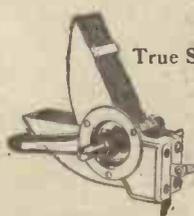


# You need these IGRANIC RADIO DEVICES—NOW!

Perhaps you have already felt the need for making certain changes in your receiver. Those distant stations which came in easily during the winter months cannot now be found. It is necessary for you to ensure that the components in your receiver are of the highest efficiency, and possibly the addition of a stage of H.F. amplification will help you to maintain the good all-round reception which is now so difficult to achieve. With the coming of summer, it is more than ever necessary to

guard against lightning by fitting an efficient earthing switch. Then, there is the need for a portable set so that you may gain the fullest pleasure from days in the open-air combined with the joys of radio music. Igranic Radio Devices will enable you to fill the foregoing needs—and many others—with perfect satisfaction. Here are a few of the most interesting Igranic and Igranic-Pacem components—your dealer will show you the complete range.



**IGRANIC-PACENT**  
True Straight Line  
Frequency  
Variable  
Condenser

Build the Igranic-Pacem True Straight Line Frequency Variable Condenser into your receiver, and you may feel confident that the energy in your aerial is being utilised to the best possible advantage, thus ensuring maximum signal strength. Further, the perfect ease of tuning afforded by the even distribution of stations over your condenser dial will make reception a real pleasure. Prices: .00035 mfd., 14/6; .0005 mfd., 18/6.



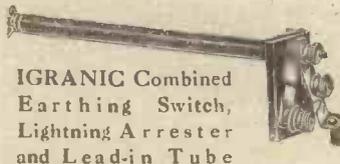
**IGRANIC**  
High-Frequency  
Transformers

Fit these Transformers and be sure that your H.F. amplifier is operating at maximum efficiency. They incorporate the well-known honey-comb duolateral form of winding, and possess electrical features which are conducive to highly satisfactory results. They will enable your set to "reach out" for those distant stations which are now becoming so difficult to receive. Fitted with standard 4-pin mounting & made in four sizes covering wave-lengths from 288 to 3,200 metres when tuned by .0005 mfd. condenser. Prices, 8/- to 12/6.



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The new Igranic Coils with real low-loss features. Equally suitable for indoor or outdoor use, because the windings are protected by attractive bakelite covers, which protect them from the harmful effects of dust and damp. Low-capacity mounting, with variable spacing of pin and socket, six sizes—220 to 1,000 metres aerial tuning. Prices 5/- to 7/-.



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A highly efficient "lead-in" device, affording perfect protection against lightning and static discharges, and simplifying connections. The ebonite lead-in tube is 10 in. long, and all metal parts are heavily nickel plated. Price 6/6.



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Jacks and Plugs

A few yards of flex and the appropriate Igranic-Pacem Jacks and Plugs will enable you to place the loud speaker, or any number of 'phones wherever required in the house or garden. There are 10 types of Jacks and various Plugs and Adapters with which you can arrange any combination of connections according to the needs of the moment. They are all robust in construction and reliable in action, and are fully guaranteed. Prices, 1/6 to 6/6.



**IGRANIC-PACENT**  
Porcelain  
Rheostats

The Igranic-Pacem Rheostat affords extremely satisfactory filament control for any type of valve. Its robust construction and dependability enable it to stand up to hard wear, while its small size renders it very suitable for use in portable sets. Resistances of 6, 10, 20, 30, and 50 ohms are available at the reasonable price of 2/6 each.

