in to the London and other programmes at the Gloucester switchboard, instead of duplicating lines right across the whole country.

A Wireless Winner.

AN Edinburgh boy, John Hood, who has won a £200 scholarship, owes his good fortune to broadcasting. His father, listening in one night, heard an announcement that entries were being received for this scholarship, which entitles the winner to two years free education at Geelong College, Victoria. The application was made, examinations followed, and now young Hood is to proceed to Australia, where he may study for a commercial, professional, or farming career, whichever he pleases !

Another Station for Denmark.

I AM informed by the Standard Telephones and Cables, Ltd. (formerly Western Electric Co., Ltd.), that the Danish administration have just ordered a complete 5 kw. broadcasting station from them. It is to be erected at Kailundborg, and all the equipment will be made in London.

The New "Beam" Stations.

THE new "beam" transmitting station at Bodmin with its corresponding receiving-station at Bridgwater, and their "opposite numbers" in Canada, have opened a new era in wireless communication. They are the first of their kind in existence, arranged to focus the radiated energy into a beam, like a searchlight, instead of broadcasting it in all directions. Bodmin uses a power of 20 kilowatts, and 95 per cent of the energy is directed along the beam.

Could They Handle Broadcasting ?

SENATORE MARCONI is hopeful that the stations could be used to transmit ordinary broadcast programmes to and from Canada, in just the same way that they can transmit ordinary morse messages. All the stations had to pass a severe test before they were taken over by the Post Office, and opened for public messages to Canada. For a whole week, from October 7th to 14th, they sent and received messages between England and Canada, at the rate of 100 words a minute. And not only was this great speed maintained, but they did it for 18 hours out of every 24 !

ARIEL.

SHORT WAVE PROBLEMS

Mr. Simmonds in his laboratory at Gerrard's Cross.

A Special Article by a foremost British Transmitter on Short Waves,
E. J. SIMMONDS, M.I.R.E.
(Staff Consultant.)

WITH the approach of autumn and winter conditions, many experimenters interested in the reception and transmission of short wave-lengths will be devoting increased attention to this fascinating and useful work. To such this article is addressed, as it endeavours to indicate a *few* of the many problems to which time may be profitably given, and to press the importance of careful experimental work on definite lines as opposed to mere DX work.

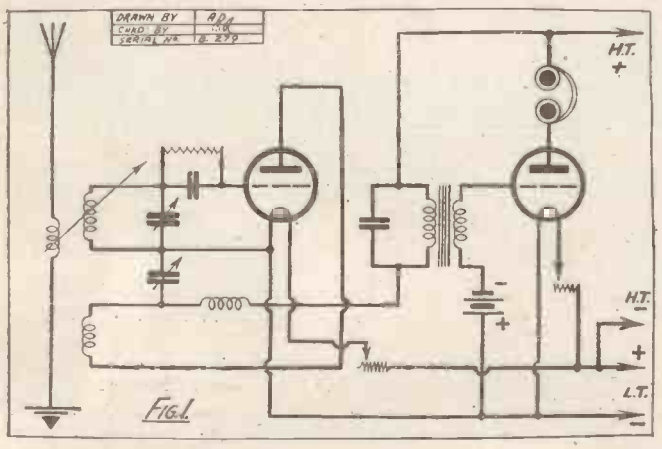


FIG. 1.

The foundations of amateur short-wave work were undoubtedly laid by the DX work of the amateur pioneers, but with the technical knowledge now available regarding the behaviour of short waves, and the increased efficiency of transmitter, aerial and valve design, it becomes possible under the necessary favourable conditions to exchange signals with *any part of the world*, using input powers of less than 100 watts. Clearly, therefore, unless future amateur short-wave work is carried out on well-defined lines, with special regard to the many outstanding problems, its usefulness will be much restricted.

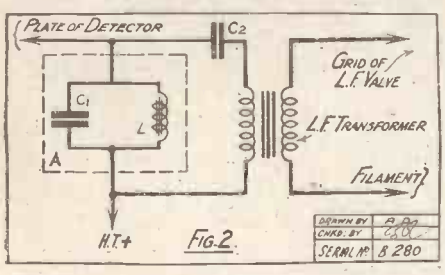


FIG. 2.

It is of utmost importance that all workers should keep a log wherein should be entered the *fullest details* of each reception or transmission, the local meteorological conditions, particulars of periodical fading effects, etc.

If you are a transmitter, and in two-way communication with, say, an Australian or New Zealand station, inquire the meteorological conditions at the distant station, also when your signals were first audible, and the "fading away" period. During your communication also obtain frequent values of your signal strength from the distant operator, and if possible carry out this daily programme with the same station for a fortnight or more.

From the data thus available it will be possible to plot a curve of the diurnal signal strength variations of the transmitter at that particular receiving station, and if the tests are spread over a long period, the seasonal variations will also be apparent. Obviously the transmitter and receiver adjustments must remain as constant as possible during such tests. This is given as an example of what may be accomplished by careful and systematic log work.

Efficient Receiver.

A simple two-valve receiver (1 Det. and 1 L.F.) of efficient design and layout suitable for these wave-lengths, and which can be thoroughly recommended, is indicated in Fig. 1.

The broad details of this type of receiver have been dealt with in past numbers of this journal, and it is therefore not necessary to discuss them again here.

There are, however, some points of improvement, which are worthy of consideration in the design of the L.F. part of the apparatus, which add considerably to the selectivity of the set. It is the endeavour of the designer of modern L.F. transformers for broadcast reception to obtain, as far as practicable, equal amplification throughout the range of musical frequencies, and this condition is of primary importance to obtain faithful reproduction. The use of an L.F. transformer of this type in a short-wave receiver, which is, of course, designed for Morse reception, will amplify with the desired signal all other interfering sounds caused by atmospherics, 50 cycle A.C. main hum, etc., resulting in a noisy background of sound, against which it is difficult to read weak signals.

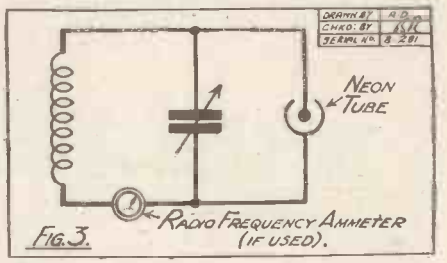


FIG. 3.

Utilising Transformer Peak.

If, however, an L.F. transformer with a sharp amplification peak between 800 and 1,000 cycles is used, in conjunction with telephones of the reed type which are also resonant to these frequencies, the pitch of the C.W. signal can be arranged to fall within this band, and will then be amplified to a much greater extent than the other interferences. Many of the older types of transformers designed in pre-broadcast days are still available, and have this desired amplification characteristic.

Another method of note tuning is indicated in Fig. 2, which shows the primary of the L.F. transformer shunted by a trap circuit, A, which may be tuned to any desired audio-frequency.

(Continued on next page.)

SHORT-WAVE PROBLEMS.

(Continued from previous page.)

This trap circuit will by-pass practically all frequencies except the band for which it is tuned. This selected band, which by suitable design may be quite narrow, is passed on to the L.F. valve for amplification, and the unwanted audio-frequencies are effectively filtered out. The following are suggested values for the components: L = 1 Henry iron core choke, which should have the self-capacity reduced to a minimum; C1 = 0·1 mfd.; C2 = 0·01 mfd.

The L.F. transformer may be of the modern design. The values of L and C indicated for the tuned trap will give an approximate frequency of 800 cycles. This value, of course, may be changed to suit individual requirements, and also the resonant frequency of the telephones by changing the values of either L or C in the trap circuit A.

Every experimenter should use a wave-meter, and wave-length readings of all stations heard should be entered in the station log with other details of the transmission. During the course of the year the writer receives a very large number of postal queries relating to the wave-length of particular stations, showing that few workers are equipped in this particular. For ordinary reception purposes the wave-meter need not be an expensive instrument, as a simple oscillating circuit (see Fig. 3), will function as an absorption wave-meter. The necessities in constructing such an instrument are a variable condenser, good both electrically and mechanically, and an inductance of such design that while electrical losses are reduced to a minimum, due regard is given to rigidity of construction in order that calibration may be held with reasonable accuracy.

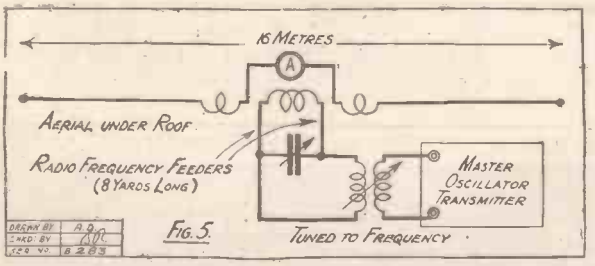


FIG. 5.

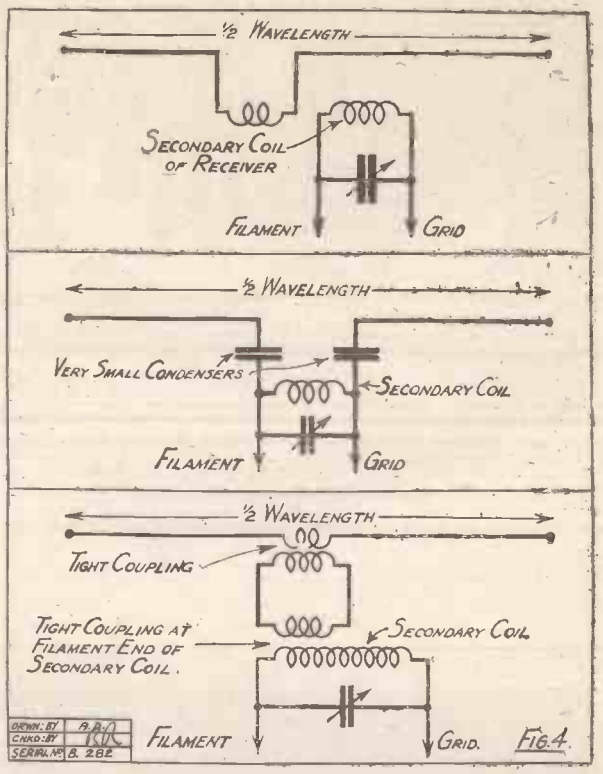


FIG. 4.

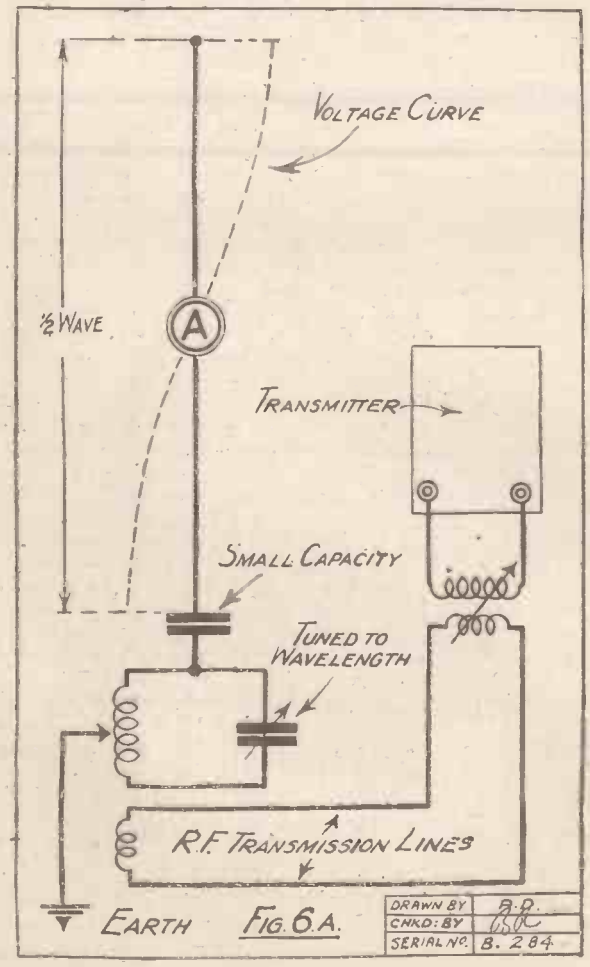


FIG. 6.A.

Neon Testers.

In operation the wave-meter is placed in the oscillating field of the secondary (grid) coil of the receiver, and a sharply defined click is heard in the telephones of the receiver when the wave-meter is tuned to resonance. The addition of a small neon tube such as is used in standard spark plug testers (see diagram) gives a visual indication when the wave-meter is used in transmitter adjustment, the neon tube glowing brightly with the characteristic orange glow when the circuit is tuned to the frequency of the transmitter. In this connection greater accuracy and sensitivity can be attained by using a Weston Thermo-couple Radio-frequency ammeter instead of the neon tube.

A recent development of great interest and utility is the work of Dr. Greenleaf Pickard, of U.S.A., on the horizontal reception of short waves. This is a branch of work particularly suitable for amateur investigators, as the apparatus required is not costly, and suitable aerials may be erected with ease. An aerial under the roof or along a suitable indoor passage will be found to work well, and a standard two-valve receiver (det. and 1 L.F.) will be quite sufficient for C.W. reception.

The added sensitivity of the supersonic heterodyne to modulated transmissions will be an advantage when telephony is being received.

Fig. 4 indicates types of aerial suitable for this work, and it will be observed that they essentially consist of a symmetrical horizontal component connected to the detector by two parallel radio-frequency lines.

The best results will be obtained if the dimensions of the horizontal component are a half wave-length, giving a current node at the centre. Thus for 40-metre reception the horizontal portion of such an aerial might be approximately 20 metres in length.

Recent Results.

If possible a short vertical outdoor aerial with usual earth connection should also be erected, in order that direct comparisons may be made between the reception factors of the two aerial systems, and to this end arrangements should be made to quickly switch from one aerial to the other so that signal strength variations on the two systems may be noted.

Those workers interested in the problems of short-wave transmission can use these types of radiators for transmission with good results, and it may be of interest to refer to the recent work done by the writer on indoor aerials.

Using an aerial under roof of house, as shown in Fig. 5, both for transmission and reception, consistent two-way communication was maintained with Australia for two hours each morning, giving an average signal strength of R 4 at the Australian receiver. The wave-length used for these tests was 32·1 metres, with an input of 100 watts to a master oscillator transmitter.

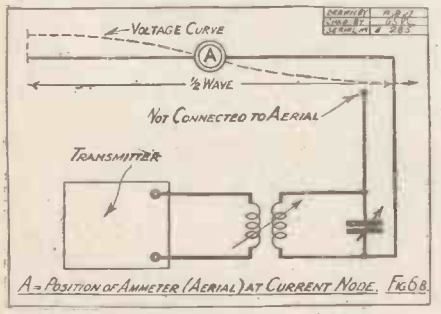
(Continued on next page.)

SHORT-WAVE PROBLEMS.

(Continued from previous page.)

The question of feeding short-wave aerials by parallel radio-frequency transmission lines is of great importance, and a consideration of some methods which apply equally to receiving and transmitting will now be given. The great advantage of using this type of feeder is that the aerial proper may be erected comparatively free of earthed bodies, which tends to give a much greater efficiency, and which becomes more marked as the wave-length is reduced.

The method commonly adopted by many workers of feeding the so-called Hertz aerial by a single wire is open to the serious



objection that this type of feeder is very likely to have a free electric field, and consequently radiate some energy, and this radiation will interfere with the calculated operation of the horizontal component of the aerial.

Figs. 6 A and B indicate two systems of feeding at the voltage node—*A* for a vertical aerial (this is the system used with such success by the American broadcasting station on 32·79 metres) and *B* for a horizontal aerial. B is interesting as one of the feeders is not connected to the aerial, and functions by cancelling the free field of the connected wire, thus avoiding useless radiation of energy from the feeder line.

The "Skip" Phenomena.

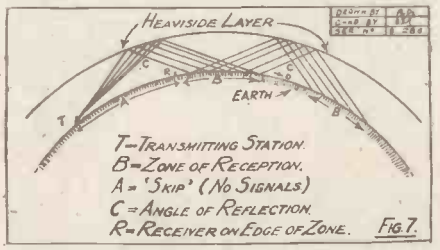
All listeners on short waves have doubtless observed from time to time the marked periodic changes and signal intensity from distant stations, and to these phenomena has been given the broad name of "fading." A careful study of this curious and interesting effect is of the greatest importance, as patient investigation may yield results which may be a very important contribution to our present imperfect knowledge of the ionised layers of the upper atmosphere (the so-called Kennelly Heaviside layer), its day and night and seasonal variations in height, which have a very important bearing on the angles of reflection of different frequencies and also the "skip distance" effect. A few words of explanation regarding the meaning of the term "skip distance" may not be amiss at this point.

Take as example the behaviour of a wave-length of 32 metres. Experimental evidence shows that the day "skip" is approximately 500 miles, while the night "skip" is approximately 2,500 miles in *winter* and perhaps 1,500 miles for *summer*. Refer to Fig. 7, which shows the rays from the transmitting station T, leaving the aerial at an angle to the horizon, and being reflected back to the earth by the Heaviside layer. There is thus a zone between T and B where no signals will be received from T, and this is called the "skip" distance. Now imagine a receiver at point R, just on the edge of the zone of reception B. As the height of the Heaviside layer is constantly changing, the angle of reflection C will also vary, causing the zone of reception to swing backwards and forwards over the receiver at R, and thus giving a great variation in signal intensity, while if the zone B swings away in the direction of D, the signals may totally disappear from the receiver at R. It will be readily seen that in transmitting signals to, say, the Antipodes, the path of the rays will include a large number of reflections between the Heaviside layer and earth.

Interplanetary Communication.

The extent to which the rays from the transmitter penetrate the Heaviside layer is largely dependent upon the frequency (wave-length) and type of aerial used, and the height of the layer, and recent experimental work indicates that for waves below 10 metres a large percentage of the energy projected by the transmitter passes through the layer and goes out into interplanetary space, never returning to the earth, which suggests that if ever interplanetary communication is possible it will be accomplished by the use of wave-lengths below 10 metres.

It should be explained that practically all short-wave transmitting aerials radiate a horizontal or direct ray, as well as the angular ray, which accounts for the reception of these signals over comparatively *short* distances.



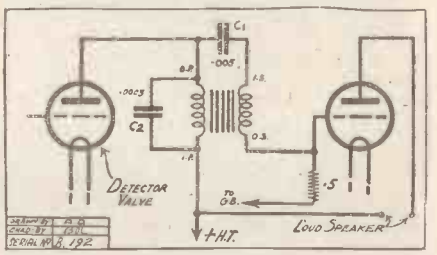
This horizontal radiation is, however, quickly absorbed, and its effect becomes negligible after a few miles.

A NOVEL L.F. COUPLING.

AN interesting low-frequency coupling method which will give most excellent results if constructed with the correct ratio transformer is shown in the diagram. The circuit makes use of both transformer and choke coupling, and combines the advantages of both types with the disadvantages of neither.

It is possible to obtain the remarkable purity of choke coupling with the amplification which usually is only possible when a high ratio transformer is used. It is well-known that to use a high step-up in the initial stage of L.F. coupling immediately introduces distortion, due to the low impedance of the primary winding. By means of the coupling condenser C1, a portion of the rectified D.C. impulses are shunted to the grid of the low-frequency valve via the secondary winding of the transformer, whilst an alternative path through the primary winding induces an E.M.F. in the secondary and considerably augments the variations of the grid potential.

The author has carried out several tests and the results show that an extremely high ratio transformer of 6–1 or 8–1, is possible without in any way affecting the reproduction of audio-frequencies. Indeed, the overall amplification is increased, and should the

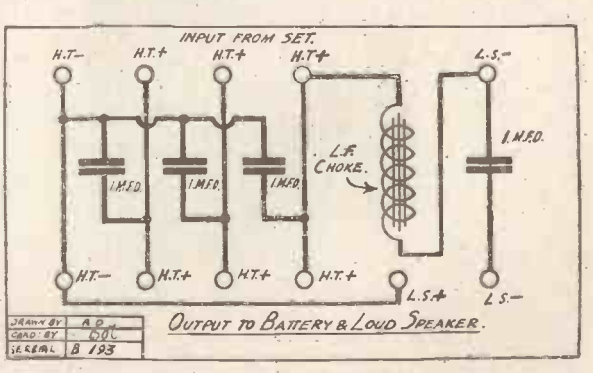


circuit be coupled up as a plain transformer the volume drops, and there is a noticeable alteration in the quality which cannot be improved by the alteration of H.T. and grid bias.

The blocking condenser, C2, can have a value of ·0003, and is intended to by-pass the rectified impulses in the orthodox manner. For the anode voltage, it is advisable to keep this above 60 volts, whilst the grid-bias voltage value must be increased correspondingly with the increase of H.T.

ECONOMY IN LARGE CONDENSERS.

WHEN more than one set is in use, or when one is in the habit of experimenting with circuits, it is convenient to provide for the use of large capacity condensers across the H.T. battery outside the set, rather than to incorporate the condensers separately in each set used. Similarly, the smoothing circuit across the loud speaker may very well be built up outside the set. The diagram shows the wiring for a small panel (about 7 in. by 5 in.) which provides for a bank of condensers across the H.T. battery leads, and also for a smoothing circuit across the loud speaker. Either terminals or plug sockets may be used on the panel, as desired. It is, of course, unnecessary to provide an input terminal on this panel for "L.S. plus," but one may be added if desired.



BROADCASTING NOTES.

FROM OUR BROADCASTING CORRESPONDENTS.

Corporation Stakes Again—The Charter The 5XX Argument—The Power of "Mic"—Chamber Concerts—A Monthly Dance Night—News for the West—"Radio Radiance"—Strengthening Variety.

Corporation Stakes : Minor Events.

WITH Lord Clarendon as Chairman, Lord Gainford as Vice-Chairman, and Mrs. Snowden the representative of women and Labour, interest is now centred in the other members of the Corporation Board. It is definitely understood that one of these will be a "City" man, and the name of Sir Gordon Nairn is mentioned in this connection. Another will be an educationist, probably an ex-headmaster of one of the Public Schools. The remaining post will probably go to an ex-Post Office official.

The Wireless League Campaign.

The Wireless League has started an energetic campaign against the policy of the Government in proposing to appropriate about half of the Licence revenue both now and in future. One of the speakers at the meeting of the Council of the Wireless League declared that if he were to conduct himself with trusts funds in the same way as the P.M.G. he would be arrested.

Mandarism at the Post Office.

From the angle of officialdom, there is nothing more to discuss about broadcasting so far as its future constitution is concerned. The Charter has been drawn, and approved by the Cabinet. The Post Office have prepared for the P.M.G. his speech to Parliament in which he will enunciate the permanent policy of "grab"—the policy which if applied will certainly lead to the eclipse of the British Broadcasting Service. It remains to be seen whether there is really any responsibility to Parliament under present constitutional practice. There is no doubt whatever of the view of the electorate, and probably of the majority of members of both Houses. They would be dead against such predatory tactics. They would reduce the Licence fee if there were a surplus.

The Daventry Controversy.

The perennial Daventry controversy has broken out again. This time it is an agitation to make 5XX really alternative to 2LO. Some listeners are complaining bitterly that Britain's premier transmitter should be merely a relay station. Now the last time this agitation occurred the B.B.C. foolishly gave way, and tried to provide an alternative service through 5XX. The result was to displease millions of listeners who had got into the habit of expecting London on 5XX. The real point is that there should be another Daventry station for an alternative service. But the vast army of rural listeners who depend on 5XX will always insist—and rightly—that they should have London on one Daventry aerial.

Mrs. Patrick Campbell.

Listeners will be glad to know that Mrs Patrick Campbell will appear before the microphone at London on November 14th at 5.15 p.m.

Paderewski.

There is a strong probability of another broadcast recital by Paderewski in November. Efforts are being made to clinch this for the National Wireless Week programmes.

Mr. Eric C. Dunstan, the 2LO announcer, who has been appointed general manager of the Indian Broadcasting Co.

Drawing Power of the Microphone.

It has been suggested that the broadcasting of an appeal as frequently as once a week is too great a strain on the benevolence of listeners. When the B.B.C. standardised its arrangements so that there would be an appeal only once a week, at 8.55 on Sunday evening, many people were of opinion that results would fall off and that the appeals would soon be withdrawn. This has not proved to be the case. Substantial results are still received, and there is no indication of surfeit or decline. For instance, it is stated that, as a result of the appeal made by Mrs. E. M. Wood for the Winter Distress League on Sunday, October 10th, over £500 in cash was received in the course of a few posts, together with several tons of clothes.

The International Chamber Concerts.

The B.B.C. has yielded gracefully to the complaints of those who have been complaining of the absence of any alternative on the nights when the International Chamber Concerts are given. These concerts are so high-brow and difficult that only a very small proportion of music-lovers themselves can understand and enjoy them. A special and a successful endeavour has been made to secure the most obscure music from remote corners of Europe. In future these shows will not be compulsory Simultaneous Broadcasts, and there will probably be a different kind of programme from Daventry.

A Monthly Dance Night for 5XX.

The B.B.C. is considering a proposal for a new monthly dance-night feature from Daventry. Last year's experiments in catering more adequately for dancers by radio were not too successful. The B.B.C. went to some pains to keep Daventry running until one in the morning twice a week. And then when listeners were asked their opinion of the arrangement, only three wrote in. When the late service was discontinued there was no audible grumbling. In the light of later exploration it is possible to state what was wrong with the experiments last year. The point really is that hardly any of the vast army of rural listeners to Daventry care to dance after eleven o'clock. But they do want to dance from eight to eleven o'clock sometimes. Thus there is a real demand for a monthly dance night from Daventry, the programme to run from 8 o'clock.

Viscount Grey for Armistice Day.

It is understood that the main talk on Armistice Day will be given by Viscount Grey of Fallodon, who will be heard from about 8.20 to 8.50 on that night.

Good News for the West.

The new West Country Repeater station will be working in a few weeks' time. This installation is similar to the repeater station at Leeds, which has transformed the character of the programmes of the North. The new Gloucester apparatus will be a tremendous boon to Cardiff, Swansea, and Plymouth.

"Radio Radiance" Litigation.

It is a pity that litigation should have been necessary in the matter of the future activities of "Radio Radiance," the revue originated and developed by the B.B.C. in co-operation with Mr. James Lester. The B.B.C. failed to get an interim injunction, and it remains to be seen whether the cause will go forward for trial.

Strengthening Variety.

The B.B.C. are evolving a scheme whereby it is hoped that the variety artistes required for broadcast programmes throughout the country may be rewarded as well as they are by music-hall syndicates. If this proposal comes to anything, the B.B.C. would no longer be handicapped by the hostility of the music-hall interests. Nor would artistes themselves have to worry about the ban clause of contracts—the thing which is so perturbing now. As soon as the B.B.C. can support its variety artistes, some of these can turn their backs on the music-hall stage.

SOME USES for H.F. CHOKES

An Article that will Interest all Valve Enthusiasts.

By G. V. DOWDING, Grad.I.E.E.
(Technical Editor).

ANY ordinary inductance coil, whether it be of the basket, spider-web or honeycomb plug-in type or of the simple solenoid pattern, is, in certain circumstances, an H.F. choke. The term is quite self-explanatory and can be read literally as meaning a component that tends to prevent the flow of H.F. current. But to do this it must have a high self inductance in proportion to that of a coil that is normally used in a circuit tuned to the frequency of the H.F. currents it is desired to choke.

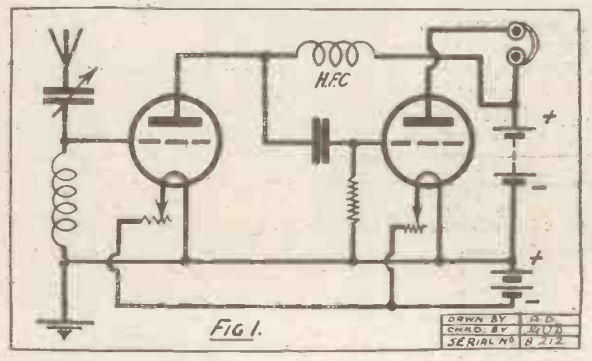


FIG 1.

Low Self-Capacity Necessary.

This is to say, that it is useless to employ a 75-turn basket coil to choke H.F. currents due, for instance, to the transmissions of 2 L O ; 250 turns or so should be employed, while for 5 X X 250 would be too small, and at least 500 would be necessary. The basic idea non-technically expressed is simply this : If the choke is to *choke* it must be a coil of a number of turns in excess of the largest coil that could be used with or without condenser tuning to tune to the frequency it is desired to choke. Further, it must be of low self-capacity, or otherwise the H.F. currents will treat it as a fixed condenser and pass through without attempting to discover whether they can overcome the barrier of high self inductance.

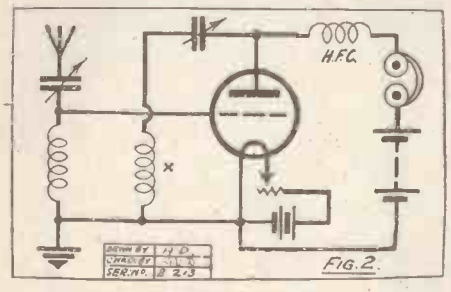


FIG. 2.

Basket or spider-web winding is excellent for coils intended to act as chokes, but the resultant size of, say, one of 750 turns is such that it is necessary to adopt some other method if compactness is to be obtained. The use of fairly fine wire (up to 32 S.W.G., S.S.C.) is permissible and, providing layers are fairly well separated, multi-layer solenoid winding is quite efficient. The H.F. choke used in the 1926 Unidyne was an example of simple compact construction, and the details of this are well worth while repeating.

Two ounces of 32-gauge S.S.C. wire should be obtained. The former can consist of an ordinary wooden bobbin, such as is used for holding small quantities of wire. It should have an internal diameter of $\frac{3}{4}$ in. and an internal (cheek to cheek) length of 2 in. A small rod of wood of this size could be used, and two circular end pieces $1\frac{1}{4}$ in. in diameter fitted.

The important point about such a choke is the method of winding. The dimensions can be slightly altered ; for instance, a bobbin $2\frac{1}{2}$ in. by 1 in. would be O.K., but the 500 turns of 32 S.W.G. must be wound not as cotton is wound on a cotton reel, but in the following manner :

Leaving about 5 in. for connecting purposes, wind about 32 turns in a bunch, then pass along the former a little way and wind another 32 turns in a bunch. Then a further two bunches and the layer is complete. It should be covered with a single layer of ordinary waxed paper and then another series of little bunches wound on, starting at the same end as the previous layer. Four layers of about four bunches per layer will conclude the 500 turns after which a length of about 5 in. can be left for connecting and the little choke is finished. To make a neat job of it a layer of Empire cloth should be wrapped round it.

The Filadyne Chokes.

There are many different makes of H.F. chokes on the market, including the "Cosmos," "Marconiphone," "Lissen," "Peto-Scott," etc., prices being uniformly round about 10s., with the exception of the "Cosmos," which is only 6s. 6d.

Having shown that H.F. chokes are both easily makable and readily purchasable, we will endeavour to indicate a few of their many uses. An example which readers will immediately call to mind is the Filadyne, only in this the H.F. chokes must have an abnormally low ohmic resistance on account of the fact that they are required to pass the filament current.

Shunting the H.T.