All reputable dealers stock them

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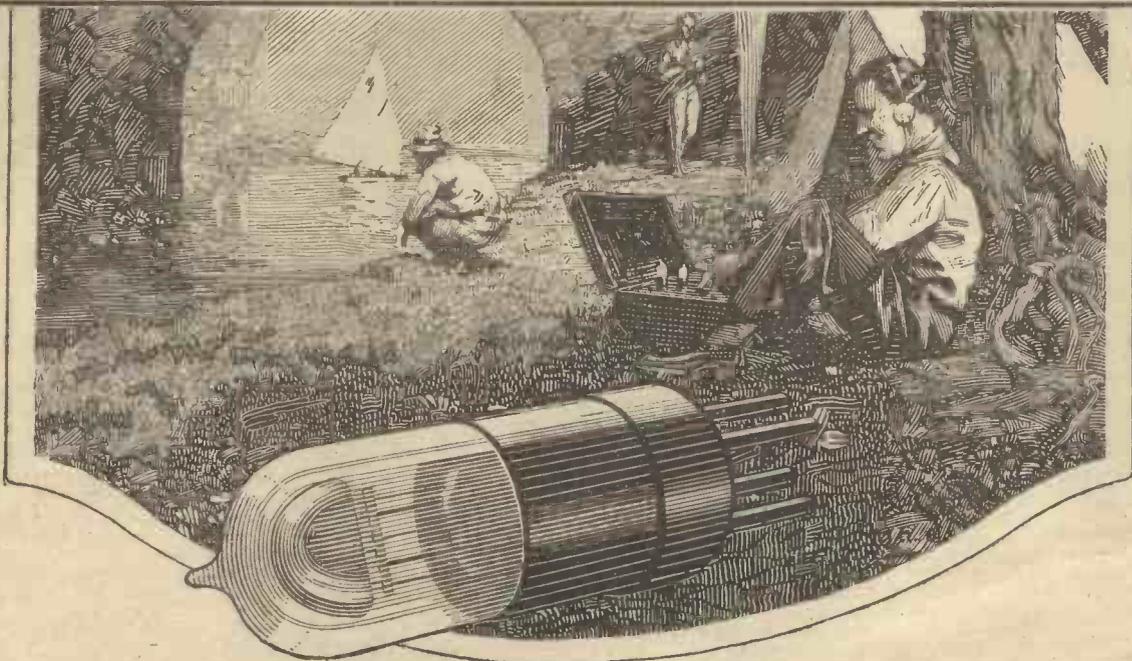


Pacem Radio  
Essentials

149, QUEEN VICTORIA ST.,

LONDON. WORKS: BEDFORD

## The Dull Emitter which popularised Summer Radio



SO long as bright-emitter valves were the only ones available the really portable Receiver was impracticable. No one wanted to carry big 6-volt accumulators out into the country for the pleasure of enjoying a Radio concert in the meadows—it wasn't worth the trouble. And even when the first dull emitters became more popular their extreme fragility rendered them unsuitable for the inevitable rough handling which every Set must get when carried from place to place.

And so the portable Receiver lagged in development. But, with the introduction of the Wuncell, summer Radio becomes a new delight. It is now quite easy to design a three-valve Receiver which can be fitted into an attache case complete with a 2-volt unspillable accumulator. Such a Receiver will give at least 10 to 12 hours' reception on one charge. And, what is more important still, the

Wuncell valves will not be harmed by the vibration and rough usage to which such a Receiver must inevitably be subjected.

The reason for this lies in the design of the filament and its method of manufacture. Instead of being a long, straight filament, it is arched and further stayed at its centre with a third support. Instead of obtaining low current consumption by thinning down the filament at the risk of fragility, the Wuncell filament is manufactured under an entirely new process. This permits an exceptionally high electron emission at a temperature of only 800 degrees—when the Wuncell valve is working, its glow is practically invisible in daytime. Even in the dark it is no more apparent than the luminous figures on a watch dial. As a result, therefore, we have every confidence in saying that the Wuncell Valve is quite as robust as even the well-known Cossor Bright Emitter.

### Types and Prices:

- \*W.1. For Detector and L.F. use - 14/- 1.8 Volts. Consumption .3 amps.
- \*W.2. (With red top) for H.F. use 14/- 1.8 Volts. Consumption .3 amps.
- \*W.3 The Loud Speaker Valve - 18/6 1.8 Volts. Consumption .5 amps.