H.F. chokes are employed in practically every transmitting circuit, but it is with receiving that we are concerned. In Fig. 1 is illustrated a method of coupling an H.F. valve to a detector by means of an "H.F.C." The circuit is similar to an H.F. det. resistance capacity coupled, except that the H.F. choke takes the place of a resistance. We prefer the choke to the resistance method the tuned transformer system is superior to both, although it involves the employment of an additional control.

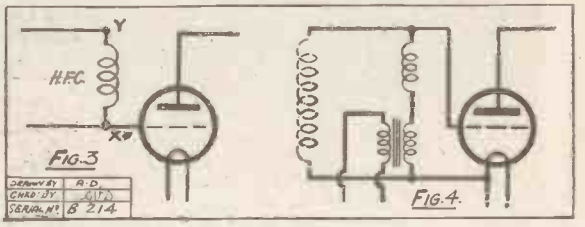


FIG. 3.

FIG. 4.

The operation of the H.F. choke in Fig. 2 is more clearly defined and it is in this case more an additional refinement than an alternative to anything. Its purpose is to isolate the telephone receivers and H.T. battery from the H.F. portion of the anode circuit, which consists of the reaction coil X and a variable condenser which controls regeneration. A classical modification of this method of "shunting the H.T." is the famous Reinartz circuit.

A Practical Illustration.

The efficiency of a good H.F. choke can be illustrated in quite a simple manner. Take any ordinary valve receiver and touch the grid socket of the detector valve-holder, a position shown theoretically in Fig. 3 at X. Signals will decrease in strength and may disappear entirely. Then connect an H.F. choke by one of its terminals to that same point. Although its other terminal is in

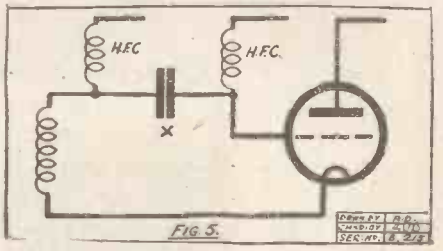


FIG. 5.

(Continued on next page).

SOME USES FOR H.F. CHOKES.

(Continued from previous page.)

direct metallic contact through its winding to X touching this, which is shown as Y in Fig. 3, will have no appreciable effect. Replacing the choke for a coil of similar dimensions to that one used in the A.T.I. or reaction position, it will be found that touching either the grid socket or the free terminal of the coil will cause loss of signal strength.

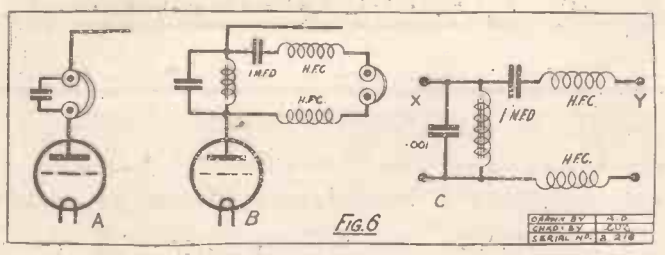


Fig. 6

Telephone By-pass System.

Now an H.F. choke will freely pass L.F. impulses and direct current, so the fact that we can get a direct metallic path to the grid without providing a path of escape for H.F. currents is of distinct importance and one that amateur experimenters will do well to remember. For instance, in Fig. 4 an L.F. transformer is shown with its secondary winding to all intents and purposes directly connected across the grid and filament of a valve without, by virtue of the insertion of an H.F. choke, providing an H.F. leakage path. Reflex enthusiasts will recognise the value of this, as also they will of Fig. 5. In this latter instance two H.F. chokes are joined each by one terminal to one side of a grid condenser. What happens to the other terminals of these two H.F. chokes will not affect the H.F. currents passing through this grid condenser, and external grid biases and what-not can be introduced with perfect freedom. Naturally, as H.F. chokes will pass direct current such as flows from an H.T. or L.T. battery, it must be ascertained that they do not cause D.C. "shorts." Burnt-out valve filaments sometimes result if precautions against these are not taken.

Probably not a few readers have experienced that trouble of instability and howling which frequently results when telephone receivers are included directly in the anode circuit of a valve in a dual-amplification receiver. Connected, as shown in Fig. 6*a*, the 'phones have to carry both H.F. and L.F. impulses, and turning one's head round to speak to a friend, or handing him the 'phones to wear, means that retuning is necessary. By means of an L.F. choke, two H.F. chokes and a fixed condenser, the telephone receivers can be completely isolated from the H.F. part of the set and from the H.T. current, and can be left to deal with only those L.F. impulses necessary to operate the diaphragms. The circuit is shown in Fig. 6*b* and is merely the well-known L.F. choke capacity by-pass system with the addition of two H.F. chokes.

A unit made up on the lines of Fig. 6*c* can be inserted between the 'phones or loud speaker and their connecting points in any stunt reflex or other circuit, and will sift out both that demagnetising, dangerous steady H.T. and those H.F. currents which claim the 'phones as a by-pass condenser.

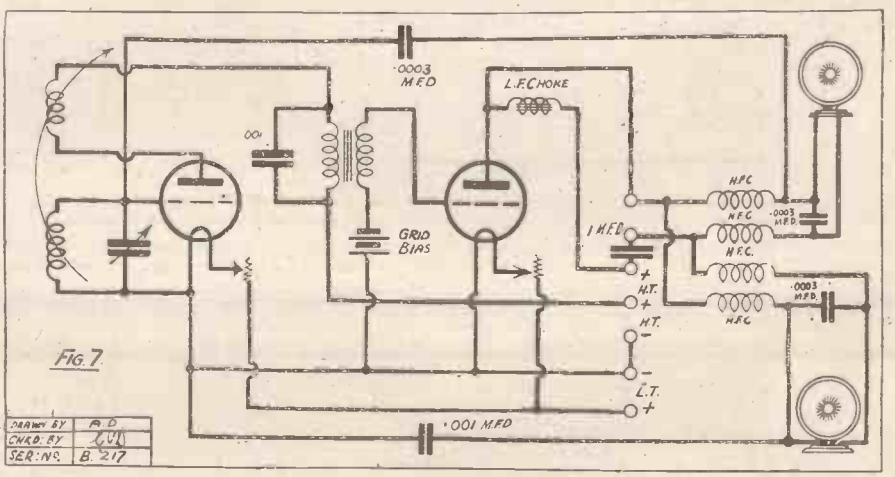


Fig. 7

A Special Circuit.

In order to provide a further illustration of the utility of H.F. chokes we have devised a special circuit and one that many readers may find attractive. It is shown in Fig. 7 and is an extension of the aerial elimination scheme described in "P.W." No. 227. If an amateur has two extension leads connected to the set in parallel and running from his receiver to different parts of the house he can use one as an aerial and the other as an earth, or, rather, as a counterpoise aerial, and get excellent indoor aerial results merely by bringing in four H.F. chokes and two fixed condensers.

It is necessary that the choke-condenser loud-speaker by-pass system be incorporated in the set, and, by the way, it is distinctly advisable to do this in any case when extension leads are employed. A complete unit including this can, however, be made up on the lines of Fig. 8 to attach to the terminals of the existing set. The two ·0003 mfd. fixed condensers across the extension lead terminals are not essential.

An L.F. Link.

Now examining Fig. 7 it will be seen that the H.F. chokes form definite H.F. breaks in the extension leads. From an H.F. point of view a very clear insight into the operation of the circuit will be gained by covering over all these chokes with a piece of blank paper. It will then be seen that the top extension leads form an aerial going through a ·0003 mfd. fixed condenser straight to the grid of the first valve. The bottom extension leads act as a counterpoise and are connected through a ·001 mfd. fixed condenser to the filament circuits of the valves. Take away that covering piece of paper and a link through which L.F. impulses can flow to the loud speakers is revealed. But as these links are H.F. chokes from a practical purpose they might just as well be blank paper as far as H.F. goes—or, rather, cannot go! The received impulses from the broadcasting station can, therefore, be collected from the extension leads just as though these were in actual fact indoor aerials. A unit such as Fig. 8 can, it should be added, be used with any loud-speaker receiver.

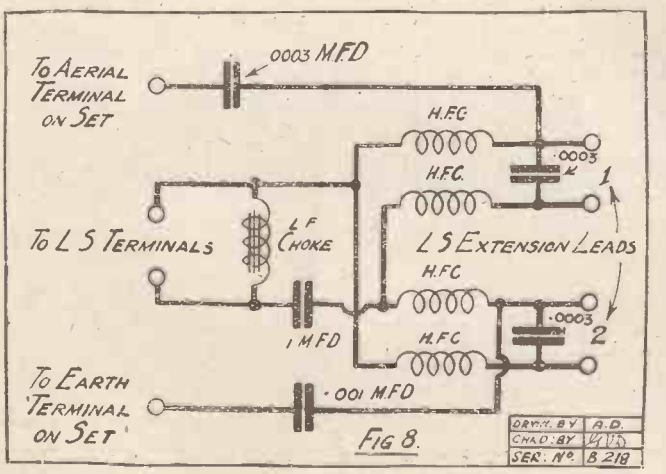


Fig. 8.

A Vast Subject.

The two sets of extension leads should be fairly well separated. Readers interested in the system are advised to refer back to the article on the subject previously mentioned.

The system described is a well tried one, and has given excellent results for both local station work and when receiving distant stations.

In conclusion, if this brief article has indicated just a few of the possibilities of the intelligent use of H.F. chokes it will have served its purpose. The subject is a vast one, and, while these handy components are already well to the fore in receiving systems, in our opinion their importance has not been sufficiently stressed in radio text-books. Perhaps it is on account of their unique versatility that they do not command their own chapter headings!

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A

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All apparatus must be addressed to:

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

TECHNICAL NOTES.

A Weekly Feature Conducted by

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

SOME very interesting observations on different methods of battery charging were recently made by Mr. W. C. Brooks of the Hartford Battery Manufacturing Company of U.S.A., and are reported in one of the American journals.

"The idea of the trickle charger," said Mr. Brooks, at a meeting of the Battery Manufacturers' Association, "is not new. In the trickle charger a small six-volt battery is permanently connected to a rectifier, which in turn is provided with a standard plug for light-socket attachment, just as an electric toaster. There are four types of rectifiers used for changing the alternating to direct current after it has been transformed at the proper voltage for charging the battery. All these rectifiers are similar to radio detectors.

Four Types of Rectifiers.

"The four types of rectifiers are: First, the bulb or vacuum tube, such as tungar and rectigon; second, electrolytic, which is divided into alkaline and acid; third, vibrator; fourth, crystal. In the bulb rectifier, a small two-element vacuum tube is employed, and this is perhaps the most popular rectifier thus far.

"The electrolytic rectifier was first developed and most commonly used in the alkaline type, being formed of a single cell having aluminium and lead electrodes and a borax solution. The second type of electrolytic rectifier, which is a new development, uses an acid electrolyte and some rare metal or alloy electrode and a lead electrode. The most familiar combination is the tantalum rectifier. This has been successfully used and is a desirable arrangement because it has approximately the same electrolyte as the battery. The only difficulty with this type is a tendency to go dry in continuous operation, especially in a warm place, but if it is properly proportioned it will need water no more than a battery.

"The third division of rectifiers, that of the vibrating type, may well be dismissed from consideration, because it depends upon a vibrating armature, which produces sparks creating interference for the set.

"A new type of rectifier for this service, which will probably have increasing application in the future, is the dry crystal. Since the trickle charger will require only a small amount of current it seems easily possible to multiply the number of detectors until they have sufficient current-carrying capacity to operate a trickle charger. There is considerable work being done on this charger at present, and undoubtedly in the near future some of these devices will be on the market."

The foregoing gives a very useful short summary of the methods at present in vogue, and it is particularly interesting to note that a rectifier of the crystal detector type is likely to come into use. The current-carrying capacity of the ordinary crystal detector is, of course, extremely small, but provided a detector of this type could be found with a considerably greater current-carrying capacity and capable of being used in parallel with other rectifiers of the same kind, there would appear to be no reason why a practical dry rectifier should not be made on these lines.

Concerning Single Control.

A new type of wireless receiving valve has been placed on the market by one of the American manufacturers, and employs alkali vapour as a filler. There is nothing particularly new in the use of alkali vapour, but the novel features of the new valve are connected with the internal design, the valve being designed so that it may be used in the standard broadcast receiver without the necessity for any change in the wiring or circuit arrangements. It is stated that a slight improvement is noticed, however, if the grid return be connected to the filament negative. High sensitivity and smooth oscillation make this valve particularly useful in short-wave receivers.

This American Receiver is stated to have taken eight months to design and two months to build and is valued at nearly £900.

It is frequently possible, where two stages of H.F. amplification are used in a set, to mount the two variable condensers upon the same spindle, or to connect them together mechanically in such a way that they are controlled by a single knob. Many constructors imagine that the arrangement of the single control for the two condensers is simpler than in fact is really the case. It is necessary that not only the two condensers, but also the two coils or H.F. transformers should be exactly matched if this single control method is to be successful, and furthermore the two H.F. circuits must be matched in all details; unless this condition is properly realised the single control method will not work or, at any rate, will work with only poor results. It is especially desirable to arrange that the layout of the components be the same and the wiring in both of the H.F. circuits should correspond both as regards the placing of the bars and the dimensions of the same. Some amateurs make the mistake of introducing a switch in one of the circuits so that it may be cut out at will, but unless this component be very carefully compensated it is liable to upset completely the conditions necessary for the use of a dual condenser with single control.

A New Super-Het. Frame.

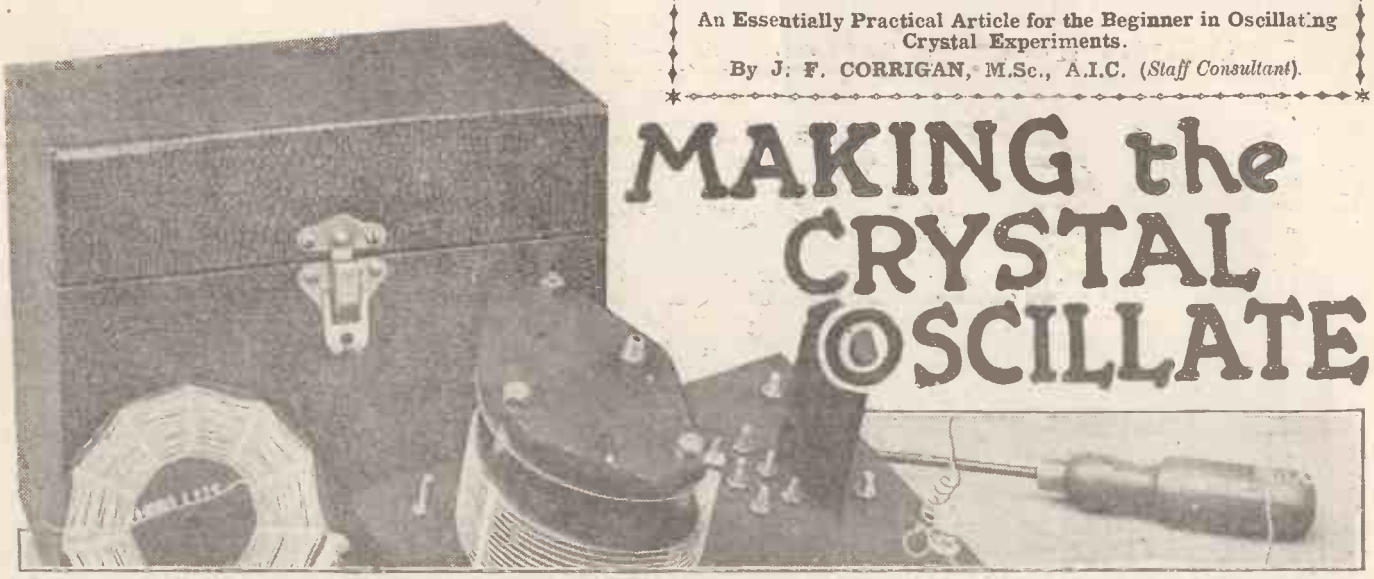
In a super-heterodyne receiver interferences often arise owing to the intermediate amplifier being directly affected by long-wave signals. In order to overcome this difficulty, a special type of frame aerial circuit has lately been devised by P. W. Willans, the well-known radio engineer, which depends upon the principle of arranging the aerial in such a way that it is for practical purposes non-inductive at intermediate frequencies. The presence of an inductance of any considerable area between the grid and the filament of the first valve, owing to the potentials set up across it when long-wave signals are incident upon it, causes interference, as mentioned above, by energising the intermediate amplifier. In the Willans arrangement a frame aerial is connected between the grid and filament, the frame aerial being divided into two portions which are electrically equal and are arranged in such a way that they are coupled together but wound in opposite directions. If these two halves are exactly equal and in opposition it is clear that the voltage produced between the grid and filament will be for practical purposes zero,

(*Continued on page 518.*)

An Essentially Practical Article for the Beginner in Oscillating Crystal Experiments.

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

MAKING the CRYSTAL OSCILLATE



THERE are some famous lines in Gilbert and Sullivan which, referring to the gentle and time-honoured art of courtship, would have us believe that success in such a fateful occupation

"Is purely a matter of skill
Which all may attain if they will;
But every Jack, he must study the knack,
If he wants to make sure of his Jill."

Naturally, I hasten here to assure the reader that I am by no means going to attempt a dissertation on the above universally recommended pastime. But it has often struck me that Gilbert's celebrated lines might be very well applied to the art of getting an oscillating crystal contact to perform its required function on demand, so to speak. In fact, when you say that the process of getting a good crystal contact,

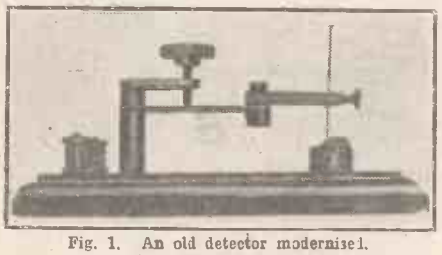


Fig. 1. An old detector modernised.

suitably included in an oscillating circuit, to generate its oscillations is mainly a matter of skill and of attaining a certain degree of that indefinable quality, "knack," you have summed the whole matter up very nicely, and in a manner which is unassailable.

A Very Important Point.

There are quite a number of amateur crystal enthusiasts, to my knowledge alone, who have tried out various crystal oscillation generating circuits, and who have before very long given up their experiments in disgust owing to the fact that they have been unable to get the crystal to develop any semblance of an oscillation. All of which is very unfortunate, because there is a tremendous amount of interest to be had from a few successful experiments with crystal oscillators.

The fact is, however, that these ill-fated enthusiasts did not take the trouble to acquire the necessary knack of getting their crystals to oscillate. Hence the resulting failures.

For reasons such as the above, therefore, it has occurred to me that it might be of interest to some readers if I set down in a brief manner the various little practical points which must be observed when conducting experiments with crystal oscillation generating contacts, referring in particular to the means by which such contacts may be made to give rise to oscillatory currents most readily.

Now, in the first place, it is a well-known fact that a considerable variety of metallic and semi-metallic rectifying contacts will give rise to oscillatory currents when they are arranged in suitable circuits. But for all practical usage it is generally necessary to employ a steel-zincite contact for this purpose. In the hands of the amateur no better crystal oscillation generator can be obtained than a contact between a piece of steel wire and a good zincite crystal. The zincite crystal must be a good one, however. That is a very important point.

The Crystal to Use.

A large proportion of the zincite on the market at the present day is utterly useless for oscillation purposes. Zincite which is coke-like in appearance may or may not rectify; but for crystal oscillator experiments the zincite used must possess an appearance similar to a very deep ruby-red piece of glass. Such crystals examined by reflected light appear almost black, and their surfaces are perfectly smooth.

Lossev, the discoverer of the practical method of crystal oscillator working, and his co-worker, Nicolaieff, and others, prepare their zincite by fusing the mineral in a small laboratory electric furnace. It is then allowed to cool slowly, carefully fractured, and selected portions of the fused mineral are then utilised. In practice, however, this procedure cannot be followed by the amateur. And fortunately, for average results, it is not required, for a good piece of zincite will generally oscillate perfectly, provided it is dealt with in the right way.

There is a wide divergence of opinion as to the exact type of device in which the oscillating contact should be mounted. Some experimenters have produced quite good results merely by mounting the zincite in the crystal cup of an ordinary crystal detector, and by replacing the cat's-whisker by a thin piece of steel wire. Nevertheless it is often a difficult matter to effect a satisfactory adjustment with this crude form of crystal oscillator.

The Miller Detector.

A better pattern is that illustrated at Fig. 1. This piece of apparatus is really an old crystal detector. Such articles are to be had very cheaply from firms supplying surplus radio apparatus, and they generally contain either silicon or iron pyrites crystals. By replacing the old crystal in one of these detectors with a fragment of zincite, and by using an ordinary pin or a short length of thin watchspring as a contact, a very efficient crystal oscillator can be made. The adjustment control by means of the ebonite knob is excellent for the purpose.

Still another efficient form of crystal oscillator is that illustrated at Fig. 2. The

Fig. 2. Mr. L. Miller's special detector.

design of this is due to Mr. L. Miller, A.M.I.E.E. In this instrument both the steel contact and the crystal itself are capable of adjustment. Moreover, as the crystal is mounted in an ordinary spade terminal tag, a number of these mounted crystals may be arranged radially around the vertical axis of the ebonite knob, and thus a number of different crystals may readily be tested within a very short time.

(*Continued on next page.*)

MAKING THE CRYSTAL OSCILLATE.

(Continued from previous page.)

Having now discussed the characteristics of zincite for oscillating purposes, and also the methods of mounting the crystals, let us now consider the practical means of getting the crystal contact to generate its oscillatory currents. Suppose, for this purpose, we imagine that the crystal oscillator is connected up in any well-known oscillatory circuit, such as, for example, that shown diagrammatically at Fig. 3. This circuit merely acts as an oscillation generator. It

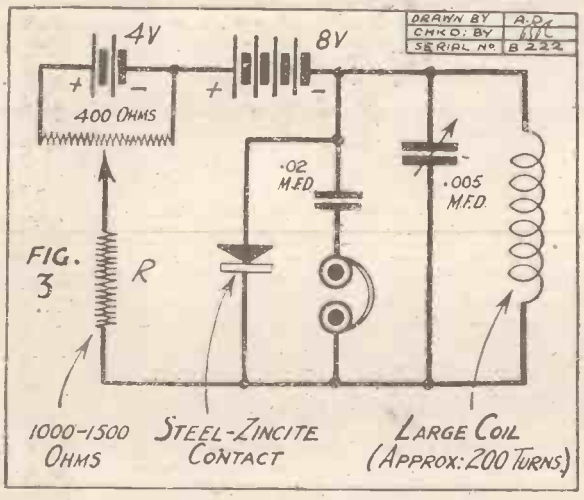


FIG. 3.

is a useful one for testing out the capabilities of different specimens of crystals, the oscillations being heard in the 'phones in the form of a characteristic quiet hum.

In order to get the crystal to oscillate in such a circuit (or in any other circuit, for that matter) first adjust the crystal contact so that the steel wire makes a light contact with the fragment of zincite. Then switch on the local battery to such an extent that about 3–5 volts pass through the crystal. Adjust the condenser so that about half its maximum capacity is included in the circuit. If audible oscillations are generated by the crystal contact a steady hum will be heard in the 'phones.

The Crystal Contact Adjustment.

Assuming, however, that the result of the above operations is a mere silence, the next thing to do is to manipulate the crystal contact adjustment and to see if this makes any difference in the results. If a frigid silence still greets these endeavours, leave the crystal contact lightly adjusted, and *suddenly* turn on the full voltage of the battery. Here is a point which is worthy of attention, for it often happens that the sudden turning on of the full E.M.F. of the battery is sufficient to start the crystal oscillating.

Another little point to bear in mind is that the crystal may often be made to begin its oscillations if the panel of baseboard of the instrument is sharply tapped with a finger. It is best to give the end of the steel wire a rounding off by rubbing it a few times over a sheet of sand-paper, for if the end of the wire is too sharply pointed the contact will tend to become far too critical of adjustment for practical usage.

The amateur should remember also that the frequency of the oscillations generated by the crystal contact depends not only upon the amount of capacity and inductance included in the circuit, but also upon the E.M.F. of the applied current. Thus, if, after carrying out the various manipulations outlined above, and carefully regulating the current supply by means of the potentiometer adjustment, the crystal fails to oscillate, try the effect of a coil containing a larger number of turns than the one in use, at the same time, however, keeping the condenser setting constant. After this the readjustment of the condenser setting may be attended to, and the latter should then be adjusted so that its vanes are more widely separated.

Practical Advice.

There is now the question of the resistance which is included in every crystal oscillator circuit. This resistance is shown in the circuit, Fig. 3, at R. The function of this resistance in the circuit is to permit the crystal contact to attain a negative characteristic in its current curve. This resistance must always be of such a value that it is greater than the negative resistance of the crystal contact (which latter value is nearly always about 800-850 ohms). Therefore, the resistance, R, in any crystal oscillatory circuit must not be less than 1,000 ohms. The resistance should also be inductively wound in order that it may act as a choke in preventing the oscillations generated by the crystal contact from flowing through the local battery circuit. For this purpose an ordinary choke coil may be used, and it will be of interest to the experimenter to try the effect of using choke coils of varying resistances on the ease with which the oscillations are generated

Fig. 4 indicates the most usual type of circuit employed for crystal H.F. amplification. It will be noted that fundamentally the circuit remains exactly the same as the basic circuit, Fig. 3, on which the principle of the crystal's oscillatory function is dependent. Thus, in such a circuit, and, in fact, in any type of crystal oscillatory circuit, the above-mentioned points connected with the obtaining of the necessary oscillations apply in an equal manner.

Given a good sensitive piece of zincite, there is nothing difficult about getting it to generate oscillations provided the task is gone about in the right manner. And it is fortunate that zincite which rectifies well is also generally an efficient oscillation generator.

To any amateur who has attempted experiments in the subject of crystal oscillations and who has obtained nothing but bad results, I would stress most particularly the fact that a really sensitive piece of zincite must be employed. There are a number of crystal dealers who supply zincite which has been specially selected for oscillation purposes. The cost of such crystals is generally about two or three times that of an ordinary crystal of the same mineral. But, for the experimenter, it is an investment worth making, for working with one of these crystals, the amateur may feel sure that the mineral is in good sensitive condition. And thus if only poor results are forthcoming the cause may be looked for in the circuit itself, or, more generally, in the technique of working.

Finally, it is often the case that a steel-zincite contact will begin its oscillations readily, but it will refuse to maintain them. The cause of such short-lived oscillations is mainly to be looked for in the employment of too much capacity in the circuit, and also in the use of a bad steel contact point. Work, if possible, with the variable condenser almost at a minimum setting, and do not employ a steel contact which is too fine. By these means the stability of the circuit will be increased, and the oscillations will be generated steadily and more or less continuously.

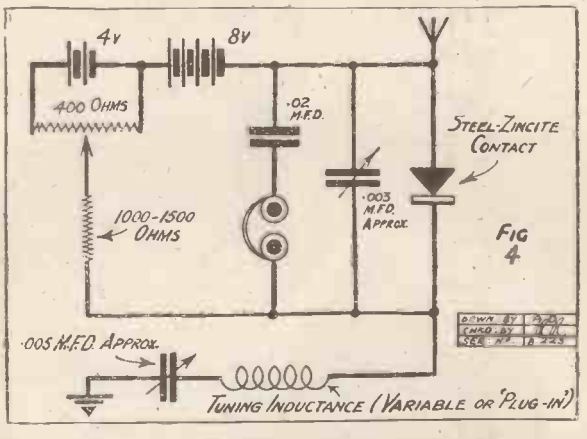


FIG 4

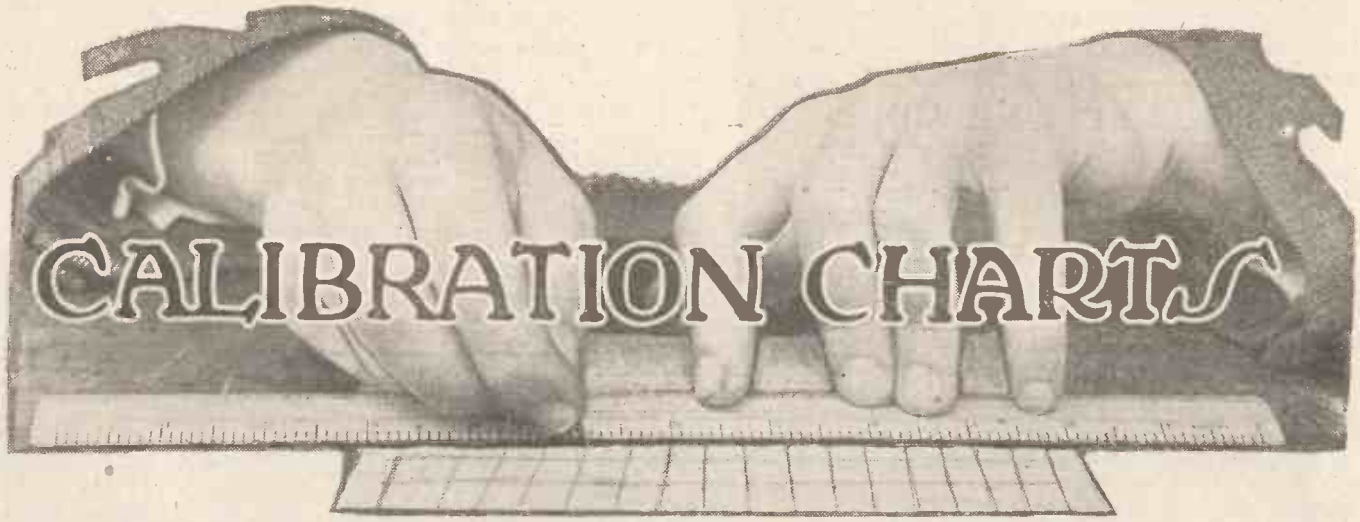
A LOUD-SPEAKER PROTECTING DEVICE.

By J. F. C.

THE diaphragm of the average household loud-speaker is notoriously prone to accumulate a varied collection of dust particles. Complete protection against this state of affairs may, however, be obtained by following a very simple procedure.

Unscrew the horn of the speaker, remove any particles of dust, etc., then obtain a small (roughly circular) piece of grease-proof paper, and stretch it tightly across the stem of the loud-speaker. Prick one or two small holes in the stretched paper with a small pin, and then attach the loud-speaker horn in the usual way, taking care, during the operation, to maintain the grease-proof paper in a perfectly taut condition.

The presence of the paper in the loud-speaker will not affect the tone and volume of the reception obtained. It will simply act as a convenient protecting device, and, when cleaning time for the loud-speaker comes round again, all it will be necessary to do will be to remove the piece of stretched paper, and to substitute a fresh one in its place.



CALIBRATION CHARTS

A Wireless Application of a Recent Development.
By "EARTHPLATE."

IT has recently been shown that calibration charts for tuning circuits can be compiled for a number of coils upon one sheet. Indeed, a number of variables can be so plotted that any value which is connected closely with others is easily read off by using a ruler.

The method is called the Principle of Alignment, due, we believe in the first place, to M. D'Ocagne, and it is proposed to give here the simplest forms of its application.