\*Also in special base with resistance to suit 2, 4 or 6-volt accumulator 16/-

# Cossor Valves

# Popular Wireless

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## RADIO NOTES AND NEWS.

### German Super-Station—Imported Programmes—More Covent Garden Opera—Four Stations in One—Trans-World Congratulations—A Radio Hoax.

#### Imported Programmes.

ARE Continental programmes worth relaying? This month will probably see the question decided, for the B.B.C. is trying a once-a-week dose of this fare, which will be continued hereafter if the listening public approves. The "imported" programmes will be picked up at Keston and relayed every Tuesday during June.

If the programmes themselves please you, and the quality does not suffer en route, you should drop a line of appreciation to the local station. The experiment will only be retained as a regular feature if there is a demand for this class of overseas fare.

#### The Boatswain's Mate.

ON Saturday, June 5th, the Newcastle Station Repertory Players will broadcast "The Boatswain's Mate." This is a comedy by W. W. Jacobs and H. C. Sargent, which should come over very well, the humour being of the broad and hearty brand that is especially suitable for the microphone.

#### Listeners to Hear the Prince.

IT is expected that when the Prince of Wales speaks at the dinner of the African Society—which is to be broadcast on June 9th from the Savoy Hotel—his subject will be his recent trip to Africa.

The speech of Earl Buxton, at the same function, will also be broadcast.

#### Germany's Super-Station.

A NOTABLE addition to the Concert of Europe is the great new broadcasting station at Langenberg, which is to be opened this summer. It will be the broadcasting boss of Europe, with a power of no less than sixty kilowatts!

Langenberg is about a dozen miles from Cologne, and the new station will therefore be well situated to cover the Rhine and Ruhr districts.

#### Europe's Best Broadcaster.

WHEN this new German super-station starts up, the two existing stations at Dortmund and Elberfeld will be unnecessary, and will probably close down. Langenberg will rival 5 X X for the honour of being Europe's most popular station,

and its audience will certainly be a vast one, for the crystal range will be well over 100 miles. The wave-length and call sign have not yet been announced.

#### The New "Editorials."

HOW do you like the B.B.C.'s stunt of giving out an "Editorial" before the news is announced? Personally, I must admit straight away that I don't



A recent photograph of Mr. Harry Faulkner, the Engineer-in-Chief of the Hillmorton Station.

like it at all; but, of course, that may be because, to me, it is too much like talking "shop." Not many readers have yet expressed their views upon the subject, so if you happen to be writing in I should be glad to know your opinion of this innovation.

#### Bournemouth Municipal Orchestra.

A PROPOS of the recent announcements regarding the cessation of the Hallé concerts, a Hampshire reader raises the question of whether a parallel situation will arise in connection with the Bournemouth Municipal Orchestra? Inquiries made locally elicited the opinion that there was little likelihood of a similar claim being

made. Members of the orchestra receive no extra fee for broadcast performances, but the Corporation receives £21 per concert. When the present contracts expire the question of paying a small extra fee may arise, but 6 B M's popular municipal broadcasts are not likely to cease on this account.

#### Wireless Wisdom.

IN spite of all its inventions, is humanity any wiser now than a hundred years ago? asks a contemporary. I think so. If television comes it will make "seers" of us all in no time.

#### Four Stations in One.

THE great Post Office Wireless Station at Rugby is really four different stations rolled into one. There are two main transmitters there (one for short waves, and one for long), either of which is capable of world-wide range. Then there is a long-wave transmitter of medium range, which is kept pretty busy most of the week. And finally on Sundays there are the tests of the experimental telephony transmitter. This latter is on speaking terms with any place within 4,000 miles of Rugby, so altogether the Post Office can claim to have put up a four-fold station unequalled in the whole world.