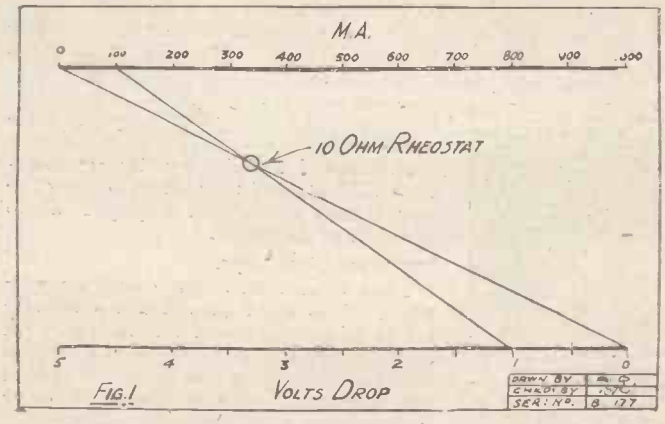


FIG. 1.

Take, for instance, the voltage drop due to a rheostat—a point which often baffles beginners, since when using a strange valve one is not quite sure whether the rheostat is of the correct resistance to protect and control the filament.

Calculating Resistances.

It is considered necessary to use a P.M. 4 power valve in the last stage of our set. Reference to the maker's figures shows that 3·8 volts must be applied across the filament, following which ·1 ampere (100 milliamperes) is consumed. Then, by Ohm's Law, $C = \frac{E}{R}$ where C = the current, E = the voltage, and R = the resistance. We want to find what volts are required to push the ·1 ampere through the rheostat—i.e. E = CR. We have, say, a 10-ohm rheostat, then E = ·1 × 10, which equals 1 volt

That rheostat will drop the battery volts by 1, and we have a 4-volt accumulator; 4 volts − 1 = 3, the minumum volts left to apply to the filament, which is just about right in this case.

These calculations are easy, but set them out by the Principle of Alignment, see Fig. 1, and note that the current in milliamperes has been drawn along a line to a convenient scale, and that the volts are set out similarly on another scale below. Commence by choosing a maximum and minimum between which values are required; the upper and lower values can be to quite different scales so long as each is accurately drawn. It is to be noted that the increase occurs in opposite directions.

For simplicity, in Fig. 1, we have shown zero in both cases; further, since it is obvious that a zero current through any resistance of this nature will give a zero volts drop, a line is first drawn from zero to zero. Now, take the 10-ohm rheostat and calculate the volts drop for any valve by Ohm's Law, drawing a line in the correct place across the chart. We have taken the calculation as above, drawing a line from ·1 amp. to 1 volt. The two lines will intersect, and you may call that point your 10-ohm rheostat.

Now note, that a ruler placed across the ampere-volt lines, provided always that it passes through the 10-ohm rheostat point, will give the volts drop according to the current taken by the valve. In such a way a comprehensive valve chart can be drawn up on the lines of Fig. 2. The cross lines can be removed, of course, once the points of intersection are marked.

The above application, though useful, is not so apt as that of condenser dial readings against wave-length. Since, unlike a curve of wave-length against condenser reading plotted on squared paper, where one curve per coil is required, once having drawn the upper and lower lines a number of points—each representing a coil—can be set out between.

Wave-length Calibration.

In this connection, and in the majority of other cases, one must be sure of the *rate* of increase of one value relative to the other. The original type of variable condenser of semi-circular moving vanes had a straight-line increase of capacity. That is to say, given a capacity of approximately ·0003 at 45 degrees, then at 90 degrees it is approximately ·0006, and so on increasing in proportion to the dial reading. But wave-length increases only as the square of the capacity. If, therefore, the capacity on the lower line is set out in equal divisions representing the dial reading, then the wave-length on the upper line must be squared, as we have shown in Fig. 3.

The procedure in this case is to take readings of two broadcast stations of known wave-length, draw a line from the degrees to the metres in both cases, and where the lines cross that point can be called the coil in question. Now, set a straight-edge to an unknown and required wave-length, let the edge pass over the coil point, and the correct condenser reading is obtained on the lower scale. The ideal tool would be a straight-edge of steel into which has been inserted at one edge a needle point. This

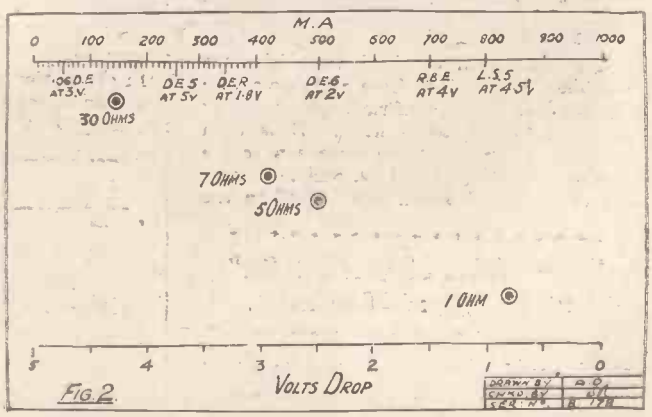


FIG. 2.

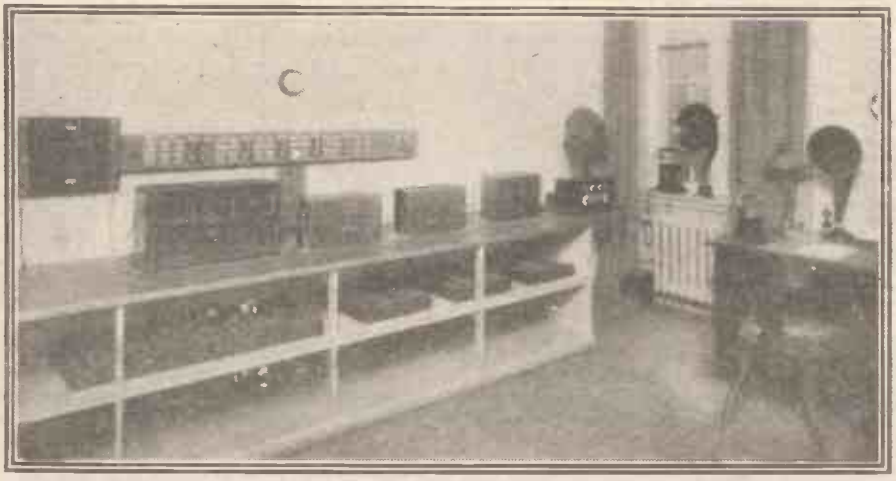
(*Continued on next page.*)

ELIMINATING AERIAL SWAY.

By "AMEC."

WITH the autumn days now setting in, wireless enthusiasts may expect a good deal of high winds, breezes which are capable of putting even the most efficiently and strongly constructed aerial to stringent tests of stability. Of course, an aerial may sway in the wind and not come to any great harm. But one effect of a swaying aerial is sometimes to cause a peculiar fading phenomenon to be set up in the reception which the set produces, a fading which is peculiarly rhythmical in character, and which is naturally intensely annoying to the listener.

This swaying effect may be completely got rid of by adopting the following method of stabilising the aerial: Procure two small pulleys, a suitable piece of iron or lead weighing ten or twelve pounds or more, and a length of strong rope. The rope should preferably be tarred, or treated in some other manner which will render it waterproof and rot-proof.



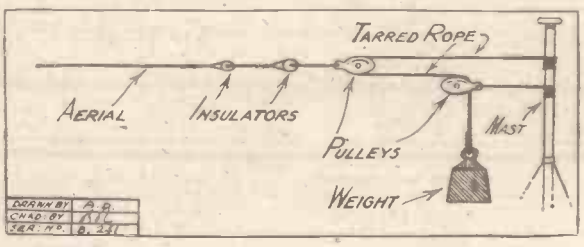
A corner of the control-room at the Copennagen Broadcasting Station.

Automatic Adjustment.

The manner in which these articles are combined will be seen from a glance at the illustration. One end of the rope is securely attached to the aerial mast. It is then threaded over one of the pulleys near the last of the aerial insulators, and then over the other pulley which is attached to the aerial mast by means of a short length of the rope. The weight is firmly fastened to the free end of the longer length of rope passing over the pulleys. It dangles about five or six feet below the level of the aerial.

The actual weight of the lump of metal attached to the free end of the rope should be just sufficient to keep the aerial nicely taut, but it should not be sufficient to prevent any gentle sway of the aerial mast itself.

With this arrangement in operation, what happens is this. When a high wind comes along and sways the aerial, the weight immediately compensates the movement, especially if the motion is in a vertical direction. More than this, the arrangement prevents horizontal sway, because by means of it the aerial is always kept in a taut condition, thus making it difficult (and, in many cases, impossible) for any side to side swaying motion to take place.



"THE RADIO CONSTRUCTOR"
Next Week's Special Supplement.

CALIBRATION CHARTS.

(Continued from previous page.)

conjunction with a square law condenser. In this type of unit it is claimed that the capacity increases in such a manner that the increase of wave-length is directly proportional to the dial reading. In both cases, however, it is advisable to make the initial observations somewhere between 60 and 130 degrees, since the capacity at the lower and higher points on the scale may be unreliable. The coil points thus obtained represent values as they are. That is to say, the wave-length is that due to the inductance of the coil, its self capacity, the end on capacity of the condenser, and the casual capacities of the connecting wires and the like.

Following this, it is interesting to note that a line drawn from zero wave-length through any coil cuts the capacity line to the left of zero degrees, and it is reasonable to say that this negative value exactly represents the sum total of the inherent capacities to the same scale as the condenser readings. From the simple chart it is impossible to get at the self capacity of any coil, but one can, at least, make comparisons between coils working on nearly the same wave-length.

It is feared that these notes are somewhat sketchy, but they serve to show the way to and the method employed in the Principle of Alignment.

Improvised Wave-meter.

These calibration charts constitute very useful guides when tests of a new receiver are to be carried out, for it is usually an easy matter to pick up two known stations and then when the graphs have been plotted the chart will render searching for other transmissions a much simpler matter.

Conversely, of course, the chart can be used to find out the wave-length of a station that is not known. Having tuned-in the station, the rule applied across the chart will give the approximate wave-length that station is working on. This enables DX searching to be carried out quite successfully and with a minimum of trouble without the need for a wave-meter, always an expensive item to purchase and a difficult one to calibrate accurately if constructed at home.

The readings obtained by means of the Principle of Alignment will not, of course, be so accurate as those obtainable by means of a well-made and calibrated wave-meter but they will constitute a rough and ready guide when searching for distant stations, or when trying to find out what station you have received when no call sign or announcement is given.

latter could be used as a pivot centred on the coil point, while the rule is swung over the scales.

In connection with Fig. 3 it must be said that the squaring of the top line is unnecessary if the chart is to be used in

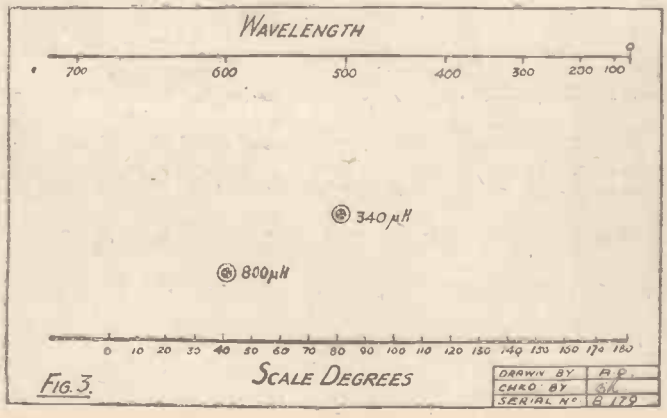


FIG. 3.

Things are not always what they seem

2. The case does not make the Watch

THE most exquisite case imaginable will not make an accurate timekeeper. Unless the delicate mechanism is assembled and adjusted by experienced hands with the same care as those which fashion the case, the watch will not fulfil its purpose.

As in timekeeping, so in Wireless. Take the fixed Condenser. In outward appearances two of different makes may be identical. As with the watch, however, the correct functioning does not rely upon the case alone. How, then, are you to judge a Condenser? You buy this, more than any other component in your set, in the dark.

Do not prejudice the success of your Receiver for the sake of a few pence; pin your faith to T.C.C.—the proved Condenser. One embodying the experience of over twenty years Condenser making. One which is the choice of the foremost radio technicians of the country. One whose sale extends to several millions. With a T.C.C. Condenser in your Set, you are freed from condenser trouble—*for ever.*

T.C.C. Mica Condensers come in capacities from '0009 to '001, price 2s. 4d. The Mansbridge type ranges from '0009 at 2s. 0d. to 2 mfds. price 4s. 8d.

T.C.C. Condensers

[Mansbridge and Mica]

Telegraph Condenser Co. Ltd., Wales Farm Road, N. Acton, W. 3.

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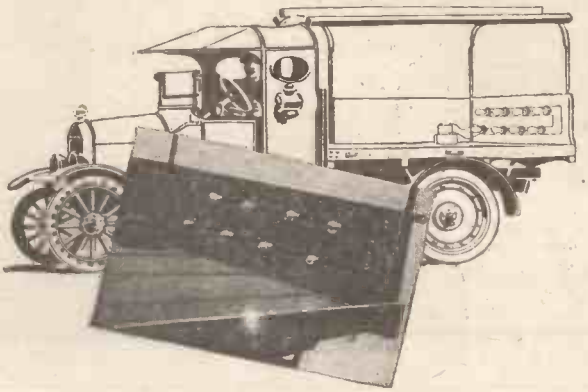

Here's Proof that the 'LOTUS' Survives Shock and is anti-microphonic!

EIGHT Lotus Valve Holders fitted with large power valves and fixed to tailboard of a Ford motor lorry, driven over rough roads for 30 miles survived the test.

At the finish each spring was as it started—perfect. No damage or looseness at the connection of leg socket and spring—no valve became loose from the holder. Both were electrically perfect all the way.

That is why we guarantee the security of Lotus Valve Holders against shocks and vibration.

Fit the Lotus to *your* set and protect your valves

Prices:
Combination GRID LEAK and VALVE HOLDER
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Made from best bakelite moulding with springs of nickel silver and phosphor bronze valve sockets.

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MANCHESTER EXHIBITION—Stand NO. 15.

CURRENT TOPICS.

BY THE EDITOR.

A Fourteen Valve Experiment.

ON October 27th, POPULAR WIRELESS will repeat an experiment which it made about two years ago when the Planet Mars was very near the earth. On October 27th that planet will come into a most favourable position for observation; indeed, the most favourable position that it will occupy for a hundred years. Its distance from the earth will be 42,600,000 miles, and although this is actually 8,000,000 miles farther from the earth than it was in 1924, this fact is offset for European and American observers by the fact that the planet is 32 degrees farther north.

Listening For Mars.

Readers of POPULAR WIRELESS will remember that in 1924, in view of Senatore Marconi's suggestions that certain peculiar signals on a very long wave-length might possibly be emanated from Mars, we constructed what was then the most powerful valve set in existence—viz. the famous "P.W." 24-valve set. Over a period of two or three nights, when the planet was in its most favourable position, we conducted a series of experiments on very long wave-lengths in an attempt to receive signals, if any, from the planet Mars. These experiments were conducted in the presence of Press representatives and several well-known scientists, and our readers will also remember that these impartial observers agreed that at certain times signals, although not in any known code, were received on a wave-length which we believe was somewhere near forty thousand metres. These facts were common knowledge at the time and were reported in the Daily Press, and although much ridicule was poured on the experiment by those who make excessive use of the word "impossible," and although we ourselves were not inclined to credit these signals as being sent out by people on Mars, we nevertheless conducted that experiment in the firm belief that nothing is impossible and that, however fantastic an experiment, it is usually the fantastic which offers the most startling results.

This year we have determined to make another effort and to see whether those untranslatable signals, which were definitely proved not to be atmospherics or from any other earthly source, can be received again. Since 1924 considerable progress has been made in wireless reception, and it is now no longer necessary to use such an unwieldy and complicated receiver as the 24-valve set which we built two years ago.

The New Set.

In consequence, the technical staff, under the direction of the Technical Editor, Mr. G. V. Dowding, have specially designed and constructed a new receiver for this experiment. The receiver is a 14-valver. Full technical details, together with diagrams and photographs, will, if possible, be published in our next issue, also a report on the conduct and result of the experiment which we shall carry out on the evening of October 27th.

The following details, however, regarding this 14-valve set may be of interest to our readers.

The set consists of:

(*a*) A 2-valve tuned H.F. unit employing special transformers of our own design;

(*b*) A 3-valve resistance capacity coupled H.F. unit;

(*c*) An intermediate 2-valve tuned H.F unit employing a special form of coupling;

(*d*) A detector unit which can act as a limiting stage;

(Nothing above a desired strength of signal will have any effect, so that a means for the suppression of atmospherics is provided.)

(*e*) An L.F. unit consisting of three stages resistance coupled with two parallel power valves in the last position.

The Worcestershire Cadets trying out a 10-watt wireless set during recent manœuvres.

These five units constitute the long-wave receiver which can normally operate from fifteen hundred to forty thousand metres; but in addition there is connected to the receiver:

(*f*) A 2-valve super-heterodyne oscillator unit specially designed for the reception of short waves, from thirty metres up. After passing through this unit the energy can be carried to the main receiver and amplified at five thousand metres or at any other desired long-wave lengths.

The Units.

The units (*a*), (*b*), (*c*), (*d*), (*e*) and (*f*) can be arranged in any order. It will be seen that many combinations are possible, ranging from that of a 5 to a 14-valve super-heterodyne set and from a 3-valve set consisting of two H.F. and detector, to a 12-valve set consisting of seven H.F., detector, and four L.F. valves.

In the test for receiving signals from Mars the full number of valves will be used with alternate periods of listening on short waves and very long waves. Incidentally, the receiver will also be used at a future date for many interesting transatlantic and other DX tests this winter. We have already received K D K A on a very small frame aerial in a badly screened building with remarkable volume and freedom from interference from atmospherics, and we anticipate many interesting results with this receiver when used in connection with a series of experiments which we are planning for a later period in the year.

Note The Date.

October 27th will, indeed, be a red-letter day for many astronomers, and all over Europe and America they will be examining Mars through their telescopes.

The Wireless League, we are interested to note, has advised its members that the period round about October 27th will be the most favourable for the reception of any possible signals which may be transmitted from the planet Mars, and amateurs are asked to make observations of any unusual signals or disturbances at this time and to communicate with the head office of the Wireless League so that the observations may be co-ordinated.

At any rate, speculation at the present moment is very futile, but on October 27th it will be interesting to observe whether these unintelligible signals will again be picked up. If they are, and if we receive them on our 14-valve se tand they are also received at other points, interest will indeed be concentrated anew on the possibilities of life on Mars.

The RADIO CONSTRUCTOR

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

IN this, the first, issue of "The Radio Constructor," I am privileged to tell you something of the policy of this new supplement to POPULAR WIRELESS, and to talk quite frankly about my ideas for its future conduct. By the courtesy of the proprietors of POPULAR WIRELESS this section of the journal will be placed entirely in my charge. In it I hope to be able to give you each week the results of my personal work and experiments, in the form of constructional articles describing sets I have actually made and thoroughly tested in my own laboratory, and descriptions of interesting new experiments and tests which can be easily repeated by readers themselves in their own homes.

Considering Your Pocket.

As one who has been personally engaged in experimental and constructional work for many years, I am very interested in the financial aspect of home construction, and am particularly keen on finding methods for reducing the cost of home building. This aspect of set building will be found carefully considered in the pages that follow, for while the tastes of those who want the best will be catered for, every endeavour will be made to show how to obtain the best results by really economical methods.

Thus, in the present issue, you will find the first of a series of articles showing how to modernise your older sets at very small costs, thus carrying you along until such time as you find it convenient to build a more modern receiver. I firmly believe that such a policy will do more to popularise radio than one which aims at immediately scrapping everything and starting afresh. By proving the efficiency of modern methods by trial, it will ultimately lead to a much wider use of modern receivers.

As I explained in an article in last week's POPULAR WIRELESS, the arrangements made by the proprietors of this journal enable me to devote just as much time as I desire to my literary and laboratory work, and thus I am now able at once to conduct many researches, and develop and test certain new ideas which otherwise would have had to wait for some time.

From Home and Abroad.

I am, further, in the closest touch with research workers both in this country and abroad, and these, too, are co-operating with me in a number of ways. The result will be, I hope, that readers of "The Radio Constructor" will find an abundance of interesting constructional and experimental articles, full of up-to-date ideas.

For several years I have regularly received letters from home constructors in all parts of the world, and, although from their very number it is impossible to reply to all of them individually, the suggestions made have often led to the construction of receivers which have proved very popular. For this reason alone such letters are most welcome. What, for example, is your ideal receiver?

Operating the one-valve loud speaker set described in this issue.

Do you think it worth while to make a receiver more complicated in order to receive Radio-Paris and Daventry? What type of set do you wish to see modernised? Do you prefer 2, 4 or 6-volt valves? Let me have your views and opinions, for in this way I am able to gauge your requirements. Perhaps your present receiver suits your purpose admirably but for one or two points. Tell me what they are, and I can probably show you an inexpensive way of overcoming your difficulties.

At the same time, if you want to build a really up-to-date instrument, "The Radio Constructor" can be relied upon to give you sound and tested designs in which careful regard will be paid to both efficiency *and* your pocket.

An Independent Policy.

Finally, it should scarcely be necessary to add that the editorial policy of "The Radio Constructor" will be strictly impartial, for only in this way is it possible to gain and retain the confidence of the reader. The Editor of POPULAR WIRELESS in the issue of September 18th (page 150) has already made the position of this journal quite clear, and I can only add that I am in the fullest agreement with all his remarks on the subject.

A year or two ago the position of the designer of sets for the home constructor was made the more difficult by reason of the absence of any wide choice in the components he could use to build a really efficient set. Practically all readers want to know the name of the actual components used, and the policy of naming the parts incorporated in the set described will be followed in the pages of the "Radio Constructor," but I am anxious to make it clear that the British manufacturer is now producing such excellent components that in the great majority of cases the reader can substitute other well-known makes without the slightest loss of efficiency. All responsible authors make their selection over a wide range of components, in order to maintain a strict impartiality.

With these opening words, then, we will "ring up the curtain," and leave you to view, criticise, and, I hope, enjoy the first issue of "The Radio Constructor."

Percy W. Harris

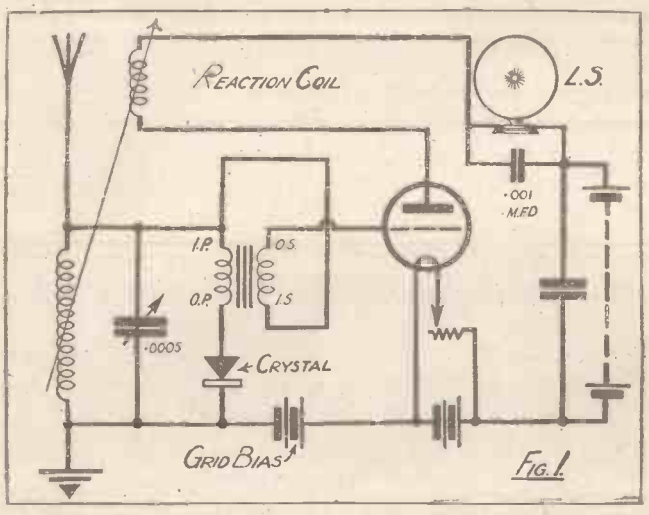
HOW TO MAKE THE "HALE" RECEIVER.

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

"Of all the simple one-valve circuits I have tried, none have interested me more or given better results."—P. W. H.

SUPERLATIVES have been used so often in connection with wireless circuits that I hesitate to describe the circuit I am about to give you as "astounding" in case this rather overworked adjective fails to impress upon the reader that I have something really good to show him.

Let me say at once that of all the simple circuits I have tried none have interested me more or given better results from a single valve than the one described below. Fortunately the circuit is extremely simple, it can be made up in a wide variety of ways, and so can be tried by thousands of experimenters within half an hour of reading this article.



The theoretical "Hale" circuit.

An Experimental Model.

My own experimental model on which I investigated the circuit is shown below, being merely a boxed condenser around which the various components have been screwed and rapidly wired up. With a single ·06 ampere dull emitter, a permanent detector, and only 60 volts high tension, this little set immediately gave the following results.

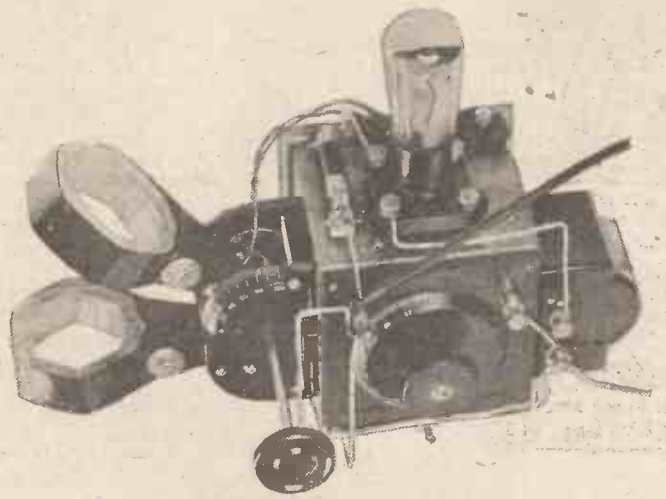
1. Full loud speaker strength on 2 L O (seven miles away) using my ordinary outdoor aerial.

2. Adequate loud speaker volume for any ordinary sized living room on 12 feet of wire as an indoor aerial.

3. Comfortable daylight telephone reception from Bournemouth on the same twelve feet of wire. In fact, when the loud speaker was connected one could just hear the announcer's voice when standing quite close to the horn.

4. Comfortable telephone strength from Birmingham (both Bournemouth and Birmingham reception just referred to were in full daylight and free of London).

5. After dark dozens of stations were heard in the telephones, using the outside aerial; and late at night I obtained small-room loud speaker strength from two of the Madrid stations (Union Radio and Radio Iberica).



How I first tested the circuit!

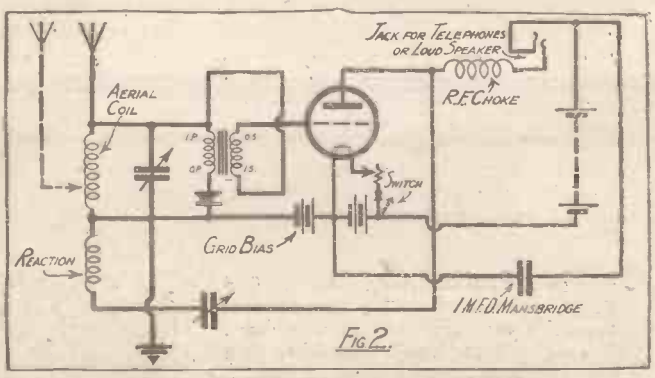
At first glance you may very likely say "Oh, a reflex circuit!" and immediately think of all the troubles generally associated with reflex receivers—instability, squawks and howls, critical adjustment, uncertain reaction control, and above all, a particular sensitiveness to changes in transformers and valves.

Allow me to state at once that the circuit is by no means an ordinary reflex, and to the best of my knowledge is different from anything yet published for home constructors, although it slightly resembles the Trinadyne circuits previously described in POPULAR WIRELESS.

The arrangement, as will be seen from Fig. 1, consists of the usual aerial tuning devices, a crystal rectifier in series with the primary of an L.F. transformer, and—here is the essential point—a very peculiar connection of the secondary of the transformer with the grid of the valve. In the anode circuit of the valve is a reaction coil, after which we proceed with the telephones or loud speaker in the usual way.

How the Circuit Works.

Examining the circuit in its detailed functioning, the following processes may be said to take place. First of all, the oscillatory currents set up in the tuned circuit are rectified by means of the crystal, and applied to the grid and filament of the valve rectifier. Indeed, if the I.S. connection of the transformer were taken straight to filament, the arrangement would be identical with the ordinary crystal detector and one stage of low-frequency amplification. The latter arrangement will give quite good results near a local station, but will not give good distant reception. In such an arrangement, of course, there is no reaction coil.



The "Hale" circuit with Reinartz reaction.

The circuit is the invention of my friend, Mr. G. W. Hale, and is fully patented by him. The more technical reader will be particularly interested in the following virtues of the circuit: 1. Undesirable low-frequency reaction phenomena cannot occur. 2. No damping has to be introduced to obtain stability. 3. No part of the winding of the iron core transformer is connected to earth, and consequently low-frequency electrical disturbances, which usually cause so much trouble in reflex circuits, are avoided.

It will also be noticed that both primary and secondary windings of the iron core transformer are connected to the grid of the valve, thus preventing many undesirable low-frequency "chain" and reaction effects.

In the past it has been proposed to insert a reaction coil in the anode circuit of the valve as a certain amount of the high-

(Continued on next page.)

THE "HALE" RECEIVER.

(Continued from previous page.)

frequency energy gets through the transformer to the valve and, this being so, there is a possibility of applying it again in a magnified form to the grid circuit through the reaction coil. Such devices as usually described are unstable, erratic and critical, and although I have tried a number I have failed to get really satisfactory results from them.

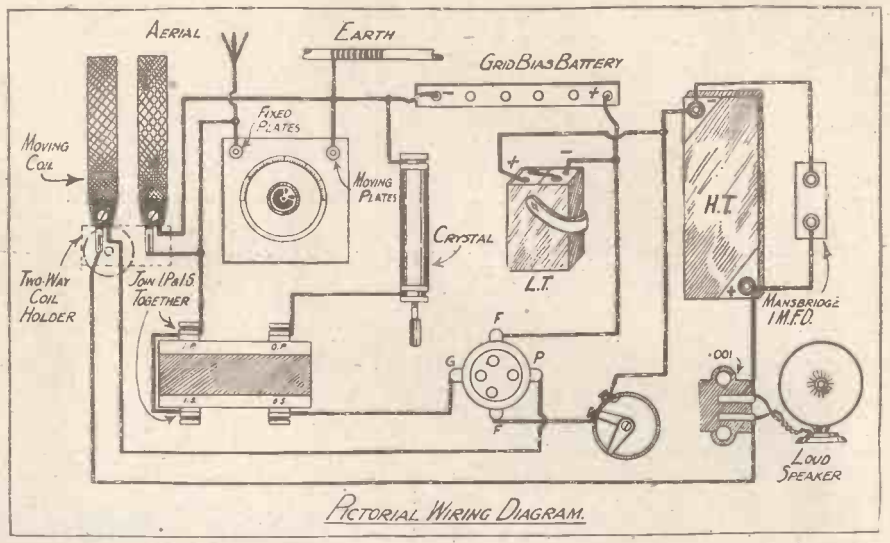
An Important Difference.

The new arrangement, however, is vitally different in its action, for the high-frequency currents in the tuned circuit are applied very simply to the grid and filament of the amplifying valve by means of the self capacity of the transformer and its windings. Thus, while the high-frequency currents cannot pass through the windings as can the low-frequency currents, the connection from the aerial to I.P. and direct to I.S. enables the high-frequency currents to be applied to the grid with ease. This is because there is an appreciable capacity effect between the primary and the secondary windings and in the windings themselves, which allow the high-frequency currents to pass direct to the grid.

They are therefore magnified by the valve and appear in the anode circuit in a much amplified form, whereupon they are re-applied to the tuned circuit and amplified once more. By making the reaction coupling tight enough, a state of continuous oscillation can be set up.