#### Looking for Laughter.

WE waited a long time for the Village Concert, featuring the Vicar of Mirth, but it was certainly up to expectations. Not a few listeners have told me that it was the most enjoyable programme for months, and I am more than ever convinced that microphone-mirth is the biggest need of broadcasting to-day.

I happen to know that the B.B.C. is eagerly looking for a laughter-maker—someone who will fill the studio with new side-splitters. Can you put them wise to his whereabouts?

#### More Covent Garden Opera.

OPERA is an acquired taste, and apparently listeners are getting to like it. Encouraged by the demand, the B.B.C. is putting on two more Covent Garden broadcasts shortly, viz., "The

(Continued on next page.)

## NOTES AND NEWS.

(Continued from previous page.)

Jewels of the Madonna," and "Manon." Act II. of the former is announced for June 18th, and Act II. (Scene III.) of "Manon" will follow ten days later.

### Character and Crystal Sets.

ALTHOUGH the strike clouds have happily cleared away, and the general stoppage seems quite remote history, the Continental papers cannot get over the way we weathered the storm. I notice that in the general chorus of praise, Britain's calmness is attributed chiefly to the national aplomb, but partly to radio. Onlookers are supposed to see most of the game, and in this instance I think they are quite right. The fact that Britain is the best radio-equipped country in the world has stood us in good stead, and we ought not to forget the fact.

### Objecting to the Loud Speaker.

TALKING of the strike reminds me that I saw in one of the trade papers the other day, a report that at Plymouth there was a bit of trouble over the broadcast bulletins. Apparently a section of a listening crowd objected to the broadcasting of Government bulletins, and they actually became threatening outside one shop. By the advice of the police, the dealer in question discontinued the demonstration. I think this must have been an exceptional case, for I saw nothing of the kind in the London area.

### The Surrey Songster.

ONCE again this year the B.B.C. scored a complete success in sending out the song of the nightingale, and a more beautiful item it is impossible to imagine. Down in the Surrey woods, at Miss Beatrice Harrison's home at Foyle Riding, near Oxted, the engineers sometime wondered if the coy songster was worth all the waiting. Three microphones and a lot of patience were employed, in glades favoured by the songsters, but the result justified all the trouble. Congratulations to all concerned.

### The Zug Valve.

SCHWEIZ GLUHLAMPENFABRIK, A.G., of Zug, and Karl Burk, of Basel, Switzerland, have combined together to produce one of the funniest-looking valves the heart could desire. The anode is a disc with a hole in the middle, for all the world like a penny with a big central puncture. Through this hole goes a straight filament and a dumb-bell-shaped grid! Apparently the whole contraption puts the wind up the electrons all right, for the valve is claimed to be very efficient.

### Wireless Controlled Bomb.

THEY say that an American scientist has perfected a wireless-controlled bomb. It travels 50 or 60 miles to a spot previously chosen, and then comes down and "creates," after which, presumably, the inventor whistles it off, and it goes back home. And so to bed.

If this is all that the Americans can do for "Brighter Radio," I don't think much of their contribution towards enlivening the ether, do you?

### The Ether-Busters.

ACCORDING to "Radio Digest," they have cheerful programmes at the American station WAFD. This is how that journal expresses it:

"Yes, sir, WAFD certainly does warm up the atmosphere. Take those fire-blazin' Ether Busters that put on an air-rompin' rodeo every Saturday at midnight, Smitty leadin' the bunch of tootlin' cayuses burnin' up the electrons like streaks o' blue lightning'.

"You don't mind the weather so much when you come in from beddin' down the stock, your nose and finger-tips tinglin' from the cold. You drop a coupla hunks o' hard maple in the old Detroit heater, tune in WAFD, sit in the rocker with your feet on the stove-rail, and listen. Whooo-oo-pee! That's Smitty lettin' the bars down for the Ether Busters."

Sounds lively, doesn't it?