Good Amplification.

Now, obviously we are going to get a very considerable amplification of signals in this way. Notice, however, that the crystal detector and the primary of the transformer are placed across the tuning condenser, and therefore rectified currents pass through the primary of the transformer, differences of potential are set up across the secondary windings, and these (the low-frequency impulses) are applied to the grid and filament, and thus the valve becomes a low-frequency magnifier.



PICTORIAL WIRING DIAGRAM.

You will notice the arrangement differs from the ordinary reflex in several ways. For example, the usual reflex receivers first of all magnify the high-frequency signals, and generally the magnified plate current is rectified and re-applied to the valve, which then acts as a low-frequency amplifier. This generally means two tuning controls, whereas the present arrangement has only one.

Everyone who has handled reflex circuits knows how in practically all cases the setting is completely upset by any alteration of the crystal, and how critical such sets are in regard to low-frequency transformers. Let me tell you the following points regarding the new circuit.

Nine Good Points.

1. It is astonishingly good on its high-frequency side and is equal to many 3-valve sets.

2. Not only does the circuit work well with any good make of low-frequency transformer and valve, but its functioning is not greatly altered by reversing the I.P. and O.P. connections.

3. Reaction control is steady, progressive and without overlap. Furthermore, you do not get any squawks or grunts until the reaction coupling has been carried beyond the oscillation point.

4. The circuit works just as well when Reinartz reaction is applied to it, and in fact I prefer this form.

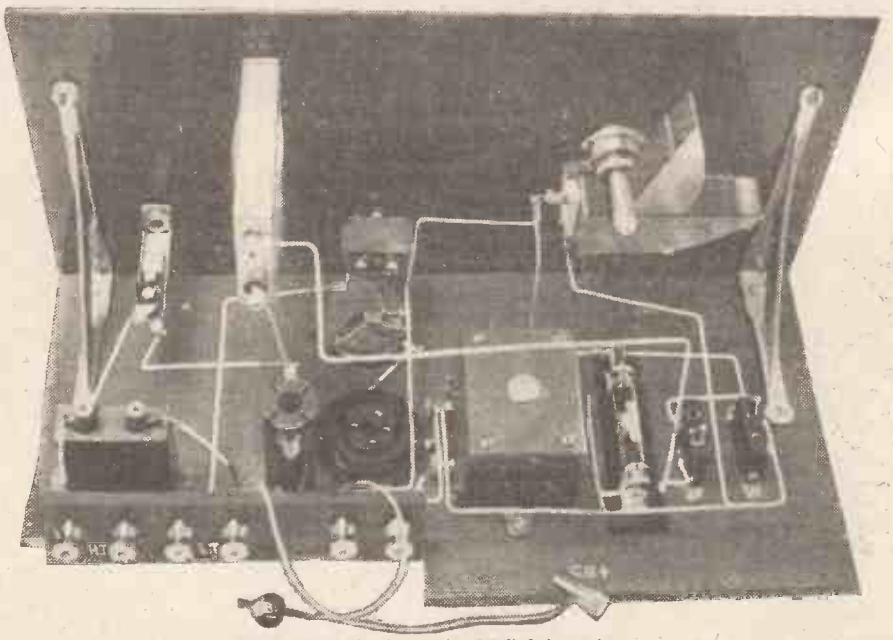
5. Adjustment of the crystal does not send the receiver into violent squawky oscillation.

6. This circuit is *not* sensitive to A.C. hum, electric light main disturbances, and other irritating noises which make themselves so objectionable on the usual reflex receivers.

7. Further note magnifying stages can be added without upsetting the receiver. In this way it differs remarkably from the average reflex.

8. Stages of high-frequency amplification can be added without difficulty.

9. Notice that there is but tuning control and one reaction control.



This photograph shows the detailed lay-out.

Constructional Notes.

Above I am giving you a diagrammatical drawing showing you how to join up any parts you may have by you, so as to try this circuit for yourself. I have been so interested in it for my own use that I have brought out a form of the circuit in which Reinartz reaction is used and the whole set is made up in cabinet form. It is, so to speak, a "de luxe" application of the circuit, and as it is particularly simple to control and highly economical in operation, many readers may care to make it up in this form. For this reason I am giving full constructional details.

Here, then, are the components needed to make up the "de luxe" Hale single-valve receiver.

One ebonite panel 16 by 8 by $\frac{3}{16}$ or $\frac{1}{4}$ inch. (Any good ebonite of guaranteed quality will suit. I have used Radion Mahoganite.)

One cabinet 8½ inches deep with baseboard and brackets. This is a standard size of cabinet and is easily obtainable from any of the cabinet manufacturers.

One ·0005 mfd. variable condenser (Igranic Pacent straight-line frequency).

(Continued on next page.)

THE "HALE" RECEIVER.

(Continued from previous page.)

Dial for same (Radion Mahoganite).

Two board-mounting coil brackets.

One low-frequency transformer of good make (Gambrell).

One anti-vibration valve socket (Lotus).

One board-mounting filament resistance (Lissen).

One ·0003 mfd. variable condenser (Polar junior). This is an inexpensive condenser with a convenient dial, using almost the whole rotation for passing from minimum to maximum. It suits excellently as a reaction condenser, but its rather high minimum makes it less preferable than the other types for the grid circuit tuning condenser in this set.)

One on-and-off switch (Igranic).

One single circuit open jack (Bowyer-Lowe).

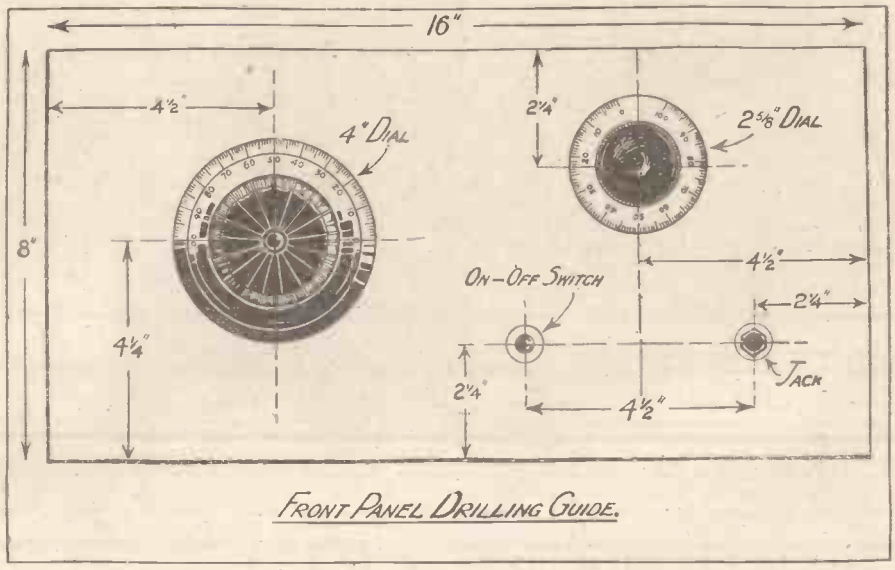
One plug for same (Bowyer-Lowe).

One Mansbridge condenser, any value from ¼ to 2 mfd. (Dubilier).

One high-frequency choke (Varley).

One permanent crystal detector (R.I. permanent detector).

Strip of ebonite to carry six terminals, 8 by 2 by ¼ inch.



Front Panel Drilling Guide.

Small piece of ebonite for mounting R.I. detector.

Six terminals.

One 9-volt grid-bias battery with wander plugs.

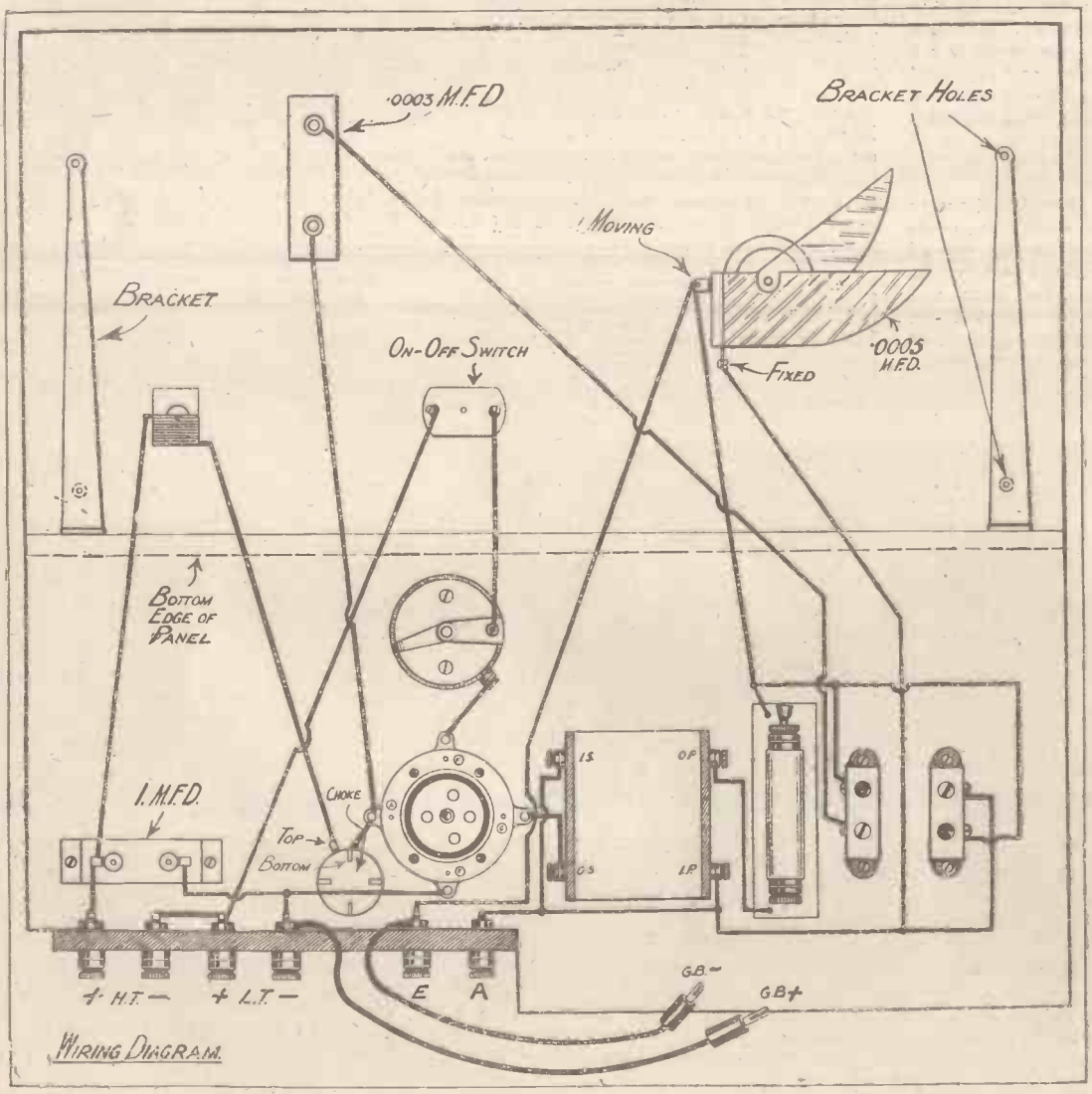
Connecting wire such as Glazite.

Plug-in coils to suit wave-length.

Transfers if desired.

It will be noted that I have named those components actually used in this receiver, but it should be emphasised that any good equivalent makes will work just as well. For example, actually I have used a straight-line frequency condenser because it was convenient and because in a coupled circuit which I may try in this receiver, such a condenser may have calibration advantages. However, with the aerial directly coupled the additional capacity so "tacked on" to the circuit will alter the "straight line" frequency reading in this condenser, and so a straight-line wave-length type would be just as convenient.

There are no particular points to explain wiring up the receiver, as the drawings show details quite clearly. The baseboard filament resistance I have used is a 40 ohm type, so as to enable ·06 ampere dull emitters to be used. However, this resistance can easily be used at the "full-on" position and experiments carried out with 2-volt valves, or at intermediate positions for others.



Wiring Diagram.

Operation.

When you have wired up this set, or for that matter, any other arrangement of the circuit, the following points will interest you.

I have actually tested this circuit very exhaustively with several

(Continued on next page.)

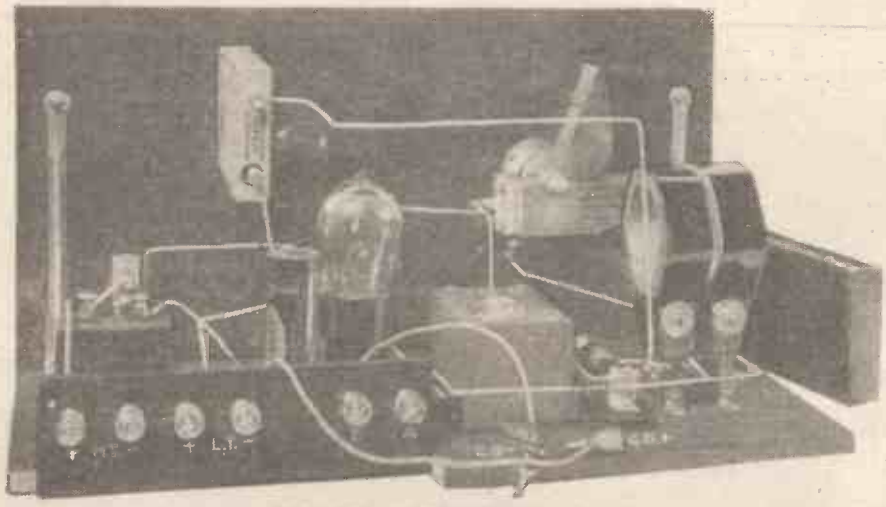
THE "HALE" RECEIVER.

(Continued from previous page.)

makes of ·06 ampere dull emitter; the various small power valves of Marconi, Osram, Mullard, Ediswan, B.T.H., and other makes; with 2-volt valves such as the Cossor Point One, Cossor Stentor and other leading makes; and with bright emitters.

Any Valve Can be Used.

I have, of course, tried both the high-frequency and low-frequency amplifying valves in these types. Although the set will work on practically any valve, the best results are obtained with those designed for low-frequency amplification. Typical economical valves which I have found to give excellent results in six, four and two volt types respectively are Marconi or Osram D.E. 8 L.F. in six volts; B.T.H. B.6 in four volts; and Cossor Stentor in two volts.



All terminals are kept at the rear of the set

At the same time astonishingly good results are given with the ·06 ampere valves with 60 volts on the plate. With those valves just mentioned as typical 100 to 120 volts give wonderfully good results, and, indeed, on a good average outdoor aerial up to 10 or 15 miles from a broadcasting station, loud-speaking results can be heard all over the house. Grid bias should be adjusted by trial.

Reinartz Reaction.

In the aerial circuit you will want a 25, 35 or 50 coil depending on the wave-length range required, and for the reaction coil a 35, 50 or 75, or the equivalent of other makes, according to your aerial damping. With small or indoor aerials a smaller reaction coil may be needed. To make sure that you have your reaction coil connected the right way round in this circuit, notice the following: Aerial is connected to the pin of baseboard coil socket and the reaction condenser is connected to the pin of the reaction coil socket. The sockets are placed side by side in such a way that the pin of one is alongside the socket of the other.

Connect your aerial and earth in the usual way, plug in your coils, say a No. 35 to begin with for the aerial, and a 75 for the reaction, put the reaction condenser at zero, plug in your telephones, and, of course, with your batteries connected up, set your filament resistance to a suitable position and switch on by pulling the switch outwards. Turn the condenser backwards and forwards and try moving your reaction condenser slowly. You will probably find that the set goes gradually into oscillation. At once turn back again to prevent interference with other receivers. In any case, I suggest that you do not try out this receiver for the first time until after the broadcasting hours. When you have become used to the control you will not be likely to cause trouble by oscillation. You will soon "get the hang" of the set, and you will find it astonishingly sensitive.

The other evening, although the reaction setting was well below oscillation point, I succeeded in hearing no less than four foreign broadcasting stations by simply rotating the single tuning condenser. Two of them were brought up to quite moderate loud-speaker strength by adjustment of the reaction control.

To make sure that this set works well in all conditions I have tried it on several aerials and, in fact, one of the first experiments conducted with it was to take it round to a friend who now has only a temporary aerial made of about No 26 S.C.C. wire slung out of the window to a pole at the bottom of the garden. The maximum height of this aerial is about 10 feet and my friend's locality is rather screened. Although he had not previously handled the set, after two or three minutes' trial he succeeded in bringing in, and easily identifying in the telephones, Dublin and a number of continental stations.

I want you to write to me to tell me the results you get with this circuit in whatever form you make it up. In any case, try it as quickly as you can; you will find it one of the most astounding crystal and single-valve sets ever devised.

One final word of warning. Do not abuse the sensitiveness of this receiver by always working on the edge of oscillation. Shortly I will tell you how to make a non-radiating Hale receiver with several advantages.

TWO HINTS.

By P. W. H.

ALMOST every home constructor now buys his panel cut to size, and designers are keeping more and more to standard sizes, which can be bought ready cut and packeted in all the reputable makes. While the panels so purchased can be relied upon to be accurate to within a very small fraction of an inch, it is unfortunately the case that the cabinets are by no means so reliable.

Fitting a Panel.

If you are unfortunate enough to find that your panel is just a little too large for the cabinet you desire to use, be very careful how you proceed in making it fit. Usually the difference in size is not more than an eighth of an inch, and to cut off a strip only this width, quite uniformly, is no easy task, even for the experienced constructor.

The best way to proceed is to mark off the width of the strip it is desired to remove by scratching a fine line on the back of the panel, clamp the panel to the table (a useful clamp will very likely be found on the kitchen mincing machine!) and cut along the line with a fretsaw.

If a fretsaw is not available, do not attempt to cut off the strip with an ordinary hack-saw unless you first take the precaution of clamping the ebonite between two straight-edged pieces of wood which can act as guides to prevent the saw slipping.

If the piece to be cut off is very narrow, it is safest to rely on the file entirely for removing it. A fairly rough file should be used as the finer varieties clog too easily.

Cigar Boxes.

A collection of empty cigar boxes can be turned to very useful account in the amateur's workshop. In one I always keep the following tools:

Scriber.
Centre punches.
3 in. steel rule.
Dividers for marking out large circles.
Small screwdrivers.
Small pliers.
Miniature spanners.

This box is taken off the shelf whenever I begin laying out a panel. In a second box is a collection of 4, 6 and 8 B.A metal screws and nuts, and in a third my collection of drills and countersinks. A fourth box is devoted to mica and tinfoil, and a fifth to measuring instruments.

The larger boxes can very conveniently be used for sundry small items always wanted in a hurry, one box being devoted to fixed condensers, another to grid-leaks and anode resistances, and a further one to valve-holders. Temporary valve-stands are easily improvised from the small boxes such as are used for 25 cigars, inch holes being drilled in the lids.

It will be found that a valve will rest easily in such a hole, the edge of the base resting on the box top, and the pins passing through. This method of holding is much preferable to drilling separate holes for each pin, as one need not trouble to look at the base before placing the valve in its socket.

BRING YOUR OLD SET UP TO DATE.

Here the Editor tells you the simplest way to modernise your present receiver at minimum cost and get greatly improved results.

This adaptor enables you to neutralise your old set.

HAVE you an old and trusted wireless set that has been giving you good service for many long months, but which you feel is really out of date? It is a shame to scrap it, although, naturally, you want to keep abreast of modern improvements. If you are a keen wireless "fan," you have probably planned to build a really up-to-date set soon. Possibly you have not yet all the new components ready to hand, and in any case there will be a frightful bother if you start pulling the family set to pieces before the new one is ready.

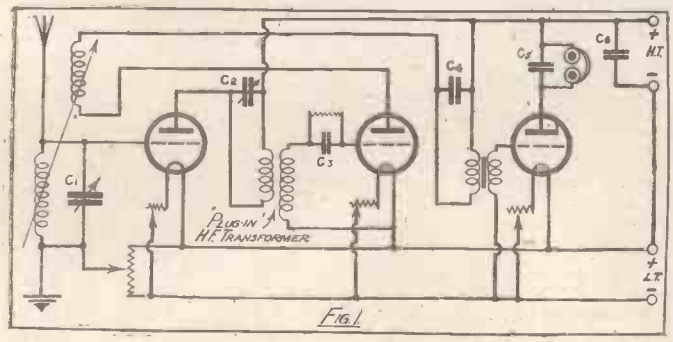


FIG. 1.

What You Can Do.

At the same time it is very annoying when you feel that those interesting distant transmissions which you can just hear faintly in the headphones would come in much better with the same number of valves on a modern receiver. Again, you *know* that when the local station is not working, your set is good enough to bring in several other main stations, but what a pity your set is not selective enough to cut out the nearby "big noise." Must you really "scrap the lot" if you want to get modern results?

Not at all! In this new series of articles I want to tell you how many existing sets of standard design can be brought up to date with a very small expenditure of time and money. I have in view the more popular type of home-built receiver, and I think you will be very surprised and, I hope, pleased when you find how easily several important modern improvements can be effected.

First of all, let us consider how the modern sets differ from the "old stagers." In both old and new sets we have H.F. valves, detectors and note-magnifying valves; we have coils, condensers, L.F. transformers—all very much the same as before, and the number of entirely new types of components is relatively small. Where the new set scores over the old is in sensitivity—the ability to give better long-distance results, or better local reception with a much smaller aerial; selectivity—enabling us to cut out the local station within a few metres on either side of its best tuning point; and, lastly, in better quality.

Of course, to get the very best results you should build a new set to one of the many new modern designs, but even with the old one, astonishing improvements can be effected by following the suggestions I am about to give you. In this first article I propose dealing with a popular type of three-valve circuit, which has been made up in many different designs. Probably your own receiver resembles it in many points, and you will see how to make several changes right away. If, as may very likely be the case, your receiver is similar to this in most of its essential features, you will be certainly surprised at the improvement in such a set as a result of an evening's work.

A Popular Circuit.

The circuit I have in mind is a three-valve receiver with one stage of H.F., a detector, and one note magnifying stage. We will assume that the aerial coil is carried in a two-coil holder, the second coil of which provides magnetic reaction. Stability in the H.F. stage is obtained by a potentiometer, and for the H.F. coupling you have one of the popular barrel-type H.F. transformers, with four pins, made to fit a valve socket. The primary is tuned with a ·0003 mfd. variable condenser, and in the detector stage you have the usual leaky grid condenser method of rectifying.

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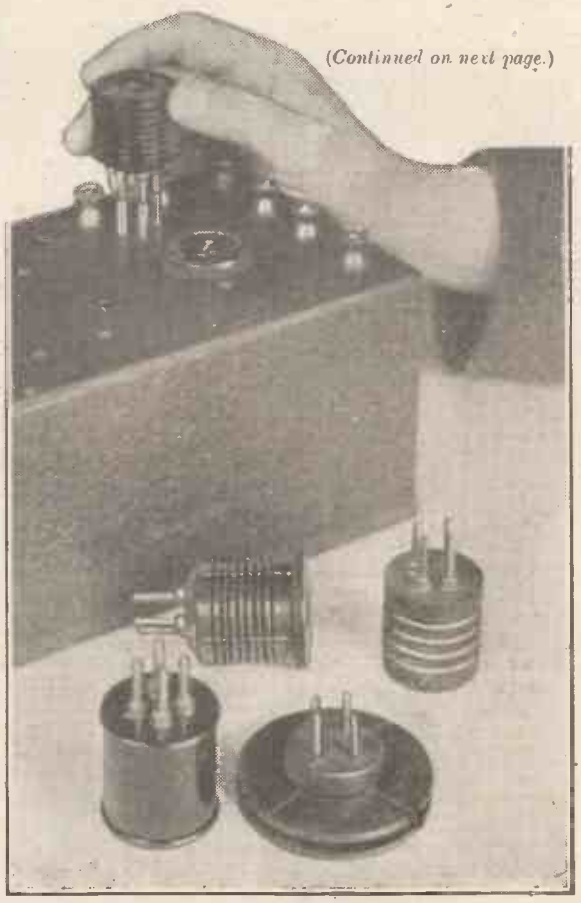


Changing the H.F. transformer for a different type.

BRING YOUR OLD SET UP-TO-DATE.

(Continued from previous page.)

The anode circuit of the detector valve contains the reaction coil, and an L.F. transformer couples the detector to the note magnifying valve. There are two terminals for the H.T., and two for the L.T. Two terminals are provided for the loud speaker, and there are, of course, aerial and earth terminals. The circuit is

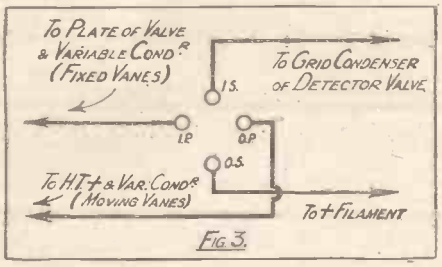


FIG. 3.

illustrated in Figure 1. Note that the filament resistances are all in the negative filament leads.

Such a set, carefully adjusted, should give quite good results, but will be very broad in tuning, and will not obtain the best sensitivity possible with modern valves.

Aerial Circuit.

First of all, substitute for your aerial plug-in coil one of the several makes of special plug-in coils, such as the Lissen X or the Igranic Unitune. You will then remove the aerial connection from the aerial terminal and connect this to one or other of the X coil tappings (test will show you which is the better of the two), or in the case of the Unitune coil, you will connect the aerial to one tap and the earth to the other.

This will only take you a minute or two, and if you do nothing else to the set you may, in certain circumstances, get an improvement in selectivity. Possibly you will be disappointed with the change. Do not blame the coil or the coupling method, for I can soon tell you why the results are not what you expect.

A Simple Explanation.

The tapped aerial coil is a very useful device when properly connected in a suitable set, and can greatly enhance the selectivity, but if you use it without further changes in such a circuit as that shown in the diagram, you will quite possibly get weaker signals and no extra selectivity.

When the grid circuit of a valve is tuned to the same frequency as the anode circuit, there is a great tendency for persistent oscillations to be set up, due to the reaction effects between the plate and grid circuits, provided by leakage of fields and by capacity in the valve itself. To prevent this persistent oscillation, the use of a potentiometer has been very popular in the past. The potentiometer is a device which will introduce damping into the grid circuit, by making the grid of the valve positive; or, put in another way, as the plate circuit is feeding back more energy than can be normally absorbed in the grid circuit, the potentiometer introduces sufficient losses to absorb that surplus energy.

Now, the introduction of losses to compensate for too much feed-back is by no means a desirable state of affairs. It is something like throwing away part of your money because you cannot get it all in your purse. The more losses you introduce the less efficient your set will be.

Now, the aerial itself, when connected as shown in the first diagram, or "directly-coupled," as we call it, introduces certain losses into the first circuit, for the aerial itself has resistance, and indeed in the case of many aerials the damping so provided is quite enough to "hold the set down" without the grid being made positive by means of a potentiometer. In fact, we may have such heavy losses introduced by the aerial that we can use the reaction coupling shown to increase signals, before reaching

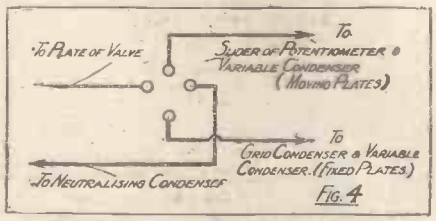


FIG. 4.

that objectionable oscillation point which we are trying to avoid.

By using a tapped coil in the aerial we reduce the aerial damping quite considerably, but in so doing we may make it necessary to introduce corresponding losses by means of the potentiometer, thus effectively nullifying the benefits the tapped coil would give us. That is why the use of a tapped coil often effects no great improvement. I shall return to this point later.

The plug-in H.F. transformer is connected

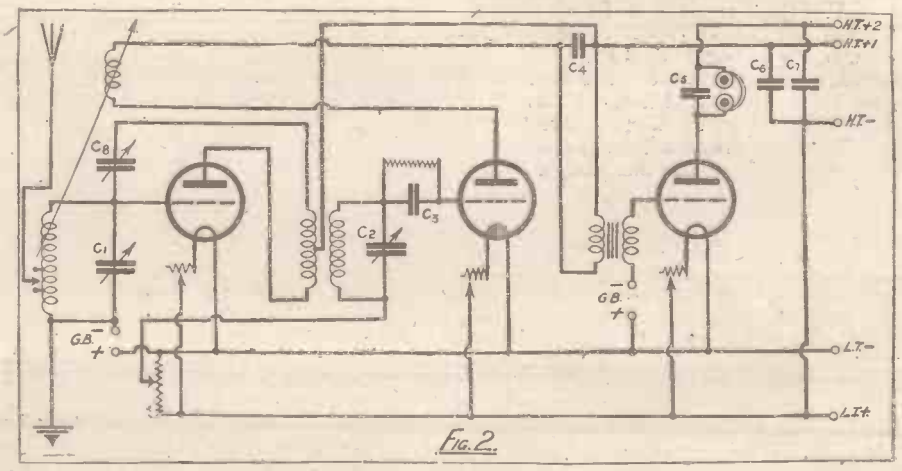


FIG. 2.

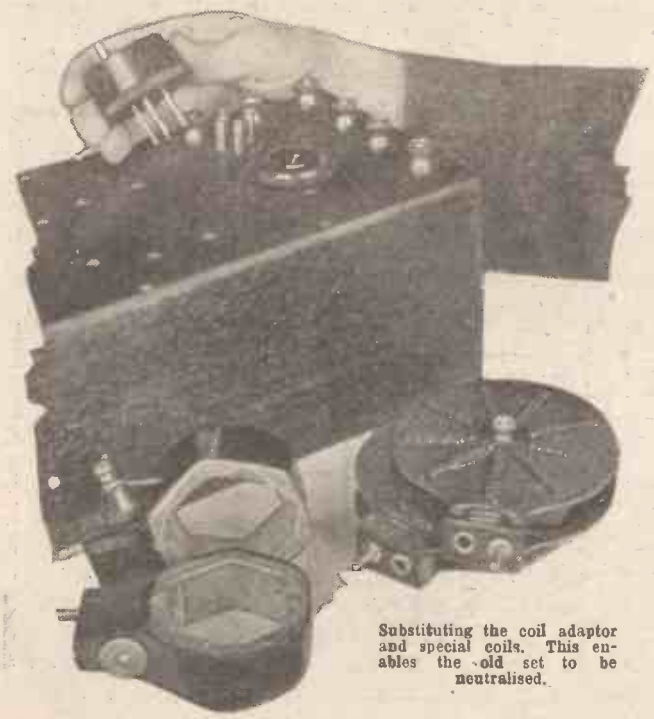
to four pins, corresponding to the pins at the base of a valve, and the diagram, Fig. 3, shows you how the connections are made. I have drawn them as the valve socket would appear on the underside of the panel where it is wired up. Possibly, in your set the I.P. and O.P., or the I.S. and O.S., connections are reversed

Transformer Connections.

The two pins which would correspond to the grid and anode of the valve are the two secondary terminals, while the two pins corresponding to the filament pins of the valve go to the primary winding.

Probably you will have tuned the primary winding in your existing set. Notice if this is the case, that one terminal of the primary goes to the anode of the valve, and to the variable condenser (if correctly wired up, it should go to the fixed vanes), while the other terminal goes to H.T. positive and the moving vanes of the variable condenser. The two secondary windings are led to the positive of the filament of the detector valve, and to the grid condenser and leak respectively.

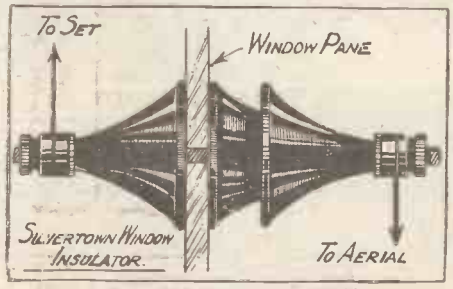
How to convert the Figure 1 circuit to that of Figure 2 will be explained next week.



Substituting the coil adaptor and special coils. This enables the old set to be neutralised.

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

I HAVE just received a letter from a friend in Alassio, Italy. Alassio, by the way, is situated between Nice and Genoa, on the northern coast of the Gulf of Genoa. For reasons of health he has been compelled to take up his residence in this part of the world, and having settled his household effects is now anxiously awaiting



the arrival of wireless apparatus from England. "I do not know what reception here will be like," he writes, "three hundred yards behind the house a mountain slopes down into hills. Rome has a clear field over the water.

Some Aerial Difficulties.

"Power and lighting are in every room of the house, so there will be no difficulty in accumulator charging. I have with me a Tungar charger for H.T. and L.T. and the accumulators are on the way. The licence is about £1 7s. 6d., and I understand there is an extra charge for valves. I have only seen four aerials in Alassio. They are all of the double type, and much longer than any I have seen at home.

"My difficulty is the aerial question.

"On all five sides of the house I have plenty of room for any kind of an aerial of any length. Right or wrong, I prefer the single type, which I believe you advocated some time ago. My difficulty, however, is bringing the aerial and earth into the house. Whoever built the house must have had in his head the idea of a stronghold! It rests on a bed of solid concrete 18 to 20 feet deep, and the stuff extends all around outside for 6 feet. The outside walls are 2 feet 6 inches of stone, impossible to cut through. The windows are equally impossible.

They are protected with either outside wooden blinds or semi-outside shutters or both, and are set in steel frames. I cannot see how on earth I can get through into the house. I am lost without my wireless. I want to hear of 'that deep depression' over England. When I get going, I will give you an account of the conditions of reception."

Some Suggested Cures.

Beginning with the earth, I have written to my friend suggesting he makes a good, sound soldered connection with the water supply to the house, using, as a further precaution, a number of buried wires or earth plates distributed around the house and joined to the water-pipe system just outside the house. Occasionally, particularly in countries such as Italy, the water-pipe may be carried a considerable distance before it joins a main pipe, and possibly through the air or other substances, which may be fairly effective insulators.

In such cases the effect of joining your earth lead to the water-pipe system is to give a very long earth lead which is always undesirable. If the additional connection is made to a number of earth plates or buried wires as close to the house as possible, this effect may be largely reduced and the water-pipe can then act as a "lead-in"

With regard to the aerial lead-in, the problem is certainly more difficult, and I am suggesting as one solution drilling the window-pane and fitting one of the Silvertown window-pane insulators which, incidentally, are quite short.

Supplied in the box is a small copper bit and a quantity of carborundum powder, so that by fitting the bit into one's ordinary drill, a hole can be drilled in even a thick window glass with astonishing ease. I speak from experience in this matter, as I have already fitted two such insulators in one of the side windows of my laboratory (the window, by the way, is of quite heavy glass, through which I was able to drill in less than fifteen minutes).

Finding the Space.

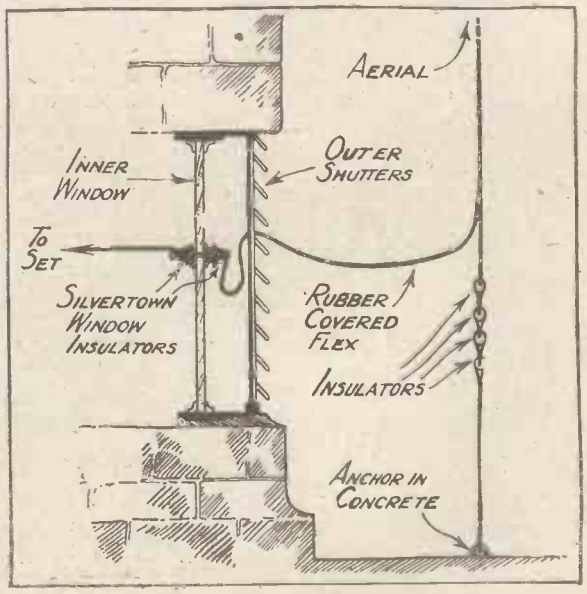
Probably there will be sufficient space between the outside of the insulator and the wooden shutters in a suitable window, and if a heavily insulated flexible wire is connected to the exterior terminal of the insulator and then threaded through the slats of the shutters, it should be possible to open or close them without more than bending the flexible wire to enable the glass window to be opened when desired. In order to take the strain off the flexible wire, I have suggested that the aerial connection outside should be made in the manner shown in the sketch.

The Earthing Switch.

Suitable control of an earthing switch from the house is not easy in such circumstances if the earthing switch is really to carry out its duty effectively. It should be remembered that any scheme which merely earths the aerial, at the same time leaving the lead-in attached to the aerial, or within a very short distance of it, is not a particularly efficient safeguard, for we simply provide the lightning with two paths to earth in parallel, one straight to the earth and the other through the set.

Probably the bulk of the discharge will go to the direct earth, but a tiny fraction of it is quite enough to wreck a receiver. However, in such localities as that in which my friend finds himself, I am strongly in favour of adequate earthing of the aerial by means of a proper switch.

In the case of the average suburban aerial, such as we find in this country, I have much doubt whether any real danger exists save in very exposed places where the aerial is particularly high.



Longer life!

The NEW SIX-SIXTY "GLOWLESS" VALVES

WHEN a piece of red-hot iron is dipped in cold water, it suddenly contracts and becomes hard and brittle. With one or two notable exceptions, this tendency to become brittle is shown by all metals with high melting points, and is dependent, among other things, on the rate of heating or cooling.

Now take the case of Radio Valves. The filament in the ordinary valve on the market to-day has to be heated to incandescence to produce the requisite electronic emission, and owing to its remarkably small dimensions, the rate of heating and cooling is very rapid, a process which quickly produces brittleness, and eventually tendency to fracture.

With the new Six-Sixty Point One Valves, there is absolutely no "glow" whatever from the filament when operating at the rated voltage, in fact, there are no valves on the market to-day that can boast of a longer life because there are no valves that operate at a lower temperature.

In addition, every advantage of the special Six-Sixty filament—which requires barely ·1 amp. to ensure the best results—is utilised to the highest degree possible by our Duo-Triangular system of suspension to produce the perfect valve.

It is interesting to note that Messrs. A. J. Stevens & Co. (1914), Ltd. have decided, after exacting and exhaustive tests to standardise Six-Sixty Valves in their famous "Symphony" Range of Receivers.

S.S. 2A., H.F. and L.F.
D.E., 1·8 volts, ·1 amp.
H.F., L.F. and Detector **14/-**

S.S. 10.
D.E., 2 volts, ·15 amp.,
Power Amplifier .. **18/6**

S.S. 7.
D.E., 3·7 volts, ·1 amp.,
Power Amplifier .. **18/6**

S.S. 8.
D.E., 3·4 volts, ·1 amp.,
General Purpose .. **14/-**

These prices do not apply in the Irish Free State. Descriptive leaflet S.S. 9-26 with particulars of complete range free on application.

SIX-SIXTY VALVES
Better by Six Times Sixty

The Electron Co., Ltd., Triumph House, 189, Regent Street, London, W.1.

By O. J. RANKIN.

A WELL-ORGANISED workshop is the job half finished, a fact often realised by those who take more than a passing interest in their hobby.

The following hints are intended for owners of *semi*-organised workshops—i.e. in cases where all tools occupy their proper places in racks, nests of drawers, etc., and where all materials and parts are left lying about in a state of disorder.

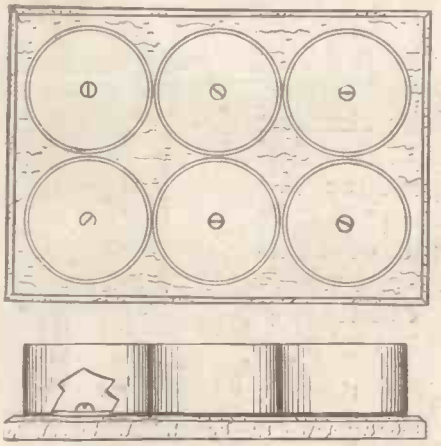


Fig. 1.—A tidy receptacle for small screws.

In order to be able to place one's hand on some small screws of the right size, at the right moment, those screws must first be placed in a certain receptacle kept exclusively for those particular screws, and not mixed up with other screws, terminals, etc., of various sizes. Here one requires a shallow wooden box divided off into a number of sections, or failing this, one may use a nest of empty tobacco tins (2 oz. size), which may be screwed down to a rough baseboard in the manner shown in Fig. 1.

One nest of tins might be kept exclusively for small screws, another for nuts and washers, another for terminals, and so on. Similar tins may be arranged to accommodate lengths of brass rod and tube. (See Fig. 2.)

To construct such a container, or rack, as shown in the sketch, one will require six tins and a piece of board about 12 in. long by 8 in. wide and ½ in. in thickness. Remove the base from each of the three tins intended for the top, so that they form bands, and nail them to the board in the approximate position shown. Then attach the other tins to the lower portion of the board, nail the board to the wall, and the rack is ready for use.

A Place for Everything—

We usually purchase rods and tubes in 12 in. lengths; the distance between the two rows of tins on a rack kept specially for whole materials should therefore be about 8 in. For shorter materials the top tins may, of course, be placed proportionately lower. A very useful rack might consist of six sections (12 tins), the upper row of tins being arranged in step fashion in order to accommodate materials from about 3 in. to 12 in. or more in length.

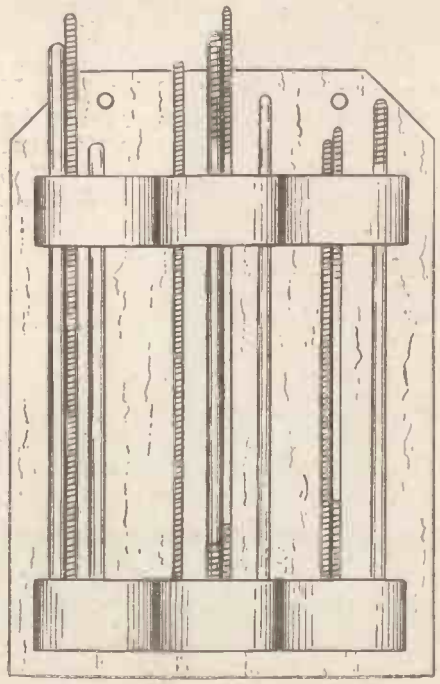


Fig. 2.—How to store brass rods and tubes.

Nuts should be stored in small boxes or tins, or kept on wire rings. A large slip-on paper-fastener will accommodate several dozen of the smaller sizes. A system favoured by many is shown in Fig. 3, where the nuts are kept on vertical screwed rods attached to an odd strip of ebonite, which is screwed down to a fairly heavy wooden base.

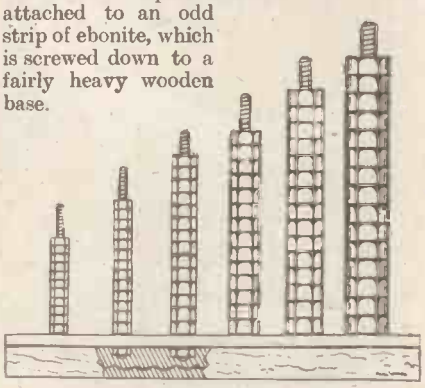


Fig. 3.—A handy rack for nuts.

The idea outlined in Fig. 4 may be extended and adopted to many different purposes; it shows how an old metal spider coil former may be mounted on a suitable support and made to serve as a revolving rack for small nuts, washers, etc., small rubber or hardwood knobs being fitted over the ends of the spokes in order to prevent the various fittings from slipping off.

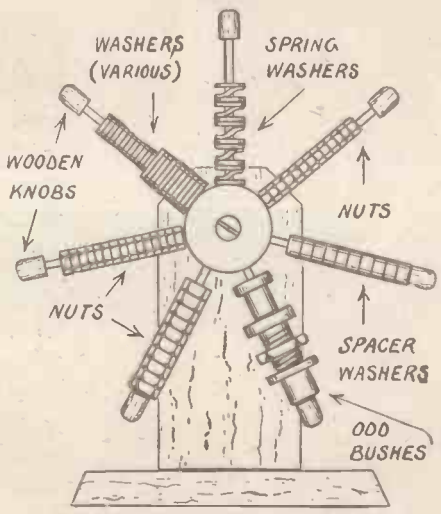


Fig. 4.—A revolving rack for small parts.

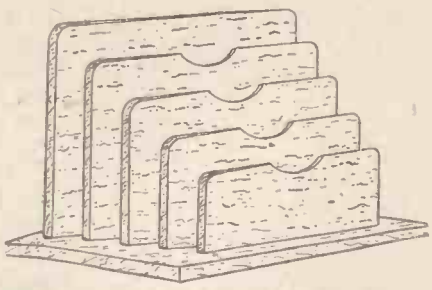


Fig. 5.—An easily-made ebonite panel rack.

All panels should be kept in a proper rack, such as that shown in Fig. 5. This may be easily built up from a few pieces of board at a cost not exceeding the wear and tear of the saw and hammer.

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6. The names of prize winners will be advertised in a January issue of this journal.
7. No employee of Messrs. C. A. Vandervell or their associated Companies or Agents or Agents' employees are eligible to compete.
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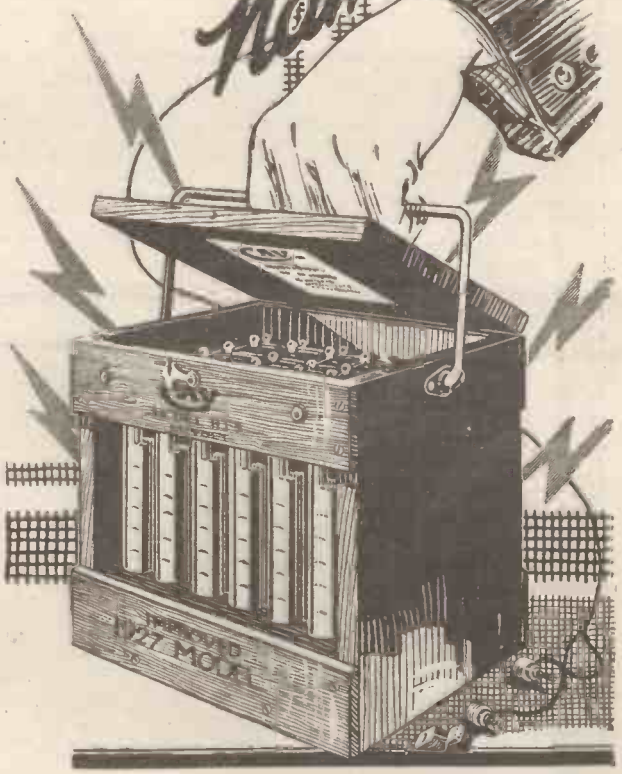

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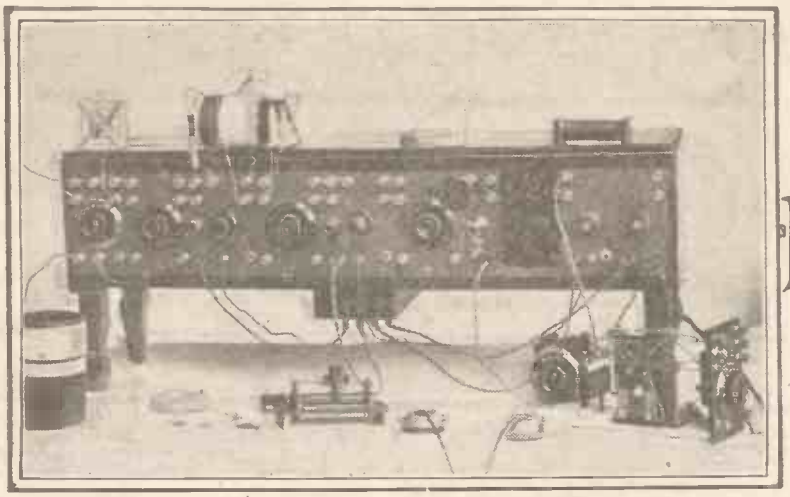


The INTERPLEX

The Interplex system is the outcome of attempts made to design an ideal experimental set. Our contributor will deal with this interesting system in a series of exclusive articles in this journal.

By J. ENGLISH.

PART I.

COULD we but peep into the wireless den of some ardent experimenter, the chances are that we should find him delving among a mass of wires and components quite bewildering in its complexity to the uninitiated. Should this be one of the occasions upon which the latest idea did really work, then, no doubt, we should be surprised at the good results obtained with such a set.

However, even if the experimenter's "hook-up" is quite orderly and compact, it must suffer from a lack of coherence as a whole, and has an amazing facility for collecting dust, the bane of all radio work. Moreover, although this arrangement is to a certain extent flexible and adaptable, a lot of time and thought is wasted in changing from one circuit to another.

Invaluable for Experimental Work.

From time to time various systems have been devised in order to obviate these disadvantages, but none of them have given that extreme flexibility and limitless adaptability that is demanded by the true experimenter. Again, success in experimental work necessitates apparatus that can be rapidly connected up into any form of circuit, no matter how unorthodox, and then the experimenter, no longer hampered by the mechanical difficulties of carrying out his ideas, can give full vent to his inventive faculties.

The Interplex system is the outcome of attempts made about two years ago to design what was then considered to be the ideal experimental set, one which should be self-contained, neat of appearance, and yet possess infinite adaptability to experimental conditions.

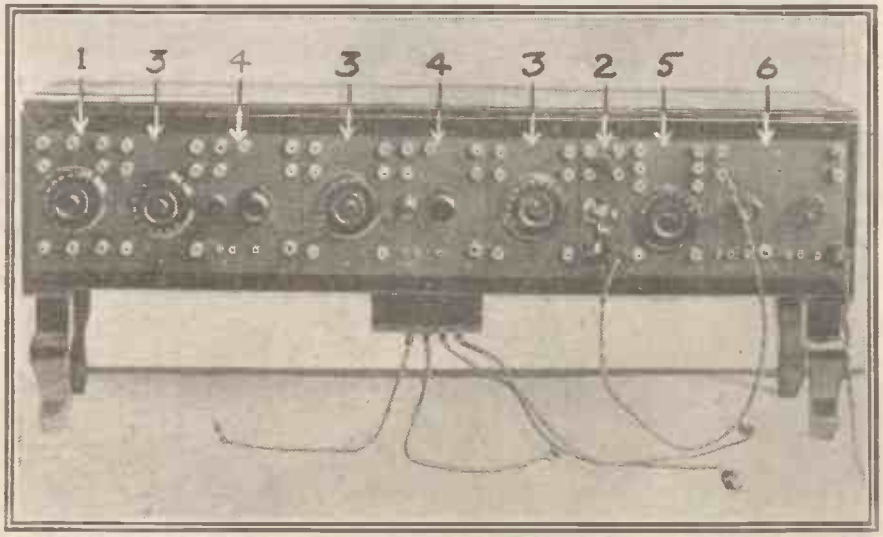
Ignoring previous ideas, the original set departed in many ways from the then current practice, but it has proved eminently successful and invaluable for experimental work of all descriptions.

Although the system is now two years old, I have refrained from describing it before until it had been exhaustively tested and proved capable of being adapted to the rapid progress recently made in radio technique. The apparatus described herein has been specially constructed for the purpose of this article, and, while it is to all intents and purposes a replica of the original, it incorporates all the improvements suggested by past experience. Even now the possibilities of the Interplex system have by no means been exhausted, and I am confident that this improved installation will satisfy the requirements of the most exacting experimenter.

Two Outstanding Features.

From the photograph of the complete system, it will be seen that the general appearance is quite neat and compact. The general scheme of construction, which has of late become very popular, is such that all components are mounted within the cabinet, and only controls and terminals are visible on the panel face.

Two outstanding features of the system are, firstly, the method of assembling the units, namely, two bars in the cabinet face between which the unit panels are engaged in any positon, and secondly, the grouping of components into different classes of units, the idea being to minimise inter-unit connections by joining up groups of components in a certain way to form units having a particular electrical function to perform, but without in any way diminishing the general flexibility. In fact, the Interplex system may be likened to a box of radio bricks with which any combination



A complete Interplex frame with panels : (1) aerial and earth unit ; (2) crystal detector panel ; (3) variable condenser units ; (4) universal valve unit ; (5) L.F. coupling panel ; (6) two-Valve L.F. unit.

What may at first sight appear to be a single ebonite panel in the face of the cabinet is in reality a number of unit panels, some of which are fitted at the back with baseboards, upon which are mounted such components as valve holders, transformers, etc.

The means of retaining these unit panels in position in the face of the cabinet is, as will be seen in the above photograph, such that the device permits of any order of assembly, as each unit can be lifted out and replaced in a moment, or slid along the bottom bar of the cabinet front. The weight of components mounted in each unit retains it firmly in position. The cabinet is mounted on four short legs, so that it can be placed on a table, but, if desired, it may be fixed to a wall just above the operating bench.

of components can be readily built up from a crystal set to a superhet. Another point of general interest is that constructional work is very easy, amounting almost to the assembly of simple components, while the overall cost is very moderate. The full number of units need not be constructed all at once, and quite a useful installation can be built up with half the number.

As in most unit systems, the input terminals on each panel are on the left and the output terminals on the right, so that the inter-unit connections are of minimum length. In general, terminals connected to points of high potential will be at the top of the panel, and those

(*Continued on page* 503.)

Announcing A GREAT

IN this, the first announcement of the new S.T. series of valves, I would, as the designer, like to make some preliminary remarks.

I have for several years watched valve development very closely, noticing the advantages and disadvantages of every type and every process. When I decided to enter the manufacturing field myself, I resolved to combine the best features of existing valves with my own ideas. The Company of which I am now managing director has acquired a licence under all the leading patents which have contributed to valve development in order that we shall not be hampered in any way in producing the best. Although this has added to the manufacturing cost and minimises the profit, I was not prepared to place a valve bearing my name on the market unless it represented the highest technique in valve manufacture and design.

While head of the Elstree Laboratories, my duties included the technical criticism of existing valves and acquiring an intimate knowledge of their respective advantages and limitations, and I would not have produced a series of valves unless I believed they would stand out above others.

John Scott-Taggart, F.Inst.P., A.M.I.E.E.

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THE INTERPLEX.

(*Continued from page 499.*)

connected to points of low or earth potential beneath these or at the bottom of the panel.

As each unit is designed for a certain purpose, they may be assembled so that the order of connections follows that of a conventional theoretical circuit diagram. In fact, once the idea of the system has been grasped, it is an extremely easy matter to connect up the units *direct* from such a diagram, and no matter how complex the latter may be, very few inter-unit connections are needed.

Everything Accessible.

While the Interplex system permits any circuit to be connected up in the minimum of time, and into one compact whole, it is chiefly intended for experimental work, and not so much as a multi-circuit receiver. For this reason an attempt has been made to include as many as possible of the essential components, with provision for the maximum variety of interconnections, and the ready accessibility of any part of the system is a feature that experimenters will appreciate. Every unit, every component, in fact, every terminal and connection, is easily accessible for inspection or alteration in a moment, no matter where it may be situated.

Unlike other unit systems, the Interplex units do not include any inductances, as experience has shown that it is highly desirable to keep such components apart from the main apparatus, so that the coupling, replacement, etc., of coils may be easily carried out.

It is most convenient to have all fixed inductances such as chokes and H.F. transformers on the lid of the cabinet, while coils of an experimental nature, where values of inductance and coupling are to be varied, are best placed on the bench or table beneath the set. For this reason the body of the cabinet is raised on four legs so that nothing shall interfere with the accessibility of the unit panels and their controls.

Six Classes of Units.

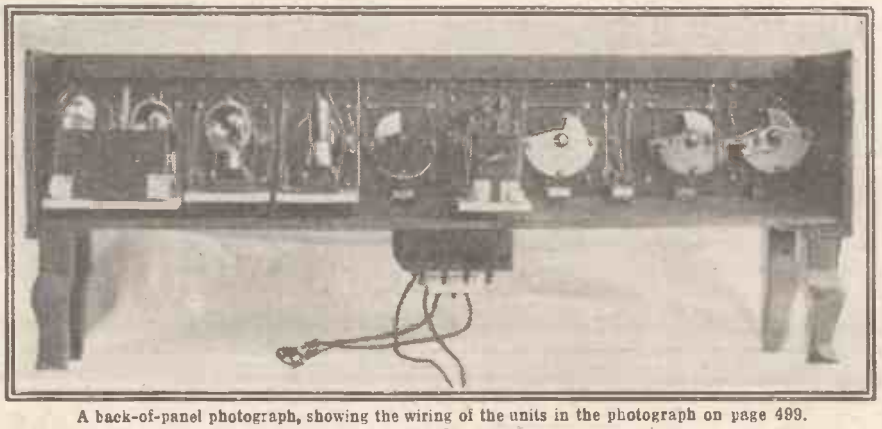
The length of the containing cabinet places a limit on the number of valves that may be employed, and in order that this length should not be more than three feet, it was decided to use four valves, this number being sufficient to cover most work, excluding superheterodynes, in the case of which a second frame work standing on top of the cabinet can be built to carry the I.F.A. valves. However, although but four valves are provided for, the extreme adaptability and flexibility of the system is such that it will be a very considerable time before its possibilities are exhausted.

The units, of which there are ten, are divided into six classes. The number of each class considered sufficient for general requirements has been decided upon after much experiment, but there is no reason why anyone should not make up as many of each as he requires, extending or building up the carrying framework in sections. Before proceeding with constructional details we will first consider briefly the design and purpose of each unit. In the photograph of the cabinet will be seen on the extreme left Unit No. 1, the *aerial and earth panel* on which are mounted main terminals for permanent connection of the aerial and earth leads, and subsidiary terminals for other connections to these points. The unit also contains a variable condenser which can be used in any manner to tune part or whole of the aerial circuit, or as a wave-trap condenser.

Most Interesting Panel.

Unit No. 2, the *crystal detector panel*, comprises input terminals on the left to either a permanent detector for standby work or to an experimental type. Output of the detectors to the two terminals on the right or through a jack into which can be plugged 'phones or the input of an audio-frequency circuit. This unit is useful when experimenting with reflex circuits, and in conjunction with Unit No. 1 and suitable inductances it constitutes apparatus for experiment with simple crystal receivers.

Unit No. 3 is the *variable condenser panel*, of which three are used in the system, the condensers being of different types and capacities.



A back-of-panel photograph, showing the wiring of the units in the photograph on page 499.

On the panel are mounted three pairs of terminals wired in parallel across the condenser, and to these terminals can be connected grid or anode circuit inductances, H.F. transformers, etc., so that these units form the basis of any tuned circuit or tuned coupling that may be required.

We now come to the most interesting unit of the system, the *universal valve unit*, No. 4, of which there are two. This unit is so arranged that valves of any type can be used in any desired manner, such as detector, amplifier or oscillator, by making connections from appropriate units to certain terminals on the panel. The design of this important unit will be described more fully when we come to consider its construction.

Economising in Components.

Unit No. 5, the *intervalve L.F. coupling unit*, provides a means of employing either resistance-capacity, choke-capacity or transformer coupling. This unit is useful when experimenting with reflex circuits or where a high resistance or an iron-cored choke is required. The connections to the primary and secondary of the transformer are variable, and interchangeable condensers are provided across both windings. To economise components the primary of the transformer is also used as the coupling choke. A ·0001 variable condenser is also mounted to fill up available panel space and is useful for control of capacity reaction, etc.

Unit No. 6 is the *two-valve audio-frequency amplifier*. Experience has demonstrated the need of an amplifier of more or less fixed design needing little attention and capable of being brought into circuit in the minimum of time.

The input coupling is a transformer with choke-capacity coupling between the two valves. This constitutes, with the separate grid bias, filament control and anode filament voltages provided for each valve, a reasonable distortionless amplifier. Grid bias batteries are contained within the unit. Two jacks are provided so that either one or two valves may be used, and a plug connected to the input terminal can be plugged into the jack of any other unit to which it is desired to add audio-frequency amplification.

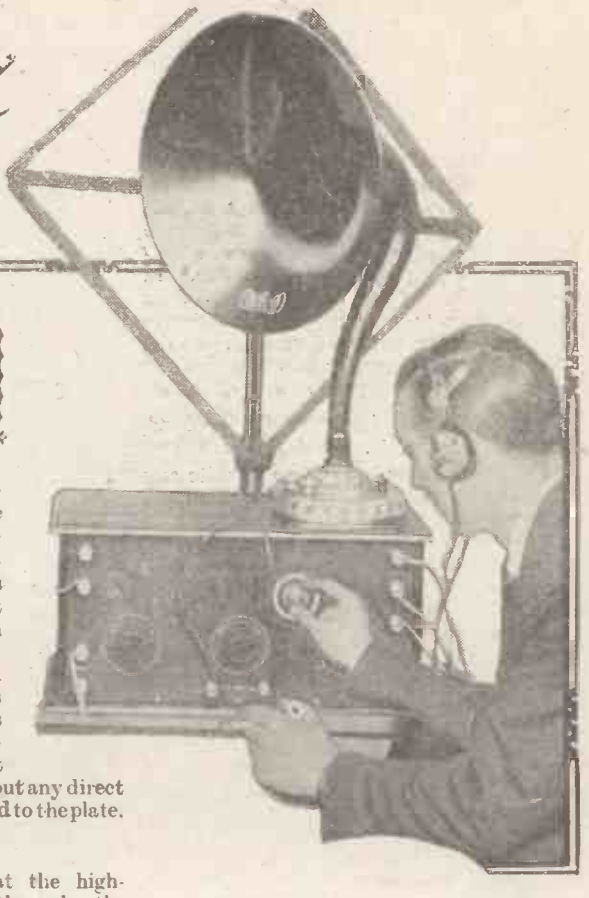
The Battery Leads.

Filament current to each of the four valves of the system is supplied by a length of flex furnished at each end with a plug one end plugging into sockets on the valve units and the other into sockets on the *filament control panel*, which is mounted underneath the bottom of the cabinet. In this position the sockets are completely protected from the danger of accidental short circuits. On this panel are mounted four groups of five sockets wired up to four terminals, which are connected to the accumulator in such a way that each valve by means of its group of five sockets may be supplied with current at 2, 4 or 6 volts. Thus various types of valves, bright, dull or semi-dull emitters, may be worked at the same time. The panel also incorporates a master rheostat and a fuse box. The H.T. supply is also by means of flexible leads, one for each valve, a wander plug at each end plugging into a socket on the valve panels and into the H.T. batteries.

A telephone jack is used in each valve unit as well as in the amplifier so that telephones or an audio-frequency circuit may be plugged into the anode circuit of any valve. Withdrawal of the plug does not break the anode circuit, and this feature is of value as breaking into any anode circuit can be done rapidly.