### Experimenter Speaks to Spitzbergen.

AN Ulster experimenter, Mr. Frank R. Neil, recently succeeded in getting into radio touch with KEGK, the exploration ship "Chantier." This is the vessel that is carrying the Byrd Arctic

## SHORT WAVES.

"The most wildly exciting of all modern inventions is 'wireless.'"—Lena Ashwell, O.B.E.

"I am a devoted listener-in, and every evening I switch on my set to hear the broadcast. Just as I am beginning to enjoy it we are switched on to some barbaric orchestra and I have to listen to shrieks and yells from an indeterminate number of barbaric instruments."—Lord Anslow, interviewed by the "Manchester Evening News."

"By the aid of the telephone circuits already constructed between England and the Continent it may be found possible later to connect anyone in Western Europe to anyone in North America through Rugby."—Dr. W. H. Eccles.

"It is to be hoped that all those newcomers who have found radio such a boon during the strike crisis will not forget to show their gratitude by joining the ranks of licensed enthusiasts."—"Evening Standard."

Expedition, and at the time she was lying in King's Bay, Spitzbergen. News of Amundsen's Expedition was eagerly received by the other Arctic explorers, who stated that the "Chantier" was leaving for London in a few days.

### 2 L O-Quacious!

WHAT a hornet's nest the B.B.C. stirred up with those "Editorials"! For one thing, the word "Editorial" was unfortunate, I think, being pretty certain to arouse suspicion amongst those responsible for printed editorials. And then the treatment of the topics seemed a trifle like Grandma's lectures to naughty boys and girls, didn't it?

Of all the Press comments I think the "Evening News" took the Huntley and Palmer, with a reproachful headline which packed volumes into the simple statement, "2 L O-QUACIOUS"!

### Ruling the Broadcast Waves.

INCIDENTALLY it was stated under that heading that the Postmaster-General said, "I have not seen the Editorials referred to, but I have asked for copies of them, and I shall then judge

whether they infringe the rule against broadcasting matters of political controversy."

Considering the extent and importance of the broadcast editorials, it seems a trifle casual and P.O.-like, doesn't it?

### The Intrusive Pips.

"IS the B.B.C. getting careless?" asks an indignant reader, who hates to hear the Six Pips from Greenwich butting in to concerts or other items. He grumbles and grouses because at one time this never happened, and he fancies that they have become casual at headquarters, and don't take the care with the timing of programmes that was taken a few months ago.

There is no need to despair because the time signal now obtrudes itself, sometimes. It is impossible to time to seconds through a long concert, and the authorities think that most listeners would prefer the time-signal to be super-imposed upon the programme, rather than interrupt or hurry a good item for it.

### Madame Melba Broadcasts Again.

SIX years ago, in June 1920, Madame Melba delighted radio enthusiasts by broadcasting from the old Chelmsford station. It was the first time that all Europe had been able to listen-in to a world-famous voice, and though that novelty has now worn off, the great singer is again assured of a vast and appreciative audience on June 8th. She is making her final public appearance in opera on that day, in "La Boheme," at Covent Garden, and excerpts from the performance will be relayed by the B.B.C.

### PCGG Again.

OUR old friend PCGG, the Dutch wireless station at the Hague, is going to have another flutter upon Europe's ether. This was the good old station that was commissioned by The "Daily Mail" to provide Britain with broadcasting from the Continent, prior to the foundation of the B.B.C. It served its turn valiantly and well, and thousands of old-time listeners will be glad to hear this pioneer broadcaster upon the air again.

According to present arrangements, PCGG will take turns with the Hilversum station. The wave-length will be 1,150 metres, and attempts will be made to reach the Dutch East Indies upon 130 metres.