Throughout the units, all fixed condensers are of the interchangeable type.

The Retrosonic Receiver



DETAILS ABOUT A VERY CURIOUS CIRCUIT.

By J. C. JEVONS.

SOME months ago interesting accounts were published in the daily press of the results achieved by a young Sheffield amateur, Mr. H. W. Roberts, with a new type of circuit, known as the Retrosonic.

The complete receiver was publicly shown for the first time at the Olympia Exhibition where it attracted considerable attention. The chief claim made for the new circuit is unusual range, in view of the fact that it comprises only three valves, combined with a high degree of selectivity.

Tuned Loop Circuit.

No details were available of the actual circuit arrangements until the recent publication of patent specification No. 256,998 covering the principles employed.

Those who are well versed in the mysteries of radio science will be the first to admit that results are sometimes achieved by methods which do not appear to conform to recognised practice. At first sight the Retrosonic circuit must apparently be included in this class.

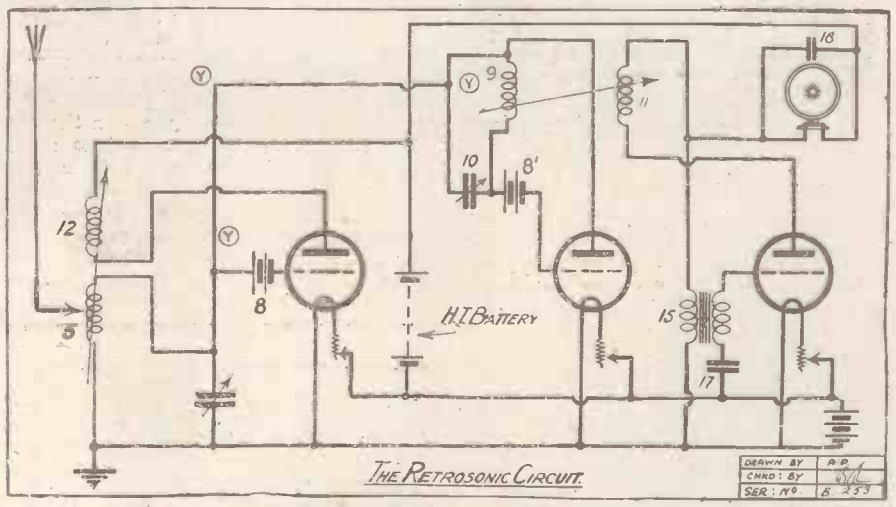
The inventor states that the aim of the improved circuit is to secure from three valves a volume of sound equivalent to that of an ordinary set having five or six valves, together with greater purity of tone and a proportionally extended range of reception.

So far as selectivity is concerned, the characteristic feature of the circuit is the use of the tuned loop circuit 9, 10, shown in the middle of the circuit diagram. In the first place, this appears to be an ordinary rejector or trap circuit well-known in itself, but for some peculiar reason, which the inventors themselves are apparently unable to explain, it acts with extraordinary efficiency in shutting out unwanted signals even when these emanate from a powerful transmitting station at close range.

The second feature that calls for comment is the fact that the circuit is not reflexed in the ordinary sense of that term. Although some sort of feed back action undoubtedly takes place between the valves it is not of the ordinary kind. Another point of interest is that the second valve functions without any direct high-tension voltage being applied to the plate.

H.T. Shorted.

Finally, it is apparent that the high-tension battery is shorted through the telephones or loud speaker windings and the primary winding of the inter-valve transformer 15. This, however, is a not matter of great importance, since the resistance of the shorting path is very high.



Commencing on the input side it will be seen that the tapped inductance 5 conveys the received radio impulses directly to the grid of the first valve through a biasing cell 8. Regarding the first valve as a radio-frequency amplifier only, amplified high-frequency currents will flow through the reaction coil 12 in the plate circuit of that valve. Simultaneously, a part of the aerial energy, reinforced by reaction from the coil 12, will find its way from coil 5 through the direct lead YY provided to the loop circuit 9, 10, and will impulse the latter.

In other words, the one-point tapping through the lead YY from the grid of the first valve to the loop circuit 9, 10 transmits voltage impulses which build up by resonance effect into a swirl current of considerable magnitude inside the loop circuit, provided the latter is accurately tuned to the wave-length to be received.

Large voltages will accordingly be produced across the coil 9, from which they will be applied between the plate and grid of the second valve, and corresponding amplified currents may be expected to flow in the plate of that valve. The coil 9 co-operates with the coil 11 to form a radio-frequency coupling, and inductive effects are accordingly transferred through that coil and the transformer 15 on to the grid of the third valve. The plate of the third valve, it will be seen, is provided with a high-frequency path through the shunt telephone 16, and the reaction coil 12 back to the plate of the first valve.

Cumulative Rectification.

The process of rectification must be assumed to be a cumulative one. Those high-frequency impulses that are applied directly to the grid of the first valve are rectified owing to the presence of the grid cell 8. Partial rectification also takes place in the case of high-frequency energy reaching the second valve via the loop circuit 9, 10, owing to the action of the grid battery 8. Finally, a blocking condenser 17 isolates the grid of the third valve.

Rectified impulses from the first valve will accordingly flow in the coil 12, and because this is coupled to the coil 5 are transferred to the coil 5, giving rise to a species of low-frequency reaction between

(*Continued on page* 506.)

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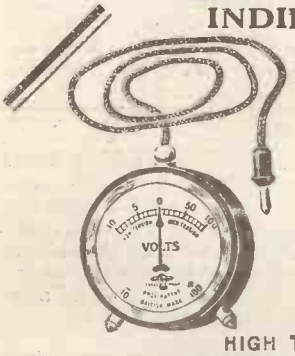

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THE RETROSONIC RECEIVER

(Continued from page 504.)

the plate and grid circuits of that valve. In addition some of the audio-frequency currents find their way to the loop circuit 9, 10, and are thus amplified at low-frequency across the plate and grid of the second valve. Finally, audio-frequency currents flowing in the coil 9 are transferred across the coil 11 to the grid of the third valve through the transformer 15.

Special Loop Circuit.

The inventors lay special stress upon the dimensions of the radio-frequency transformer comprising the loop circuit 9, 10, and the coil 11. They state explicitly that for receiving broadcast signals between 100 and 600 metres the primary coil 9 must have 64 turns of 24 S.W.G. wire and the secondary coil 11, 89 turns of 28 S.W.G. wire, giving an inductance value of 389 microhenrys.

They add that although the high-tension battery is not directly connected to the plate of the second valve, it is found in practice that a difference of potential will be set up between the plate and grid of that valve, corresponding approximately to the terminal voltage of the high-tension battery. Thus potential difference can actually be detected (so long as the set is energised and signals are being received) by means of a volt meter connected across plate and grid of the second valve.

To summarise the operation of the receiver in the inventor's own words, "the incoming signals are applied at radio frequency directly on to the grid of the first valve, and simultaneously (in part) on to the grid of the second valve through the branch lead to the loop circuit 9, 10.

The Rectification Process.

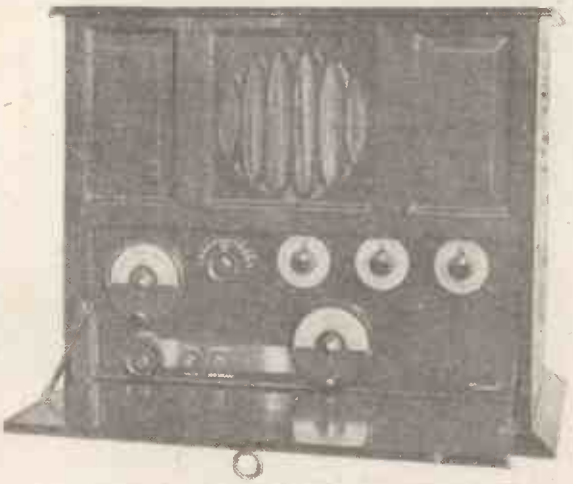
"From here they are transferred to the grid of the third valve and so back to the coil 12.

"Partial rectification takes place in the first valve owing to the action of the grid battery 8, and a similar operation takes place at the second valve owing to the presence of the grid cell 8.

"Finally, any high-frequency energy reaching the grid of the third valve will be rectified by the action of the blocking condenser 17."

Results Obtainable.

On a recent test the "Retrosonic" receiver has proved itself capable of extremely gratifying results. It is apparently best used with an outdoor aerial and on the occasion referred to was able to pick up practically any of the provincial stations at will, while 2 L O was on and only a few miles away from that station. All stations with the exception of one or two were picked up at good signal strength on the loud speaker. A remarkable feature being the fact that Cardiff was picked up clearly and at good volume on the loud speaker, while London was busily turning out orchestral music. The test proved that when working correctly the "Retrosonic" is undoubtedly capable of surprising things with commendable qualities for range work and a surprising degree of selectivity. On the whole the set is an extremely interesting one, and worthy of the attention of the amateur.



A Retrosonic Receiver as constructed by the firm bearing that name and incorporating a hornless loud speaker and all batteries.

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 unbiassed guide as to what to buy and what to avoid.—EDITOR.

A NEW FIXED RESISTOR.

MESSRS. LIONEL ROBINSON & CO., 3, Staple Inn, London, W.C.1, recently sent us a hand-made model of their new fixed resistor, which is to be retailed at 1/9. Although remarkably simple in design, this component is quite a novel one and will fill a longfelt want. It consists of a resistance winding fitted with four terminals and soldering tags. Two of these terminals are tappings, so that the device enables three values of resistance to be obtained. Thus in a 3-valve set the resistor would allow the use of three valves of different voltages to be used, or it would provide sufficient compensation to cover the switching off of one or two valves of those operating at similar voltages. It is to be made in various types to suit different types of valves. Were the two tappings placed at certain points the device as a whole would allow six values of resistance to be obtained. It has numerous possibilities, and is a refinement that will in our opinion easily find a secure place on the market. It is neat and compact in design and can be mounted on either a panel or on a base-board. Messrs. Lionel Robinson were rather apologetic about their hand-made sample; they need not have been, for if the machine-made models are no better then we can still style them "well made and nicely finished!"

* * *

TWO T.C.B. COMPONENTS.

These two T.C.B. components consist of a 300-ohm potentiometer and a 30-ohm filament rheostat, and were sent us for examination and test by the makers, Messrs. Wavio, Ltd., of Hitchin, Herts. They both operate on exactly the same principle and, in fact, are almost identical in appearance. The movement is a novel one and consists of an application of the Archimedean screw principle. The resistance elements are wound on small cylinders and the contacts travel up and down them (distances of about one inch) smoothly and firmly. Every setting is definitely positive. Both components are designed for panel mounting and occupy remarkably small spaces both above and below. They are very stoutly made, and their resistances are very accurately stated. The potentiometer costs 3/6 and the 30-ohm rheost at 2/6; other values are, of course, available. They are excellent little devices and represent decidedly good value for money. but we suggest there would be good sale for further models fitted with dials and pointers, even at increased prices. The modern amateur and even the present-day listener is a precise sort of operator and likes the definitely informative dial and pointer.

* * *

DECKOREM RUBY VALVE REFLECTOR.

Messrs. A. F. Bulgin & Co., 9-10-11, Cursitor St., London, E.C.4, seem to make a speciality of novel radio refinements. The latest to hand from this source is somewhat reminiscent of a bicycle reflector, although it is much neater and is nicer finished than some of these articles. Actually it is a new type of valve window fitted with a ruby lens which reflects the slightest glow from the valve behind it. In the case of very dull emitters a special bracket attachment can be obtained which completely solves what would otherwise be a nasty problem. This new Deckorem "line" costs 9d.

(*Continued on page 510.*)

APPARATUS TESTED.

(Continued from page 508.)

complete with mounting screws, and at this price is quite cheap. Besides its undoubted utility it enhances the appearance of a panel and gives it a distinctly novel effect.

* * *

FOUR NEW EDISWAN VALVES.

The Ediswan people have been responsible for the production of some really nice little valves in the past, and we have always had something more than a "sneaking regard" for that sturdy little power valve, the P.V.6, D.E. But the new group of Ediswan two-volters carries just as much all-round efficiency and general "punch" throughout (and, of course, it includes valves suitable for all sorts of purposes), but is, moreover, very well to the fore in respect of that most modern requirement, L.T. economy. The Ediswan group in question includes the following four valves, P.V.2, G.P.2, D.R.2, and R.C.2, and samples of these were recently sent us for test purposes. These four valves are included under a heading in the Ediswan catalogue, which reads "New ¼-watt valves." The P.V.2 takes slightly more than a quarter of a watt, but none of the other three takes anything above one fifth.

G.P.2; Fil. volts, 1·8–2·0; Fil. amp., ·1; anode volts, 60–120; amplification factor, 10; impedance 16,500 ohms. Price 14s.

Designed for H.F. amplification and initial stages of L.F. amplification, this little valve, despite its extraordinarily low wattage, can rake up enough electrons to pass over 4 m/a of anode current at zero grid volts, using 120 volts H.T. However, this is not the Ediswan valve we would choose for *any* initial stage of L.F. amplification, but it functions very well indeed as an H.F. amplifier preceding both tuned anode and transformer couplings. It also operates well as a detector, although it is not intended by its makers for this work. The D.R.2 is the "¼ watter" designed for use as a detector.

D.R.2; Fil volts, 1·8–2·0; Fil. amps, ·1; anode volts, 40–80; amplification factor, 8; impedance, 27,000 ohms. Price 14s.

As previously indicated, this valve is specially suitable for detection, although it can be used as an L.F. amplifier. In this latter case up to 100 volts H.T. can be employed, that is, of course, if suitable grid bias is provided. Tested in a "P.W." Continental Two-Valver (H.F.-Det.) with an Ediswan G.P.2 occupying the first valve holder, it operated with perfect satisfaction. Reaction control was smooth and steady and signals had that "body" which is so lacking when a poor rectifier is used. Even DX stuff seemed to lose something of its readiness on this occasion.

P.V.2; Fil. volts, 1·8–2·0; Fil. amp., ·15; anode volts, 80–120; amplification factor, 6; impedance, 9,000 ohms. Price 18s. 6d.

Considering that this little power tube consumes but one-third or less the amount taken by the P.V.6, D.E., which is hardly a wasteful valve, the punch it delivers is really excellent. As we mentioned before, we have always admired the 6 D.E., but candidly, we consider its economical brother an even better proposition. Messrs. Ediswan are indeed making strides forward. The importance of the fact that the economy of the "¼-watter" is not attended by a poorer performance than the "1-watter" deserves due consideration. We tried the P.V.2 in a three-valver (H.F.—Det. transformer coupled L.F.), and being a power valve it naturally went in the last holder. It had as companions the G.P.2 and the D.R.2. The mellowness and volume was a credit to a fine little team. In a second stage of L.F. the P.V.2 handled a very respectable volume quite capably. The P.V.2, in our opinion, is a valve that will gain considerable popularity.

R.C. 2; Fil. volts, 1·8–2·0; Fil. amps., ·1; anode volts, 80–120; amplification factor, 30; impedance, 150,000 ohms. Price 14s.

This "two-volter" is a resistance coupling valve for use in L.F. amplifiers. Messrs. Ediswan say in their catalogue that, "it is important that the anode resistance should be between 1 and 5 megohms." The grid leak recommended is 5 megohms, and the coupling condenser ·0003 mfd. Under these conditions, we have been able to obtain enormous amplification with R.C.2's, but there has been a clipping of side-bands and a tendency to H.F. inter-action. We are in communication with the Ediswan people on these points, and may have further comments to make at some future date. We have obtained good results with the R.C.2 in standard hook-ups, but these have not employed components of values as recommended, and the good results as provided may only be a shadow of those of which the valve is really capable.

RADIOTORIAL

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

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

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

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

TECHNICAL QUERIES.

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

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

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

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

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

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

All other back-of-panel diagrams are specially drawn up to suit the requirements of individual readers at the following rates: Crystal Sets, 6d.; One-Valve Sets, 6d.: One-Valve and Crystal (Reflex), 1s.; Two-Valve and Crystal (Reflex), 1s.; Two-Valve Sets, 1s.; Three-Valve Sets, 1s.; Three-Valve and Crystal (Reflex), 1s. 6d.; Four-Valve Sets, 1s. 6d.; Multi-Valve Sets (straight 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

FILADYNE-SET CONDENSER.

"FILADYNE TWO-VALVER" (London, E.11).—I have hooked-up the Filadyne 2-Valve Circuit, that was described in "P.W.," No. 218, but as I had an L.F. transformer on hand I used that instead of the Ferranti recommended.

The set does not at present go as it should, and I think this may be due to the fact that whereas the Ferranti has a fixed condenser

(*Continued on page 515.*)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from page 512.)

across its primary winding, my own L.F. transformer has not.

To test this theory I connected across O.P. and I.P. a ·0002 fixed condenser that I have on hand, and I found this improved matters. Would a larger fixed condenser be better, and would it be an advantage to use a fixed condenser across the telephone terminals ?

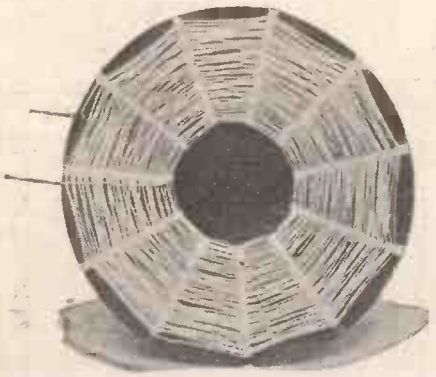
Yes, if there is only a small condenser across the primary it will often be found advantageous to connect a ·001 fixed condenser in parallel with it.

When the L.F. transformer has no condenser across its primary about ·002 mfd. will be required there to make the set function smoothly.

A rather larger capacity condenser will be required for the telephone terminals—generally a ·005 mfd.

Easily Made Coils.

L. E. A. (Stansted, Essex).—I wish to make my own tuning coils for a crystal set that I am building, to receive 2 L O programmes only. What is the easiest coil to make and



what wire shall I use ? The coil will be tuned by a variable condenser having a maximum capacity of .0005 mfd., and as I shall be using it on a fairly short aerial I should like to know the best number of turns to wind on the coil.

The easiest coil to make and one that is eminently suitable for the purpose, is a "spider web" coil, as shown in the accompanying illustration. This is wound upon a cardboard former, which may be purchased at any wireless dealers for a few pence. The wire used may be 24 or 26 D.C.C., and you will need about 40 turns in order to tune to 2 L O's wave-length.

CONSTANT FILAMENT SUPPLY.

J. W. (Seven Sisters Road, London).—"Where can I obtain large porous pots for making up the charging apparatus described in 'P.W.' No. 226 ?"

These pots can be obtained from the Economic Electric Co., Ltd., Fitzroy Square, London, W., or from Grafton Electric, Ltd., 54, Grafton Street, W.1.

Back Numbers of "P.W."

"BACK NUMBER" (Loughton, Essex).—I am very interested in several of the sets that have been described in back numbers of POPULAR WIRELESS (of which I am a new reader). Will you please inform me where I can obtain back numbers, as I find a difficulty in ordering odd copies from a newsagent.

Back Nos. of POPULAR WIRELESS can be obtained from the Amalgamated Press (1922), Ltd., Back Number Dept., Bear Alley, Farringdon St., E.C.4, price 4d. each, post free.

WHY SIGNALS ALTER IN NOTE.

"HETERODYNE" (Coalville, Leicestershire).—Why is it that when tuning in a continuous-wave signal the note alters with the adjustments made, but when tuning spark stations the note remains constant, except when it is made hoarse by oscillation ?

The note or pitch of a spark station depends upon the frequency of the transmitting spark, and it is, therefore, not altered by any tuning adjustments at the receiving end.

(Continued on next page.)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from previous page.)

The note of a C.W. station is not fixed at the transmitter, but depends upon a "beat" effect. The receiving set is made to oscillate at a frequency near that of the incoming oscillations, and the difference in the frequency of the two sets of oscillations produces a beat at audible frequency. If the receiver is adjusted so that the local oscillation-frequency is altered, the difference between the two will alter also, and therefore the received note will alter. It is readily made to vary from a very low pitch, up to a note that is too high to be audible by altering the wave-length of the super-imposed local oscillations.

P.W. COIL TABLES.

No. 2.—Basket or Spider-Web Coils.

(b) Anode Coils with Parallel Tuning Condenser.

No. of Turns	Gauge of Wire S.W.G.	Wavelength, in Metres. Capacity of the Parallel Condenser = ·0003 Max.	Min.	Capacity of the Parallel Condenser = ·0005 Max.	Min.	Suitable No. of turns in reaction coil.
20	24	185	65	235	75	20–40
30	24	275	95	350	110	20–40
40	24	375	130	475	145	20–40
50	26	470	170	600	190	20–50
60	26	580	205	735	230	30–60
70	26	690	245	880	270	40–80
80	28	805	280	1020	315	40–80
90	28	915	320	1160	360	40–80
100	28	1035	365	1320	405	40–80
125	30	1320	465	1680	520	40–80
150	30	1660	585	2110	650	40–80

Wind coils on a former having eleven spokes or slots, with an inside diameter of 1¼ inches.

The tables assume the use of a normal P.M.G. aerial, general-purpose valves, and conventional moving-plate variable condensers. The values would be considerably modified by the use of special anti-capacity valves and valve-holders, or condensers with specially low minimum capacity.

CAN I WORK A LOUD SPEAKER?

J. F. A. (Petersham).—I wish to work a loud speaker, and at present my signals are too loud to be comfortable with 'phones on. Would a one-valve L.F. amplifier be sufficient to work a small loud speaker of the "junior" or "baby" type?

It is difficult to know what you mean by "too loud to be comfortable," as some people can enjoy signals which are deafening to other people. The usual rule as to whether a loud speaker will work when an L.F. stage is added is to place the 'phones upon a table in the centre of the room. If speech is then audible all over the room a loud speaker will nicely fill it, or if music only be distinguished clearly a small loud speaker will give good results.

Where the signals are not loud enough to be heard in this way results with a loud speaker will be disappointing, as the input is not sufficient for satisfactory working.

EXTRA FILAMENT RESISTANCE FOR DULL EMITTER VALVES.

T. B. S. (Croydon).—Can you tell me how to work out what extra resistance is required when using a dull emitter instead of a bright emitter on the same accumulator?

First of all, it is necessary to discover the resistance of the dull emitter valve when it is to be used. In it is one of the types which take ·06 amps. at 3 volts, then the resistance of its filament will be $\frac{3}{.06}$ (in accordance with Ohm's law $R = \frac{V}{C}$) that is, 50 ohms.

Now if a 6-volt accumulator is to be used, obviously the total resistance in circuit must be such that when it is divided into 6 it gives ·06, and no more. ·06 divided into 6 will give this value, which is 100

(Continued on next page.)

National Wireless Week: NOVEMBER 7th—13th, "Let your Friends Listen."

QUESTIONS AND ANSWERS.

(Continued from previous page.)

ohms, and this will be required in the circuit. The filament of the valve will contribute 50 ohms, leaving another 50 to be provided: 10 ohms will be covered by the wiring and the ordinary filament resistance, and thus a fixed resistance of 40 ohms should be employed in the particular example given.

In formula form,

$$R = \frac{V^2}{C} - \frac{V^1}{C} \text{ ohms}$$

where

R = total additional resistance required, which will include that provided by the filament rheostat in use.

C = normal current consumption of the dull emitter valve which it is desired to use;

V1 = the voltage specified for the dull emitter valves by the makers;

V2 = the voltage of the accumulator or battery in use.

THE "SPIDER."

As a number of points have arisen with regard to readers' apparatus already on hand, etc., these are dealt with under the various headings below:

Valves—Detector Position.

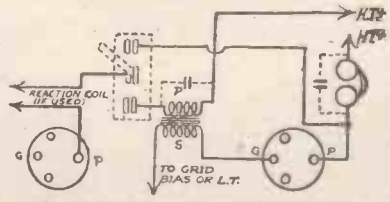
The only valves suitable for the "Spider" detector (centre) position are the D.E.R. or the B.T.H. B.5. Although the former (D.E.R.) normally require a 2-volt accumulator, it will not work from this *when used as a Filadyne Detector* (because of the resistance of the chokes used in the filament circuit), so a 4-volt accumulator must be used. With a 4-volt accumulator the resistance of the rheostat can be turned nearly "all out" as the resistance of the chokes will safeguard the valves from excessive filament current.

NOTE.—If a 6-volt accumulator is being used because the H.F. and L.F. amplifying valves are of the "6-volt" type, this accumulator may be used for the centre (detector) valve also. But in this case the detector valve's rheostat should not be turned "all out," but should be adjusted so that the correct filament voltage is applied to the valve.

(This can be done by applying a voltmeter across the two filament legs of the valve, and adjusting the rheostat so that the voltmeter reads 1·8 to 2·0 volts in the case of the D.E.R., and 2·8 to 3 volts in the case of the B.T.H. B.5.)

For the Constructor

No. 6.—Cutting Out an L.F. Valve.



The method of cutting out the last stage of low-frequency amplification (transformer-coupled) by means of an S.P.D.T. switch is shown above. The plate lead of the preceding valve is disconnected between the reaction coil and the L.F. primary. The side nearest the valve is taken to the centre of the switch, whilst the primary side goes to the lower switch contact, so that when the switch is "Down" this lead is restored.

The top switch contact is joined to a point between 'phones and the plate of the last valve, so when the switch is "Up," the transformer is put out of circuit and the preceding valve's plate current flows through the 'phones instead of through the primary.

Amplifier Positions.

The first and the last valves of the "Spider" are acting respectively as ordinary H.F. and L.F. amplifiers, so that any valves suitable for these positions can be used there, with the normal filament voltage appropriate to the valves, and the normal accumulator.

Condensers.

Separate condensers may, if desired, be used to tune the secondary, and the H.F. stage, instead of the twin-gang condenser. This, however, means that the simplicity of control is lost so one of the chief advantages of the "Spider" would be forfeited by the use of two variable condensers.

Coils.

The coils for the "Spider" can be obtained ready-made from the Reflex Radio Co., 102, High Street, London, N.16.

General Remarks.

The pictorial diagram of the Spider's Web on page 366 of "P.W." No. 228 (October 16th issue) was not intended to show the actual stations already picked up by "The Spider," but was published to indicate the long-distance possibilities of the receiver,

TECHNICAL NOTES.

(Continued from page 474.)

since the aerial is arranged so as to be non-inductive. Across one half of the frame aerial, however, is now placed a variable condenser which upsets the equality of the two halves in the frame aerial, but permits the adjustment of the discrepancy. Or, to put the matter in another way, the potential difference between the grid and filament, owing to the inductive effect of the frame aerial, can be controlled by means of the variable condenser which is placed across one half of the aerial. The controlled part of the aerial is tuned to the desired frequency (by means of the condenser), and this way the valve responds to signals of the desired frequency, whilst the potential differences caused by longer waves are practically without any interference effect.

Piezo Electricity.

Some very interesting experiments have recently been made by E. Giebe upon the effect of small pieces of quartz cut in a special way and subjected to alternating potentials. This kind of effect is generally known as "Piezo electricity," and it is no doubt well known to readers that the application of a potential difference on opposite sides of a piece of quartz (cut in the proper way) will cause a minute change in the dimensions of the piece. Conversely, if the quartz be mechanically vibrated, alternating potentials will be produced at its opposite surfaces.

An arrangement of this kind has lately been used, particularly in America, for standardising the broadcast wave-lengths, as the "quartz oscillator" (as it is now called) gives an extremely constant frequency of oscillation. In passing, it should perhaps be mentioned that although the quartz increases and decreases in length with the applied alternating potentials, and therefore sets up actual mechanical vibrations, its natural frequency of vibration is so extremely high that it is capable of responding with considerable accuracy to vibrations of the frequency generally known as "radio-frequency."

Novel Equipment.

It has now been discovered that if a quartz rod be enclosed in a partially evacuated glass bulb, the application of alternating potentials to the quartz, of a frequency coinciding with the natural mechanical frequency of vibration of the quartz, will cause the quartz to exhibit a uniform glow. Partial resonance and higher harmonic oscillations produce a luminosity of the rod, but this is not so pronounced as when the quartz is vibrated at its resonant frequency.

In this way, it is said to be possible to determine, in a darkened room, the nature of the electrical characteristics of a circuit by simply observing the quartz rod, the latter being, of course, appropriately connected into the circuit and the observer being practised in the observations.

Special configurations are produced in the distribution of the luminosity in the quartz when high harmonics of the natural frequency are applied.

NATIONAL WIRELESS WEEK.

"Let your friends listen."

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.

TOO MANY TALKS?

The Editor, POPULAR WIRELESS.

Dear Sir,—That paragraph of your "Broadcast Notes" in to-day's issue of "P.W." headed "Threat of Longer Talks" should be enough to cause 75 per cent. of the 7/22's to curl up and die. This talk question is one that, more than ever, needs continuous and vigorous combating in a "bad Press." We have a sufficiency of talks already.

Please bear in mind the Chairman of the forthcoming B.B. Commission (the Earl of Clarendon) is reported to be a keen educationalist. (Oh, help!)

It seems to me that a start has already been made to collar the "main part of the programme"—to wit, Mr. Plunket Greene's lecture recitals, 8.45 to 9.15. As a friend remarked, rather tersely, "The yap brigade have grabbed another half-hour."

After a day's work the average listener does not want these "up-lift orations," and he will not have them—he just switches off. When he gets weary of switching off his set he will switch off his licence fee. The latter method will probably have more effect than all the adverse comments ever written.

Please, please, dear "Broadcast Notes," use your pen and influence to stem this blight of TALK, TALK, TALK!

Yours woefully,
G. CHARLES YULE.

77, Llanover Road,
Wembley, Middlesex.

IN APPRECIATION.

The Editor, POPULAR WIRELESS.

Dear Sir,—On June 19th you published a three-valve set, which you named the "Suburban." I have made this set up, and wish to inform you that the reception is the best I have ever had on a three-valve receiver, considering that I am about twelve miles from "2 L O." London, Daventry and Radio-Paris, come in well on a large loud speaker; but, so far, I have not been successful in getting other stations.

One thing I would like to tell you is that accidentally I joined up my accumulator so that the positive became the negative, and vice versa, and I was agreeably surprised when I received six times the power. I have since continued, with the same results.

I am using the new Ediswan ¼ watt 2-volt accumulator combination. G.P. . . D.R. . . P.2.

Thanking you for letting us have such a good circuit.

Yours faithfully,
G. RICHARDS.

"Beechwood," Morton Gardens,
Wallington.

SOME SHORT-WAVE RESULTS.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have only recently finished the Simmonds' 10-metre receiver described in "P.W." about a year ago. Not having a D E.Q. valve at the time and being anxious to try the set out, I used a D.E.4 valve as a detector and a D.E.3 as the L.F. valve. I must say I never expected the results obtained, no difficulties being experienced in receiving telephony down to 28 metres, upon which wavelength Italian I-A E (Rome) was received from 10.43 to 12.4 p.m., on Oct. 12th at a strength varying between R.4 and R.6. The following stations have been received and identified on telephony, G-5 T Z, G-5 B Y, G-2 V L, I-A E and Koenigswusterhausen. The last of these has been received on 45 metres every night for the last two weeks.

Would any short-wave enthusiast, seeing this letter, please send me the addresses of G-5 B Y (Croydon), G-2 V L, and I-A E (Rome), so that reports of their transmissions can be forwarded to them.

Trusting that you will find space in "P.W." for this letter.

Yours faithfully,
A. G. BURGESS.

P.S.—G.E.C. variable condensers are used, and an extension handle has been fitted to the grid-condenser (·0002). A set of Eddystone Short-Wave Coils is used instead of those described.

26, Gunnersbury Park Gardens,
Acton, W.3.

FLEWELLING ON A FRAME.

The Editor, POPULAR WIRELESS.

Dear Sir,—Seeing the article in POPULAR WIRELESS of Oct. 9th about fine results in a London flat on a frame aerial with the old Flewelling circuit, I thought I would try it out. I had an old frame aerial on the spare shelf, so that was wound with twelve turns,

(*Continued on next page*)

CORRESPONDENCE.

(Continued from previous page.)

being two feet square. My first station was Aberdeen coming in at good 'phone strength, which is about 300 miles away; then the German station, I believe, which sends out a series of M's and S's during the wait, this could be heard 8 to 10 feet from the phones; Sheffield, 7 to 8 miles away, was a bit too loud to be nice, and 2 Z Y, 25 miles, was well in for the first of the runners, I am building a permanent set for future dates on U.S.A. work, hoping other readers will try it out with success.

Yours faithfully,
JOHN SUTTON.

P.S.—Will be pleased to give other readers any answers to my results.
Main Road, Bamford, nr. Sheffield.

FROM AN AUSTRALIAN READER.

The Editor, POPULAR WIRELESS.

Dear Sir,—I see by my latest copy of "P.W." July 3rd, 1926, that a listener in Wigan "does" 9½ hours a day listening. Recently I met a bootmaker at Poowong (Victoria) whose sole companion is the wireless. His loud speaker may be heard going anywhere in the township between the hours of 11.30 a.m. to 11 p.m., during which time the Melbourne programmes are being broadcast. He also frequently picks up amateur broadcasters as well as interstate, so his total is at least 10 hours a day. These are Melbourne broadcast times: 11.30–2, 3–5, 5.45–11. He has the speaker in the same room as that in which he works and it is going full blast.

A word of appreciation also for your blue prints, and the results obtainable from those circuits. I installed a two-valve (det. and L.F.) made from one of your circuits about 80 miles from Melbourne. The following stations were my first night's result, giving distance, power and wavelength:

3 L O	Melbourne	5 kilo	.. 80 miles	.. 371 metres
3 A R	Do.	1·6 "	.. 80 "	.. 484 "
3 U Z	Do.	500 watts	.. 80 "	.. 319 "
2 B L	Sydney	1·5 kilo	.. 590 "	.. 353 "
2 K Y	Do.	500 watts	.. 590 "	.. 320 "
4 Q G	Brisbane	5 kilo	1400 "	.. 385 "
5 C L	Adelaide	5 "	.. 560 "	.. 395 "
5 D N	Do.	1·5 "	.. 560 "	.. 313 "

These stations were heard quite loudly enough for two independent listeners to confirm the reception by hearing the call sign.

My next effort was a "Unidyne," and on this, using a frame aerial inside a house, I was able to receive all the above stations together with 2 F C Sydney (10 kilo, 590 miles, 1100 metre, for which I did not have the coils previously) and on an outside aerial 6 W F Perth, 5 kilo, 2000 miles, 1250 metre) came in on fair 'phone strength. Also, I received about 32 amateurs in Australia at distances from 100 yards to 700 miles from their respective transmitting stations, but have tried no serious DX work yet.

Both sets are extremely easy to handle, giving excellent reception, and I am very pleased with the results obtained. I look forward with pleasure to receiving my copy of your paper, though it is two months old, and derive much interest and instruction from its pages. With congratulations and wishes for your future success.

Yours faithfully,
M. (Le G. MITCHELL).
Cole Street, Gardenvale, Victoria, Australia.

SOME D.X. CRYSTAL RESULTS.

The Editor, POPULAR WIRELESS.

Dear Sir,—I think that the following may be of some interest to your readers *re* my DX crystal set results.

The circuit is quite straightforward, using a quality coil tuned by a ·0005 mfd. Ormond Low Loss Condenser; the crystal used is Gecozite.

Some months ago I received San Sebastian faintly but clearly. About a fortnight ago I received Radio-Wien so distinctly that I was even able to hear the ticking of the metronome between items. This station I understand is situated in Vienna. On Sunday night the 10th October, after 5 N O had closed down, I was successful in tuning in eleven stations, some of them at remarkable strength. Again, last night, I had been listening to 5 N O on this crystal set, and after it had shut down at 12 o'clock, after dance music, I heard a faint voice, and on returning I heard the Bournemouth station announcing that it was closing down, at really remarkable strength.

I own valve sets, with which I have received quite a few American stations, but I consider that my results with the crystal set are far more interesting.

I am a regular reader of your paper since the first number, and appreciate it very much.

Yours faithfully,
C. L. FOXALL.

P.S.—Aerial about 30 ft. average height, 70 ft. in length. Earth, 2 zinc plates connected by bare aerial wire, buried one at each end of the garden, underneath the aerial.
Redholme, North Avenue, Gosforth,
Newcastle-on-Tyne.

In our October 16th. issue an error occurred in Messrs. Sydney Bird and Sons' advertisement. The statement was made that the Cyldon Triple-Gang Variable Condenser at £3 10s. is used in the "Spider" whereas it is of course, the Cyldon Twin-Gang at £2 10s. which is included

WASTING L.T. POWER.

TWO-volt valves can be run off a four or six-volt accumulator providing sufficient resistance is brought in series to reduce the current flow to the required value. A valve rated at four volts ·25 amp. will have a resistance of about 16 ohms following Ohm's law of voltage divided by current equals resistance. To ensure that only ·25 amp. flows through such a valve when it is coupled to a 6-volt accumulator, at least 24 ohms resistance must exist in the filament circuit. The valve's resistance being 16 ohms it is obvious that an additional 8 ohms are necessary and these, or rather this value, is supplied by the filament rheostat.

Now many amateurs appear to believe that a resistance occasions but little loss and merely cuts down the current to the required value just at that point where it is desired—i.e. in this case, at the filament of the valve. But this is not the case, and how wasteful resistances in a circuit can be is illustrated by the following example.

A 2-valve receiver employing two valves is operated on a 4-volt accumulator. The two valves are really each two volters rated, say, at 2 volts ·25 amp., and in order that their filaments shall not be over-run, 30-ohm rheostats are used and are carefully adjusted. Now these two valves will each have a resistance of 8 ohms, but to keep the current down to ·25 amp. with a 4-volt accumulator 16 ohms resistance is required, so that each filament rheostat must be adjusted so that it provides 8 additional ohms.

Considerable Wastage.

The significance of this figure is this We have just shown that our 2 volt ·25 amp. valves have resistances of 8 ohms each, so that it is clear that instead of using 8 ohms of resistance in the form of a rheostat we could place another valve of a similar nature in series with each of the existing valves. The ·25 amp. of current which would flow through the whole circuit would operate the filaments of these valves quite successfully. Therefore with our 4-volt accumulator we could run 4 valves with no greater expenditure of energy than would be required for two. This shows very clearly the amount of wastage that can occur in a resistance.

To carry the example farther it would obviously be better to join the two cells of the 4-volt accumulator in parallel, and by thus doing halve its voltage and double its capacity.

In conclusion, amateurs should not judge a valve by its current consumption so much as by its wattage. On the face of it a 6-volt valve taking ·1 amp. might seem more economical than another valve taking ·25 amp. at 2 volts, but whereas the first eats up ·6 watts of energy the latter consumes only ·5, and is, therefore, superior from that point of view. A six-volt 20 actual ampere hour accumulator would run the six-volter for 200 hours, but if its cells were in parallel to give two volts it would run the 2-volt valve for 240 hours.

A HOME-MADE WIRE GAUGE

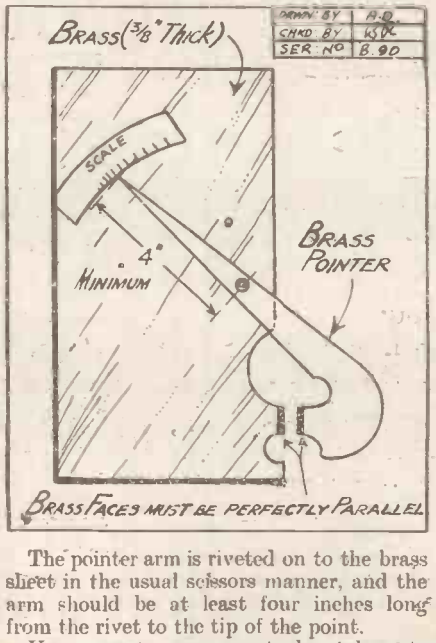
ONE of the most useful instruments which the practical wireless constructor can possess is a wire gauge. And yet, despite this fact, how often is it that such an implement is to be found among the equipment of the home workshop or laboratory?

The wire gauge described herein is an instrument which can be made by any amateur possessing facilities for simple brass cutting and working.

The illustration in which the wire gauge is depicted is, for the most part, self-explanatory. It will be seen that the gauge is made in two pieces—viz. a metal sheet on which is marked a scale, and the metal pointer arm.

The Pointer Arm.

The metal sheet should consist of brass of ⅜ in. thickness. The pointer arm may, if necessary, be a little thinner than this, but, nevertheless, it is best to have the whole instrument solidly made in order to prevent the possibility of it getting bent, and, consequently, of its accuracy being lost.



The pointer arm is riveted on to the brass sheet in the usual scissors manner, and the arm should be at least four inches long from the rivet to the tip of the point.

Very great care must be taken to ensure that the brass faces (drawn black in the diagram) are perfectly parallel. This can be brought about by the gentle usage of fine emery or sandpaper.

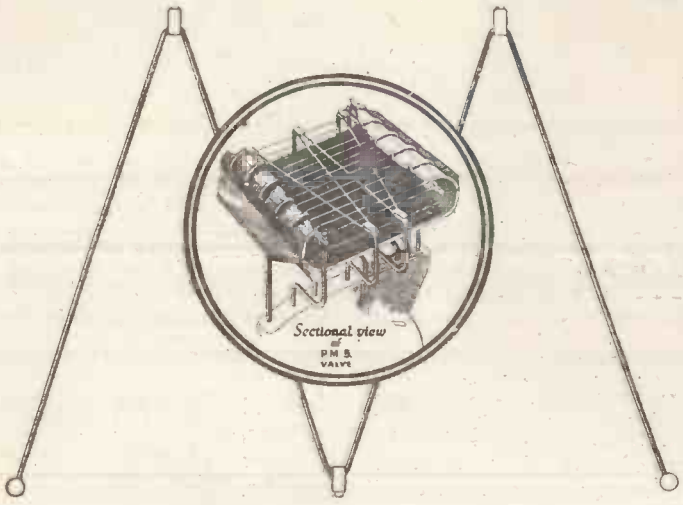
Easy to Calibrate.

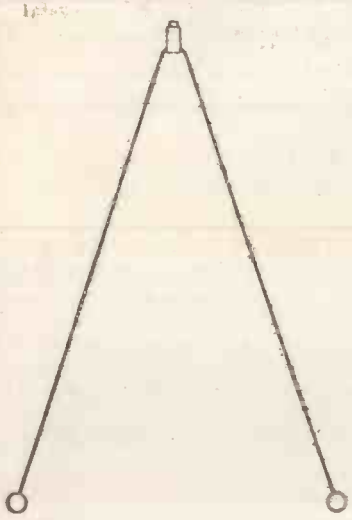
The scale may be either scratched on the brass sheet, or else it may be drawn on a small strip of paper which is gummed down to the brass.

In order to calibrate the gauge, all that it is necessary to do is to take a few pieces of wire of known standard thickness, and to insert these in turn between the measuring faces of the instrument. Holding each piece of wire in this position, a mark or scratch is made to indicate the position of the pointer on the scale. In this manner a complete scale may be built up.

R/R

HONEST VALUE





Note how short the ordinary dull filament is compared with that of the Mullard P.M. Filament for the same operation, illustrated proportionally above. This ordinary filament consumes 2½ times more current than the Mullard P.M. Filament and gives inferior results.

The miserly length of the ordinary bright filament coupled with its huge current consumption, seven times greater than that of the Mullard P.M. Filament, throws out in marked contrast the superior value offered by Mullard P.M. Valves.

Compare the length of any ordinary valve filament with that of the Mullard P.M. Filament for the same operation, and you will see the greatly increased value you receive for your money when you buy Mullard P.M. Valves.

Add to this advantage the greater thickness of the Mullard P.M. Filament and the huge emission surface that is available will be apparent.

This abundant emission surface is the essence of the improved results and wider control range to be secured with Mullard P.M. Valves.

Still further value for your money is assured by the enormous saving in upkeep costs that results from the low current consumption (only one-tenth ampere) of Mullard P.M. Valves, apart from the fact that valve renewals due to accidents are practically eliminated owing to the extreme toughness of the Mullard P.M. Filament.

In every way you stand to benefit by using Mullard P.M. Valves.

Ask your radio dealer for Mullard P.M. Valves with the wonderful Mullard P.M. Filament.

Mullard

THE · MASTER · VALVE

For 4-volt accumulator or 3 dry cells

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

For 6. volt accumulator or 4 dry cells

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

For 2-volt accumulator

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

These prices do not apply in Irish Free State.

British Made in a British Factory

Printed and published every Thursday by the Proprietors, The Amalgamated Press (1922), Ltd., The Fleetway House, Farringdon Street, London, E.C.4. Advertisement Offices, Messrs. J. H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates: Inland, 17/4 per annum, 8/8 for six months; Abroad, 19/6 per annum, 9/9 for six months. Sole Agents for South Africa: Central News Agency, Ltd.; Sole Agents for Australia and New Zealand: Messrs. Gordon & Gotch, Ltd.; and for Canada: The Imperial News Co. (Canada), Ltd. Saturday, October 30th, 1926.

R/R

SUPPLEMENT

Presented FREE with " Popular Wireless," week ending October 30th, 1926.

THE "P.W." CONSTRUCTORS' GUIDE

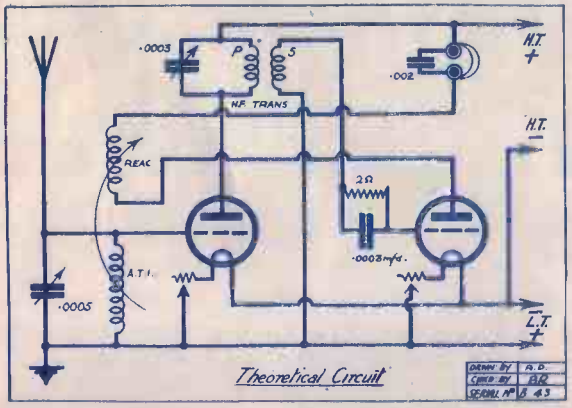
An H.F. & Det. Receiver and 2 L.F. Amplifier

The Sets Designed and Constructed by the Technical Staff of "P.W."

THE H.F. AND DET. RECEIVER.

In spite of the rapid development of radio, both on the transmission and reception sides, there are some circuits which, with slight variations, seem to keep their popularity in spite of all the various changes. One of these is the H.F. and detector circuit, which has for very long proved to be one of the most suitable for long distance reception where headphones are to be used. It has varied little during the years it has been in use, and apart from minor changes, mostly in design of components and layout of receiver, it remains very much as it was two years ago.

The example described in this article employs transformer coupling between the H.F. and Det.



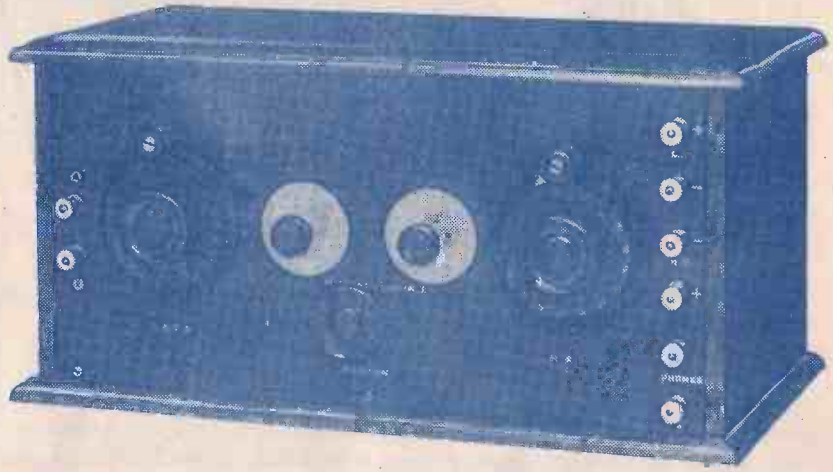
valves, a refinement which makes for easy handling and stability in the receiver. Ease of operation must needs be an essential factor if long-distance reception is to be carried out, while selectivity must also be of a fine order, though not so fine as to make stations difficult to pick up.

These points have been carefully considered in the design of the receiver described, and it is not difficult to operate. Thus, the whole design of the receiver is such that while it is capable of carrying out very long-distance reception successfully it is not a set that could be said to be specially designed for the "DX fiend." In other words, the set is built more on the household—anybody's—set principle; to give results under all conditions and under anybody's control, and not as a stunt, ultra-selective, ultra-sensitive set, which only the experienced amateur can handle.

The actual construction of the H.F. and Det. receiver is not a difficult task if the diagrams given are carefully followed, and the components mentioned in the list of parts are employed. Though other types could probably be used with success, it will simplify the building of the set if the constructor will keep to those makes specified. In this case, the drilling diagram will be of full use and the layout shown in the diagrams and photographs will not have to be altered, as might be the case if different components were utilised.

It is advisable to purchase the panel, case, and baseboard together, as by so doing the necessity for trimming the panel to fit the cabinet will be obviated, and this is a task, tedious in the extreme, which can well be avoided if possible. Should the panel have to be trimmed it should be done with a coarse file—if badly out of truth—and not a fine one.

The panel should be placed on the table with the cabinet resting on its back and the panel in position in the cabinet and tight up against the baseboard, and the fillets on the side of the cabinet. After this the components on the baseboard can be mounted and the set is ready for wiring up.



The complete two-valve receiver. Note the convenient positions of the various controls.

This is not a difficult task, especially if the constructor is more or less used to the operation of soldering. If he is not so used, we advise him to try it, because a well soldered set is, in our opinion, far more satisfactory, both in appearance and operation, than one in which the connections have been made

These points have been carefully considered in the design of the set whose photographs appear here, and the constructor will find, on examination of the diagrams, that transformer coupling and its ease of control and stability is coupled with reaction on the aerial, which gives the required selectivity and increases the sensitivity of the set.

LIST OF COMPONENTS.

	£	s.	d.
1 Panel, 13 in. × 6½ in. × ¼ in. (Peto-Scott). With cabinet and baseboard	1	6	0
1 A.J.S. ·0005 variable condenser		12	6
1 A.J.S. ·0003 variable condenser		11	6
1 Penton 2-way coil holder		6	0
2 Precision rheostats		6	0
2 Lotus valve holders..		5	0
1 Atlas ·002 fixed condenser		1	9
1 Atlas grid condenser (·0003) and leak (2 meg.)		2	9
1 Burwood valve holder		1	3
8 Terminals		1	0
Wire, screws, transfers, etc.		2	0

Thus, only three main controls are needed, the two tuning condensers and the reaction variation, though when extremely weak signals are being "copied" the filament rheostats can be used as final aids to maximum sensitivity. Separate H.T. would be an unnecessary refinement, and so the set has been designed with the same H.T. on the two valves. As the actual valves will be more or less similar in characteristics, this is a point which makes for easier construction and less complicated wiring.

It is, of course, obvious that in a receiver of this description, where H.F. impulses are being dealt with, all unnecessary wiring must be omitted and the layout of the receiver must be duly considered, so that the more important leads shall be short and straight.

SHORT LEADS IMPORTANT.

A study of the photographs and wiring diagram will show that the plate and grid leads of the valves are short—in the case of the coupling between the two valves the leads are extremely short—all these characteristics making for ease of control and sensitivity—the two main factors in the operation of a set of this description.

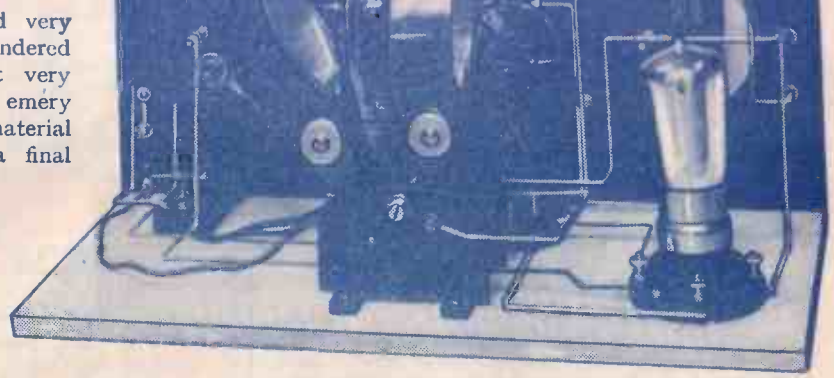
Another point that makes for ease of operation and stability of the receiver is the fact that parallel aerial tuning is employed. This enables the set to be used on short aerials, where, if series tuning were employed, the set might become unstable and

These latter become clogged very rapidly and are immediately rendered useless. If the panel is not very bad it can be trimmed up with emery cloth, and, in any case, this material should be used to give it a final finish off and to make the edges quite smooth.

WIRING UP.

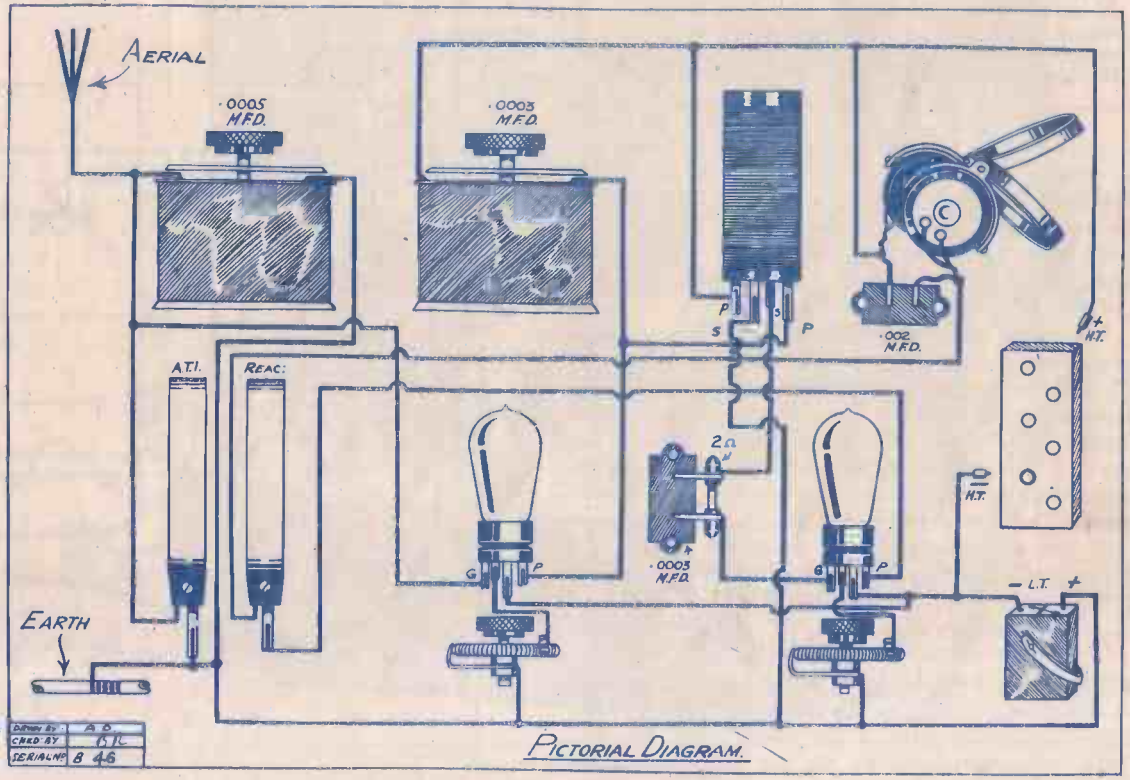
When it successfully fits the cabinet the panel should be drilled according to the drilling diagram, and then the components on the panel should be mounted in position. The next step is to mount the panel on the baseboard, and this should be done with the baseboard in position *in the cabinet*.

This is the easiest way to get the panel properly mounted, the drilling of the holes in the baseboard being carried out through those in the panel, with



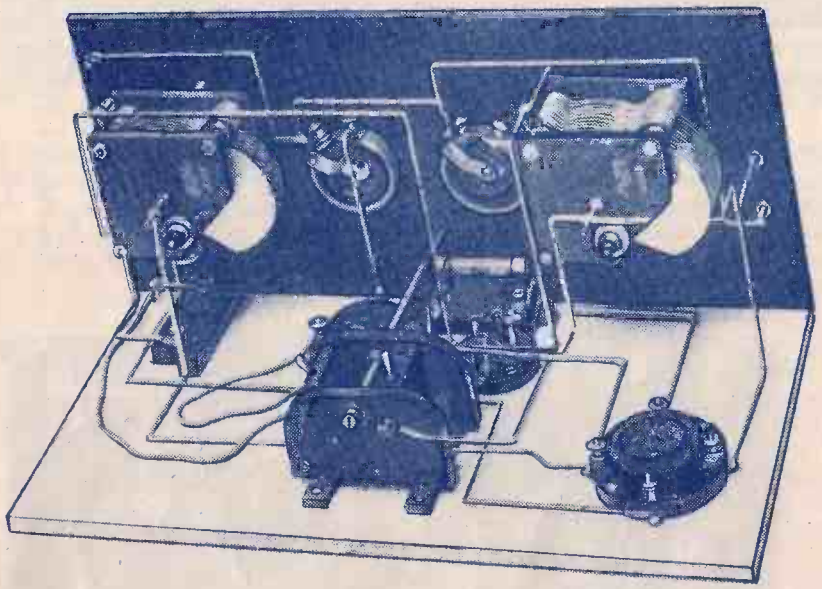
A view of the interior of the set, showing the coils and valves in position. Constructors should make sure the reaction coil has a free swing right back to the baseboard.

by screwing the wire under the terminals on the components. In this way some terminals have several wires under them and very often this results in the connections making contact at only one point and usually finishing up by working loose. Soldering is undoubtedly the best procedure,



and is not nearly as difficult as it appears at first sight to be.

The main essentials are a clean iron, well heated, and clean flux, and good "tinman's" solder. Do not use the solder sometimes recommended as "soft" or "suitable for wireless work." This often contains an exceptionally high percentage of bismuth, making it easy to melt but also causing it to crystallise after a time, thus making an unsatisfactory joint. Tin all the terminals and tags to be soldered before applying the wire to them, and in this way with careful use of flux and a hot iron a really satisfactory joint will be made. The wire that is most conveniently used for this work is the square sectioned tinned copper wire, known as "No. 16 gauge square tinned copper."



Together with the other photograph on this page, this illustration of the wiring should be used as a guide when the components are being mounted and wired.

When the wires have been soldered, the whole set should be examined to see if any faulty connections have been made, and to wipe off all traces of flux, and to remove any loose beads of solder that may be lurking among condenser vanes, valve sockets, etc. Test all joints for mechanical strength by giving them a sharp tug—if a joint breaks it will be a sign that a poor connection has been made and its discovery will have prevented all sorts of trouble that would probably have occurred after the set had been in operation some time. Finally, all the connections, which will have been made in accordance with the wiring diagram, should be checked over to see if they agree with the "point-to-point" list of connections given in the article. This will obviate any chance of wrong connections having been overlooked.

types could be used, or valves specially recommended by the makers for rectification.

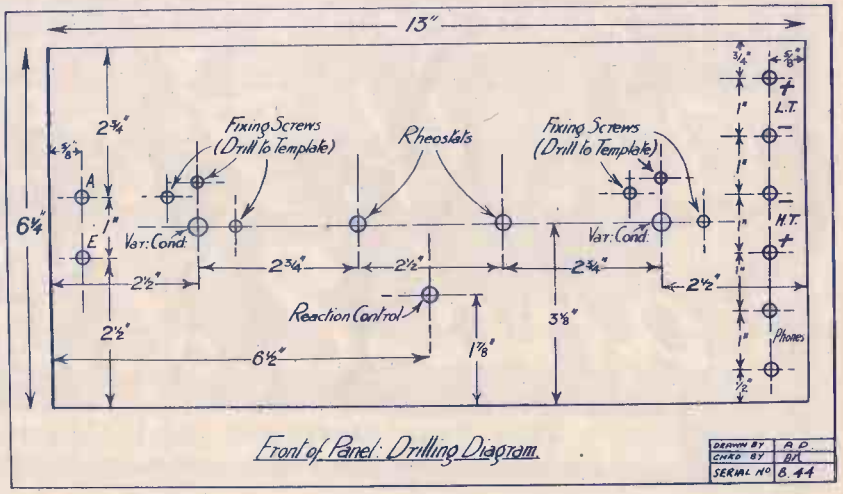
The best thing to do is either to study the valve guide recently published in "P.W." (Nos. 203 to 206), or else to go by the makers' instructions, using the valves recommended by them for use in this particular set. Any of the valve manufacturers will be pleased to give advice on the subject of suitable valves.

An H.T. voltage of from 40 - 70 volts should be available, and so one of the 72-volt batteries should be suitable. Plug-in coils of any well-known make can be used with success—those shown in the photographs being of Lissen manufacture.

OPERATION.

In operation the controls are easy to handle. The valves should be turned on and then, with the reaction adjusted so that the set is just *not* oscillating, the variable condensers should be slowly rotated together. If the set commences to oscillate when the condensers are in step the reaction coupling should be slightly loosened. Should the set refuse to oscillate at all—even with a 75-turn reaction coil—the constructor should try the effect of reversing the leads to the reaction coil.

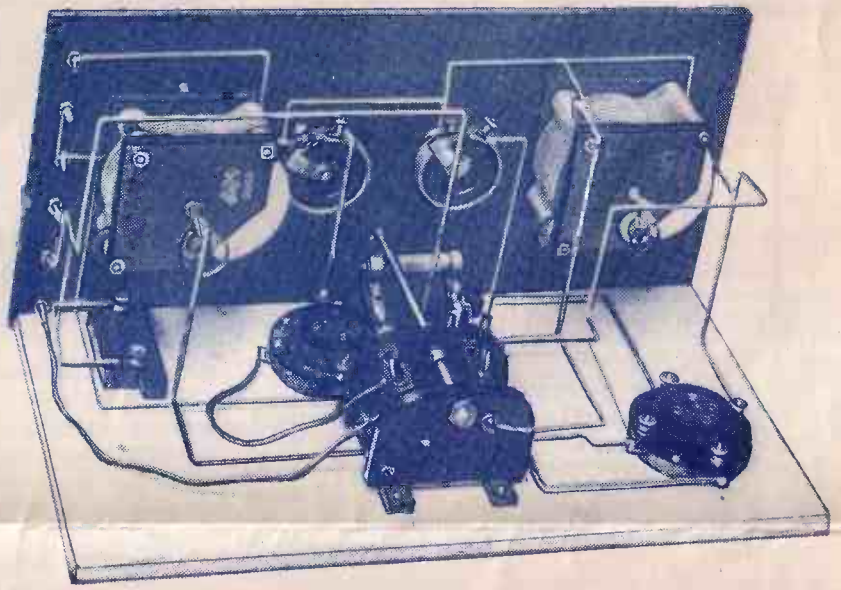
Coupled to an L.F. (one or two valves) amplifier this H.F. and Det. set should make a very good loud-speaker receiver over moderate ranges, the long-distance qualities being enhanced by further magnification of any signals received.