### A Radio Hoax.

HEARD about the great American radio mystery? A bewitched telephone line running beside the railroad, near Reading-Pa., seemed to have the power of picking up broadcasting, and often when a signalman called up his next-in-line he would be astonished to hear some joyful jazz going on. Radio experts gathered and watched, all without avail, until somebody had his suspicions of one of the railroad telegraph operators, and had him suspended from duty. Then the truth came out. It was a hoax, caused by connecting up a broadcast receiver to the line. So now the signalmen will have to buy a set if they want to hear the programmes, and incidentally, the other fellow is looking for a job!

ARIEL.



A Simple Explanation of the Propagation of Electro-Magnetic Waves.

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

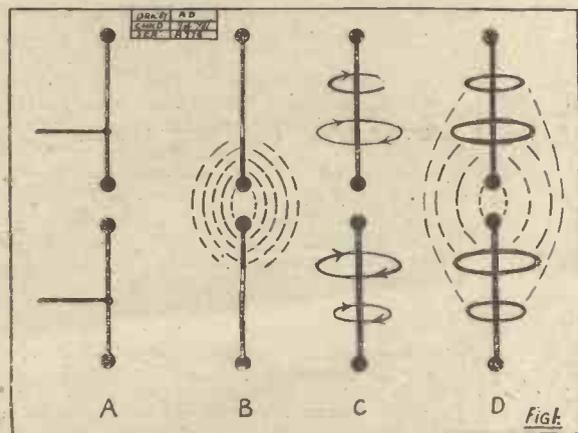
THE picture accompanying this article is intended to represent in a general way the initiation of electro-magnetic waves from the huge aerial of the new Rugby super-power transmitting station.

It will be understood, as, indeed, it is admitted by the artist who drew it, that a

the Hertz oscillator when no current is passing, the lines of electric force being indicated in the usual way. In Fig. 1 C the conditions are represented when current is actually flowing, and it will be seen that circular lines of magnetic force surround the oscillator.

career its energy is partly kinetic and partly potential.

It was soon found that the simple Hertz type of oscillator was not efficient as a radiator of electro-magnetic energy, and the history of wireless development has been closely bound up with that of the development of efficient systems for electro-magnetic radiation—in other words, with the development of the "aerial."



In Fig. 1 D an attempt is made to represent the average condition when an oscillatory discharge is taking place. In this figure the lines of electric force and the lines of magnetic force are represented simultaneously, but it will be understood that these alternate, the lines of electric force holding the field when no current is passing and the lines of magnetic force when the current is flowing. In practice, of course, except at certain instants, the state of affairs is intermediate between these two, the energy being partly electric and partly magnetic. A very simple analogy which will enable

Radiation From Present-Day Aerials.

The present-day type of aerial is, in effect, a condenser in which one plate is a vertical or horizontal or suchlike conducting wire and the other plate the earth. By suitable means, electrical oscillations are set up between the aerial and the earth, so that electricity flows first into the aerial from the earth and then into the earth from the aerial, and so on. When the aerial is electrically charged there is created between it and surrounding earth an electrostatic field, which represents a state of strain, and an electric pulse travels out from the other in consequence, just as a movement travels through a jelly if it is struck at one part.

picture of this kind can only give a very general notion of the manner in which the waves spring up from the aerial and proceed on their journey through space, and, of course, the drawing must not be taken too literally as regards its details—for one thing, the successive wave-fronts may be as much as 18,000 metres apart. Nevertheless, the picture gives a very good idea of the layout of the aerial, with its twelve 820-foot steel masts and its 800 miles of underground wiring which forms the earth.

this to be understood is that of the vibrating pendulum. When the pendulum is at the extreme end of its swing, its energy is entirely potential energy.