A TWO-VALVE AMPLIFIER.

This two-valve L.F. amplifier has been designed primarily to act as a note magnifier to the H.F. and Det. receiver previously described, though there is no reason why it should not be used with other sets if it is so desired. The only point about using it with *other* sets is that the L.T.— to H.T.— connected in the amplifier would have to be broken if the set to which the amplifier was to be attached had H.T.— joined to L.T.+.

The panel lay-out of the amplifier follows closely the lay-out of the H.F. and Det. receiver so that the two, when connected up, make a neat and pleasing four-valve receiver, the switches on the



The back-of-panel wiring from a different angle. The disposition of the components and most of the connections are clearly shown in this photograph.

SUITABLE VALVES AND COILS.

The use of plug-in coils and a plug-in H.F. transformer enables the set to be used on any wave-length above 200 metres, so that the lower band of broadcasting wave-lengths can be covered, as well as that of Daventry, Radiola, etc. For the lower band a transformer covering 150-500 metres should be used, with coils of 25, 35, and 50 for the aerial coil holder, and 50 and 75 for reaction. Daventry will require a transformer covering 1600 metres, and coils of 150 for aerial and 100 or 150 for reaction.

The choice of suitable valves is not difficult, and most general-purpose valves will operate well in the set. If the utmost is to be obtained, perhaps high impedance valves of the order of 30,000 ohms or so could be tried, but in a set of this description we doubt if the results ot special valves really justify the trouble in trying out a large number of different types. The valves tested and found most satisfactory were (among others): on the H.F. side, D.E.3 B., D.E.3, B.5H. (·06 type), Cossor Stentor, Ediswan H.F., P.M.1 among the 2 volts, and D.E.5 B., D.F.A.4, B.4 among the 6-volters.

Of detector valves there are a large number, for all the above were found to operate successfully in the detector position, so that the set could use two of the preceding types, if the constructor desired. Other well-known valves of the general-purpose

POINT-TO-POINT CONNECTIONS.

Aerial terminal to moving plates of ·0005 variable condenser, socket of fixed coil holder, and grid socket of first valve holder.

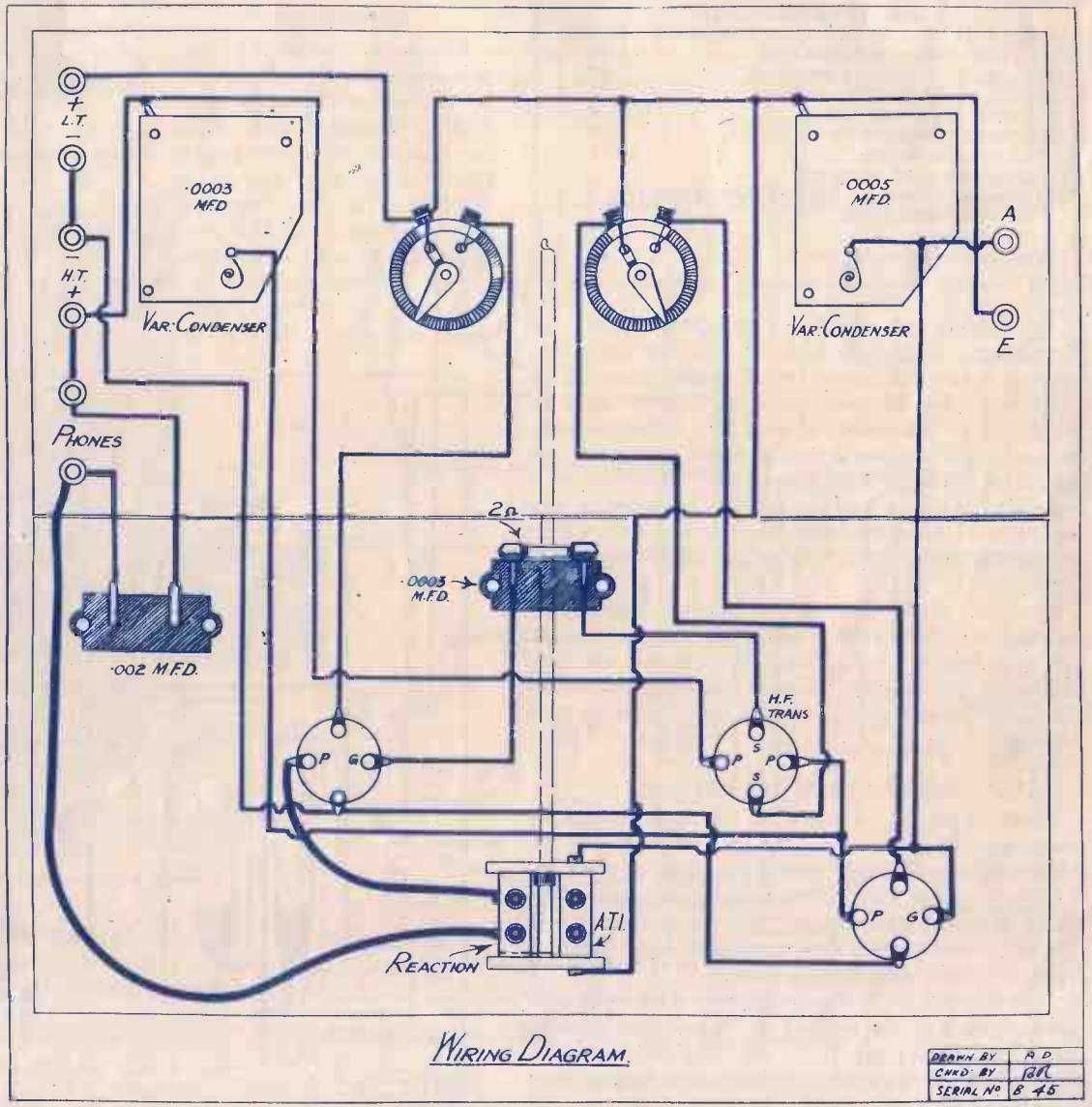
Earth terminal to fixed plates of ·0005 variable condenser, plug of fixed coil holder, L.T. positive, and one side of each rheostat. Other side of each rheostat to one filament socket of corresponding valve holder. Remaining filament sockets joined together and to L.T. negative, which also goes to H.T. negative. Plate socket of first valve holder to one filament (primary) socket of H.F. transformer holder, and to moving plates of ·0003 variable condenser, fixed plates of which go to the other primary socket and H.T. positive.

Grid (secondary) socket of H.F. transformer holder to one side of grid leak and condenser unit; other secondary socket to L.T. positive lead, other sides of grid condenser and leak to grid socket of second valve holder. Plate socket of second valve holder to socket of moving coil holder, plug of which goes to bottom 'phone terminal. Top 'phone terminal to H.T. positive. A ·002 fixed condenser is connected across the 'phone terminals.

The two-valve L.F. amplifier, described in this series is a good example of a suitable amplifier, and makes the set into a really powerful four-valver, which will bring in many stations at loud-speaker strength, besides picking up long-distance transmissions at good volume on the 'phones.

amplifier allowing either four or three valves to be used. Such a combination makes an ideal family receiver capable of picking up distant stations on the headphones, and those more near on the loud speaker at good volume.

An interesting feature about the amplifier is the fact that a variable L.F. transformer is employed.

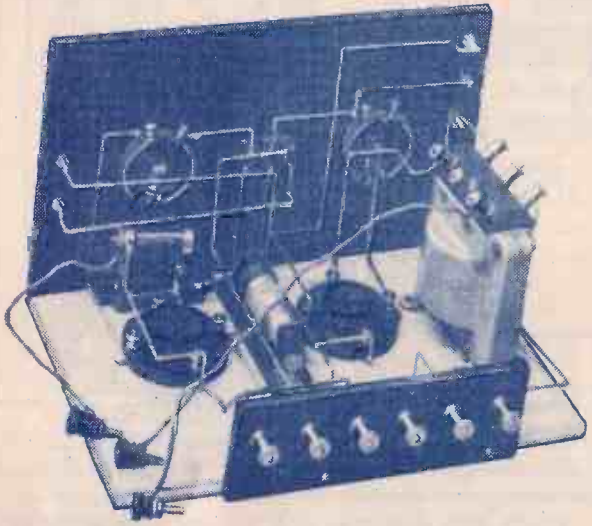


WIRING DIAGRAM.

This enables the ratio of the primary to secondary and the impedance of the transformer to be varied until the best results are obtained for the particular valves in use in the first stage of the amplifier, and in the last stage of the set to which the amplifier is connected. The switching enables either one or two L.F. valves to be employed, while the use of resistance coupling gives purity of reproduction, although extremely loud signals may be received.

THE BATTERY CONNECTIONS.

The constructor will see from the photographs and the wiring diagram that two sets of terminals



A back-of-panel view of the amplifier with valves and grid bias battery removed.

are provided—one on the panel on the left, and the others on a terminal strip on the back of the set. Those on the left of the panel are for connection to the set to which the amplifier is to be connected, and they are internally connected to the terminals at the back of the set. Thus the leads from the batteries need not show at all, and the six terminals on the panel make connection by means of wire or brass strips with the corresponding six on the H.F. and Det. receiver. This is clearly shown on the photograph, showing the two sets connected together.

In order to match the other receiver the American system of panel and baseboard mounting of the

properly fits the latter, an important point if labour and patience are to be saved. The filing up of a panel in an endeavour to make it fit a cabinet is not a task that can lightly be undertaken,

The panel lay-out of the amplifier is one of neatness and simplicity, all battery connections being made at the back.

especially if the panel is badly cut and needs a great deal of squaring up. If it *has* to be done, a rough file or rasp should be employed, and the final smoothing of the edges should be carried out by means of fairly coarse emery cloth or sandpaper.

The panel should be drilled according to the drilling diagram given on page 4, after which the panel can be mounted on the baseboard, and the terminals, switch and rheostats fixed in position on the panel. After this the remaining components should be placed in positions on the baseboard corresponding to those they occupied on the original model and clearly shown on the wiring diagram and in the photographs. Care must be taken in arranging these to leave as much room as possible between them so that the wiring can be carried out without having to crowd the leads too much.

As we are dealing with an

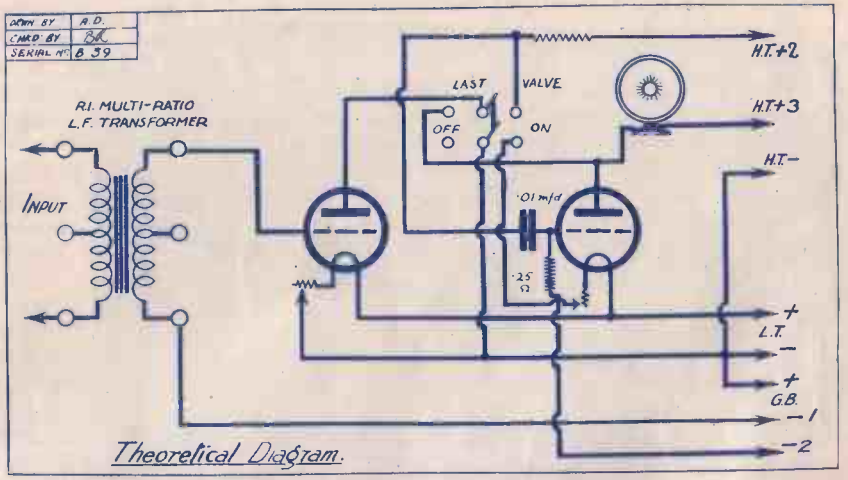
cabinet are obtained, and a suitable strip is included in the list of parts on this page of the article.

The next thing to do is to slide the panel and baseboard into its case to make certain that there is room for it to slide in and out without fouling anything.

If the bias battery or L.F. transformer come up against the lower ends of the side pieces in the case, these latter can be shortened to clear the components without in any way weakening the instrument or spoiling its appearance.

CONNECTING UP COMPONENTS.

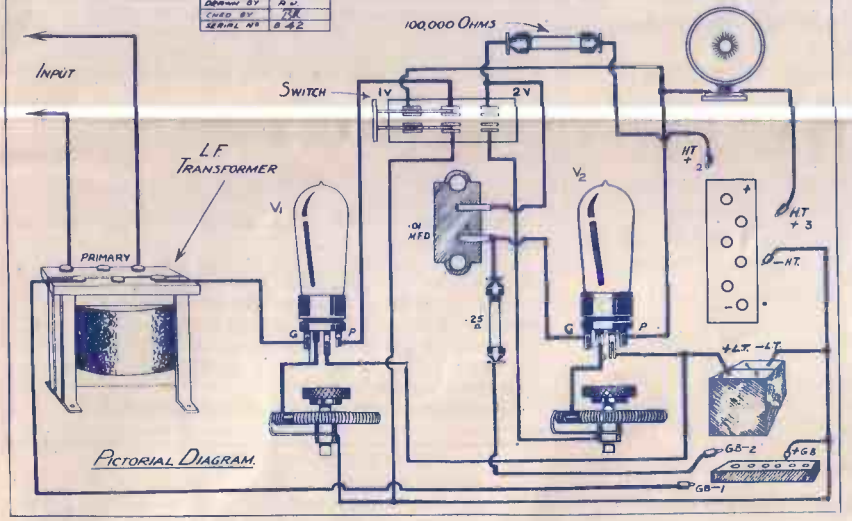
The wiring of the set should be carried out according to the wiring diagram provided, which shows as accurately as possible the relative positions of the various connections. Occasionally these may not agree with the photographs as to exact positions, but wherever possible (without sacrificing clearness) the correct relative positions are shown. This is not a great point, and the leads need not be made to follow exactly—bend for bend—every wire denoted by the diagram, but the latter should, with the help of the photographs, enable the constructor to build



Theoretical Diagram.

a duplicate instrument of that photographed and described in these pages.

All connections should be made by means of 16 gauge square section tinned copper wire, and should be carefully soldered. The flux and any



components has been employed in the design of the two-valve amplifier. This makes the set a little more difficult to wire up and to construct, but greatly enhances its appearance besides allowing a more efficient lay-out to be followed. It also enables all components and the valves to be kept out of harm's way and sheltered from dust and damp, and on the whole renders the whole receiver more compact and suitable for inclusion as a piece of household furniture rather than as a necessary but unsightly instrument.

Nothing very much can be said about the actual construction of the amplifier, as the task is not a difficult one provided the diagrams and photographs are carefully studied, and that the components mentioned in the list of parts are used. Other components would be likely to throw out the design of the set, while it would, of course, be impossible to use any L.F. transformer other than that specified, if the advantages accruing from the variable ratios are to be obtained.

As in all cases where wireless sets are concerned, it is better to purchase the panel, baseboard and cabinet together, so as to make sure that the former

LIST OF COMPONENTS.

	£	s.	d.
1 Panel, (10 in. × 6¼ in. × ¼ in.) (Peto-Scott). With cabinet slotted at back and baseboard	1	3	6
1 R.I. Multi-Ratio L.F. transformer	1	5	0
1 Variey anode resistance (100,000 ohms)		7	6
2 Precision rheostats		6	0
2 Lotus valve holders		5	0
1 Nesthill D.P.D.T. switch		2	0
1 ·01 fixed condenser (T.C.C.)		2	4
1 Dubilier ·25 meg. leak		2	6
1 Terminal strip complete (Peto-Scott)		2	6
8 Terminals		1	0
Wire, screws, transfers, etc.		2	0

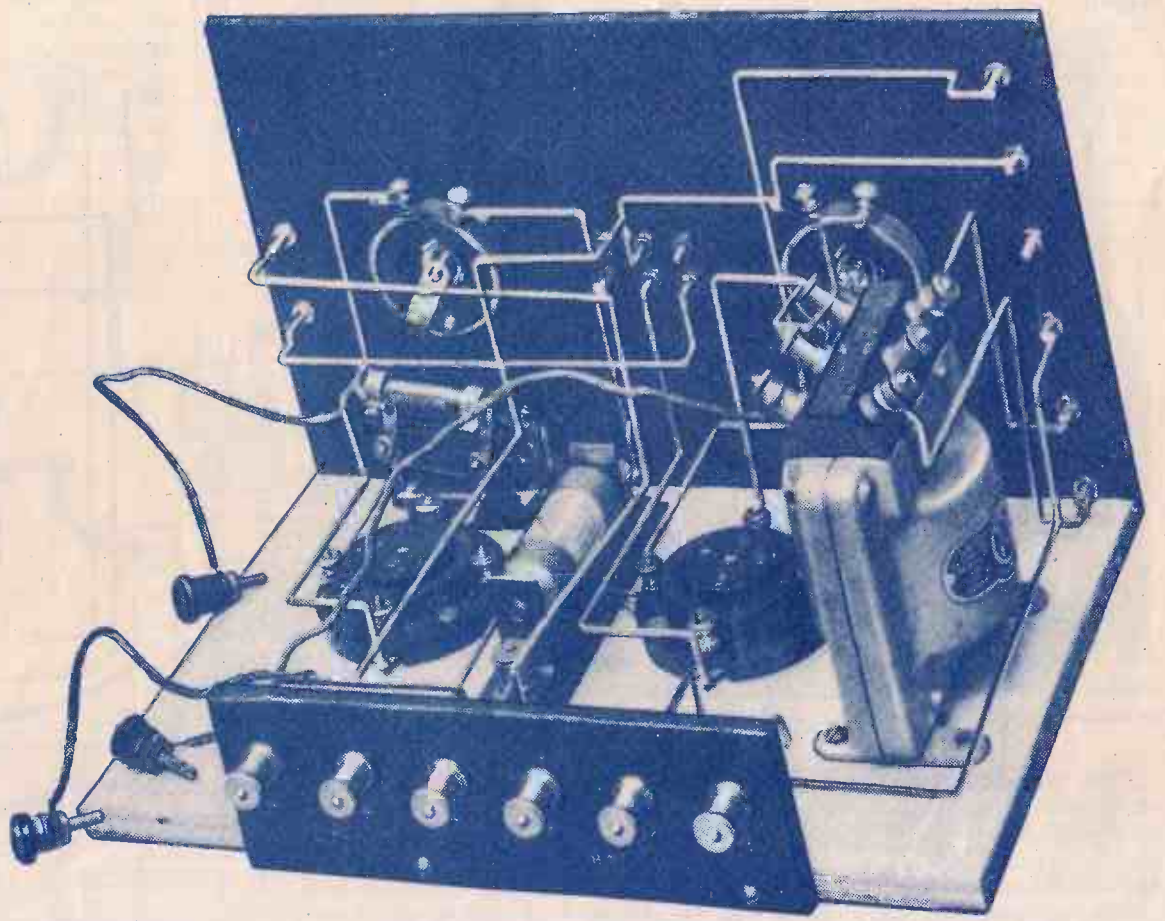
L.F. amplifier and no H.F. impulses will be passing through the instrument, we can afford to make it a little more compact than would otherwise be the case, but even so the components and wiring should not be thoughtlessly crowded together, or howling may take place whenever the amplifier is in use.

TERMINAL STRIPS.

When the components have been mounted the terminal strip should be placed in position on the baseboard corresponding with the slot in the rear of the cabinet. The strip measures about 7 in. by 3 in., and is made of ¼ in. ebonite. There is no need to make it up at home, however, as special strips, already engraved, can be purchased when the panel and loose remaining solder should be removed with a clean rag after every joint is made, and while the metal is warm. Loose beads of solder should also be dug out of their hiding places between valve sockets under-soldering tags on the smaller components and under terminals. It is advisable to remove the grid leak and the anode resistance from their clips while the soldering of the leads to these components is carried out, as the heat of the iron, if not skilfully applied, might result in a loosened connection *inside* the component, thus setting up a fault that it might be very difficult to trace

The same kind of thing applies to the soldering of the fixed condenser, which should be carefully done so that the connections of the condenser are not made too hot. It is advisable to "tin" all tags and terminals before the actual soldering process is undertaken, as this enables a quick and sure joint to be made on the immediate application of the soldering iron.

The wiring should, after completion, be checked up by means of the point-to-point list of connections provided. It will be seen that the leads to the L.F. transformer are of stiff wire (see photographs), but



A close-up of the interior of the amplifier from which the actual connections to the various components can easily be followed.

these may be of flex if variations of ratio are to be tried. On test the best ratio was that obtained by the connections shown in the diagram, and so stiff wires were used.

Other constructors might differ in opinion, and so it would be a good plan if flex leads were substituted for the three stiff ones going to the primary and secondary terminals of the L.F. transformer.

POWER VALVES.

Power valves should be used in this amplifier, and although the first valve should have a higher impedance than the last, we found B.4's gave excellent results with about 100–120 on the anodes.

Other makes have also been very satisfactory. The impedance of the first valve should not be too high, or otherwise the signals, when that valve is switched into the last position, may be rather distorted. 20,000 ohms should be ample to give good results in this amplifier, and we have tried the Cleartron 25.B, followed by a B.4, D.E.5, or D.F.A.1 with considerable success.

The H.T. voltage available should not be less than 108 max. and a 9-volt grid bias battery, tapped so that variations of 1½ volts can be obtained, will be necessary.

When connecting up the amplifier to the H.F. and Det. receiver the six terminals on the right of the receiver are connected to the six on the left of the amplifier so that they correspond (L.T. + to L.T. +, and so on).

plate current in accordance with the variations of distance between the grid, plate, and filament of each valve.

This variation of plate current is reproduced in the loud speaker as a musical note, and this note in turn *reacts* upon the valves, increasing the mechanical vibration. And so it goes on. Gradually the howl grows in intensity until it is unbearably loud.

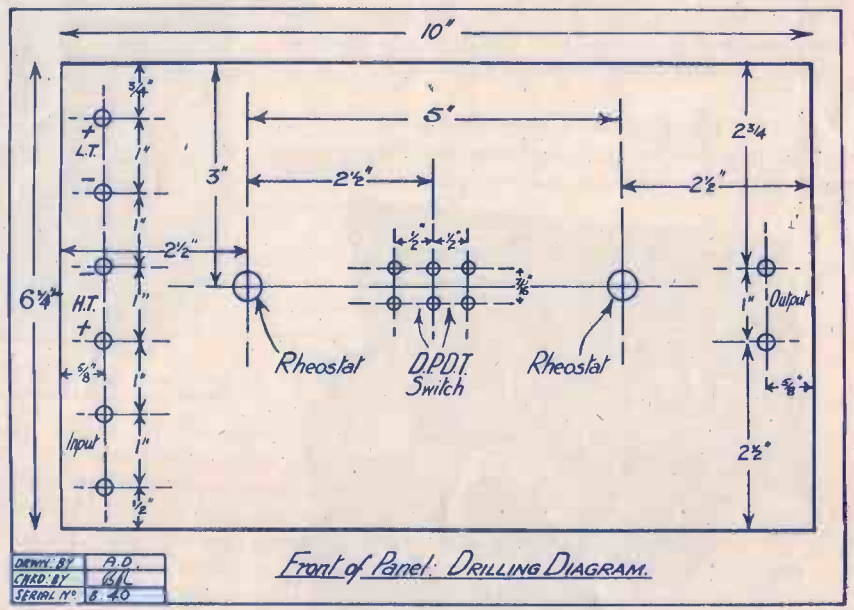
The remedy for this state of affairs is the removal of the loud speaker from the vicinity of the set, or turning it away so that the sounds from the speaker do not strike the valves with any directness or force.

ON TEST.

Another method is to wrap the valves in cotton wool to absorb all the vibrations before they reach the valves themselves.

This type of howling is not very often experienced with modern valves, however, so that the constructor need not fear that his results will be spoiled or marred by such an experience.

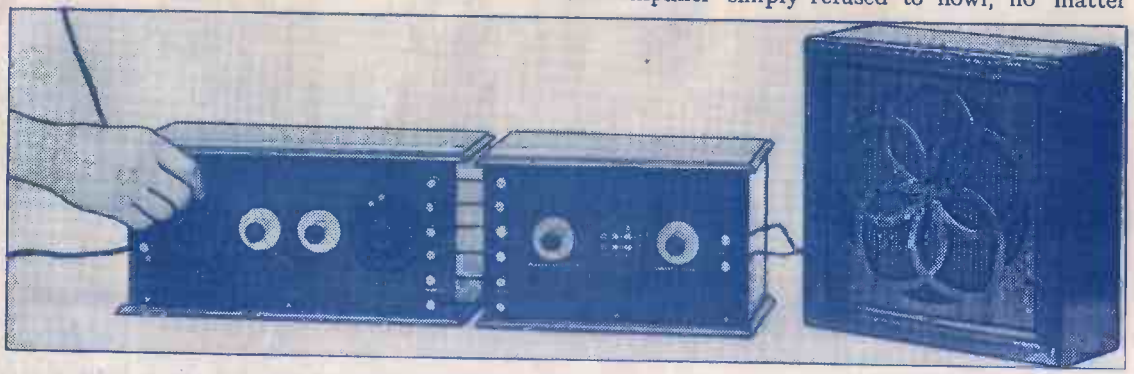
On actual test the 2-valve receiver coupled to the amplifier simply refused to howl, no matter



Front of Panel: Drilling Diagram.

effect of increasing signal strength by quite an appreciable extent, besides improving the tone and quality of reproduction.

In any case the quality will depend upon the correct use of the H.T. and grid bias batteries, assuming that the valves employed are suitable. Too much H.T. and too little grid bias will cause distortion, especially on loud high notes, and too much grid bias will give rise to "fuzzy" and possibly broken notes. Nine volts maximum should be available in the way of grid bias, and this should be varied while the set is in operation until best results are obtained. If a point is reached where the purity is almost, but not quite, right, then the H.T. voltage on the valve concerned should be varied in small amounts until the best results are reached. Final filament adjustment will then probably enable maximum purity to be obtained.



When coupled to the H.F. and Det. set, a four-valve receiver of uniform appearance and high standard of efficiency is obtained.

POINT-TO-POINT CONNECTIONS.

Input terminals by flex to two primary terminals of the L.F. transformer. One secondary terminal of transformer to grid socket of 1st valve holder. One of the remaining secondary terminals to G.B. negative 1 by flex.

G.B. positive is taken by a flex lead to the L.T. negative and H.T. negative terminals on strip. L.T. negative to

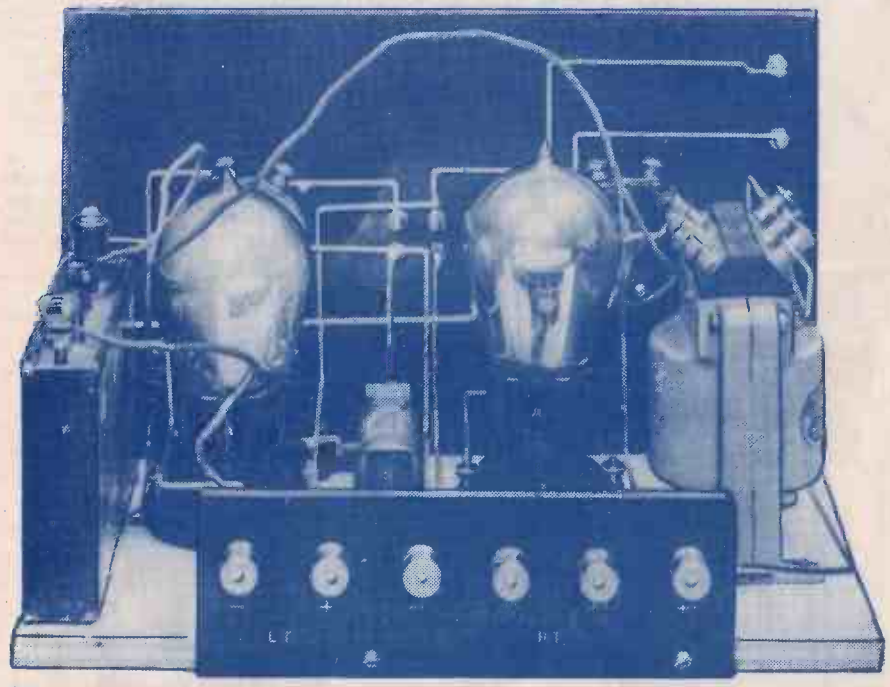
All battery connections are then made at the back of the amplifier, the terminal marked H.T. + 1 being the H.T. positive, which goes through direct to the H.F. and Det. receiver, and whatever voltage is given to that terminal is passed on to the receiver independent of the voltages applied to the amplifier, which go through H.T. + 2 and H.T. + 3 terminals.

MICROPHONIC HOWLING.

Owing to the employment of anti-microphonic valve holders the amplifier evinced no inclination to howl even, when the instrument was subjected to severe mechanical shocks. The only type of howling that is likely to take place would be caused when the loud speaker and the set were used close together.

On test this was not experienced, but it may be as well to mention it in case any of our readers come up against the problem.

It is caused by the sounds emitted by the loud speaker impinging on the valves themselves, and thus causing the electrodes in the valves to vibrate slightly.



In the photograph two B.4 valves are shown in position, with the grid bias battery on the extreme left.

This vibration would be more readily set up on certain frequencies owing to the natural mechanical resonance of the electrodes and their supports, and it will cause the distances between the electrodes to vary slightly.

This in turn naturally affects the electrical balance of the valve and causes variations of how close to the set the loud speaker was placed, or how loud the signals were.

It has been stated in the beginning paragraph of this article that the amplifier can be used in conjunction with sets other than the H.F. and Det. receiver previously described. We should like to emphasise the L.T. to H.T. — connection once more to make sure that constructors do not use the amplifier with a valve set having L.T. + taken to H.T. — without first seeing that the L.T. — to H.T. — connection in the amplifier is omitted.

For use with a crystal set such precautions are unnecessary, and the input terminals of the amplifier are merely connected up to the 'phone terminals of the crystal set. The other four terminals on the left of the amplifier are neglected except, perhaps, for the one marked L.T. —. This should be first tried unconnected to anything, and when maximum volume has been obtained the L.T. — terminal should be connected to the earth terminal on the crystal set. This often has the

corresponding terminal on panel, to one side of 1st rheostat, and to top centre contact of switch. Top left-hand contact of switch to one side of 2nd rheostat.

Other side of each rheostat to one filament socket of corresponding valve holder.

L.T. positive terminal on strip to corresponding terminal on panel, also to remaining filament sockets of valve holders.

H.T. positive 1 terminal on strip to H.T. positive terminal on panel.

Plate socket of 1st valve holder to bottom centre contact of switch.

Left-hand bottom contact to one side of anode resistance and ·01 condenser. Other side of resistance to H.T. positive 2. Other side of condenser to grid socket of 2nd valve holder and to one side of grid leak. Other side of grid leak to G.B. negative 2. Plate socket of 2nd valve holder to one output terminal and to bottom right-hand contact of switch.

Remaining output terminal to H.T. positive 3.