When the pendulum is at the lowest point of its swing, its energy is entirely kinetic energy. In practice, as the pendulum is oscillating its energy is continually being translated from the entirely kinetic

When the electricity is in flow between the aerial and earth, a magnetic field is set up, and again a magnetic pulse travels out through the ether. The two are not independent, however, as we have briefly explained above, but are definitely correlated, and the result is that from the aerial, or, to be more accurate, from the space between the aerial and the earth, there

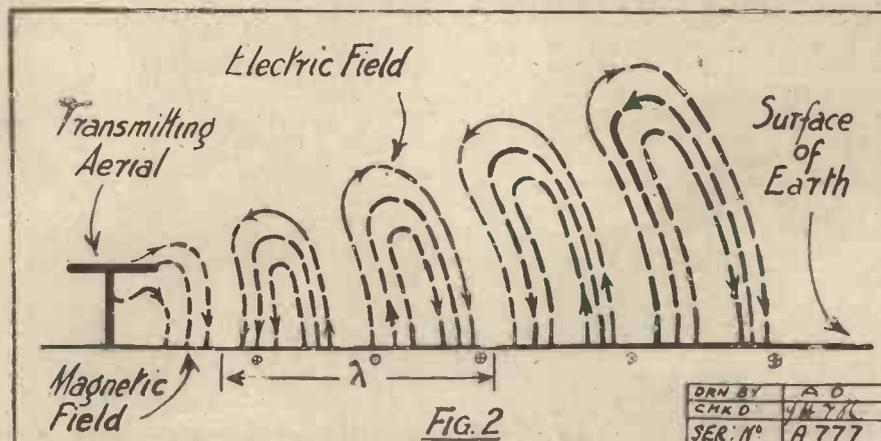
The First Hertz Aerial.

What remarkable strides are represented by an aerial such as this when compared with the original oscillator used by Hertz in his original experiments! It is interesting to recall that the first Hertz aerial consisted of two short wires, each with a metal ball mounted at the end, these wires being connected to a spark coil or static machine. As every reader knows, the oscillations were set up owing to the fact that when the potential difference between the two wires reached a sufficiently high value the insulation of the air in the gap broke down and a spark passed, the electricity on one wire jumping across to the other, there storing itself up for a moment, then returning, jumping back across the spark gap, and storing itself up on the first wire, and so on.

This phenomenon is known as an oscillatory electric discharge. In Fig. 1 is shown

form to the entirely potential form, but it is only wholly one or the other at certain definite points of its swing and at certain instants, and for the greater part of its

springs a composition of the electric and magnetic disturbances, the whole of the radiation being known as a system of (Continued on next page.)



## CREATING RADIO WAVES.

(Continued from previous page.)

electro-magnetic waves. How these waves travel through space, and how they may affect any other conducting body upon which they fall—in particular a “receiving aerial,” as it is called—is a matter of common knowledge to the readers of this journal, and there is no necessity to dwell further upon it.

### Some Interesting Observations.

In Fig. 2 is indicated, roughly, the way in which the waves proceed from a transmitting aerial. It will be noted that the Rugby station transmits on a very long wave-length, and is therefore in a class entirely different from that of the short-wave amateur stations which are now so rapidly becoming popular in various parts of the world. The two represent, in fact, the extremes of wave-length in wireless transmission.

Some very remarkable and important discoveries have lately been made in

connection with the behaviour of short electro-magnetic waves during the course of transmission, and it is interesting to refer to these in connection or in comparison with the very long waves, such as those generated by the station depicted in the accompanying illustration.

It will be seen from Fig. 2 that, owing to the effect of the surface of the earth and certain other conditions, the wave-front, after a certain distance has been covered, becomes “staggered,” and, furthermore, it has been found, notably by an American experimenter, Dr. G. W. Pickard, that the short waves, after travelling a certain distance, which in cases under observation were of the order of 20 to 30 miles, are to a large extent twisted around so as to be nearly horizontal. He found that when the short waves of 80, 40, and 20 metres were measured by means of a special antenna they appeared to arrive at the receiving station with the electric displacement in the horizontal plane.

Dr. Pickard carried out his experiments by the use of a wooden tower about 20 feet high with a small platform at the top, upon which he mounted the special antenna. This latter consisted of two stiff wires about

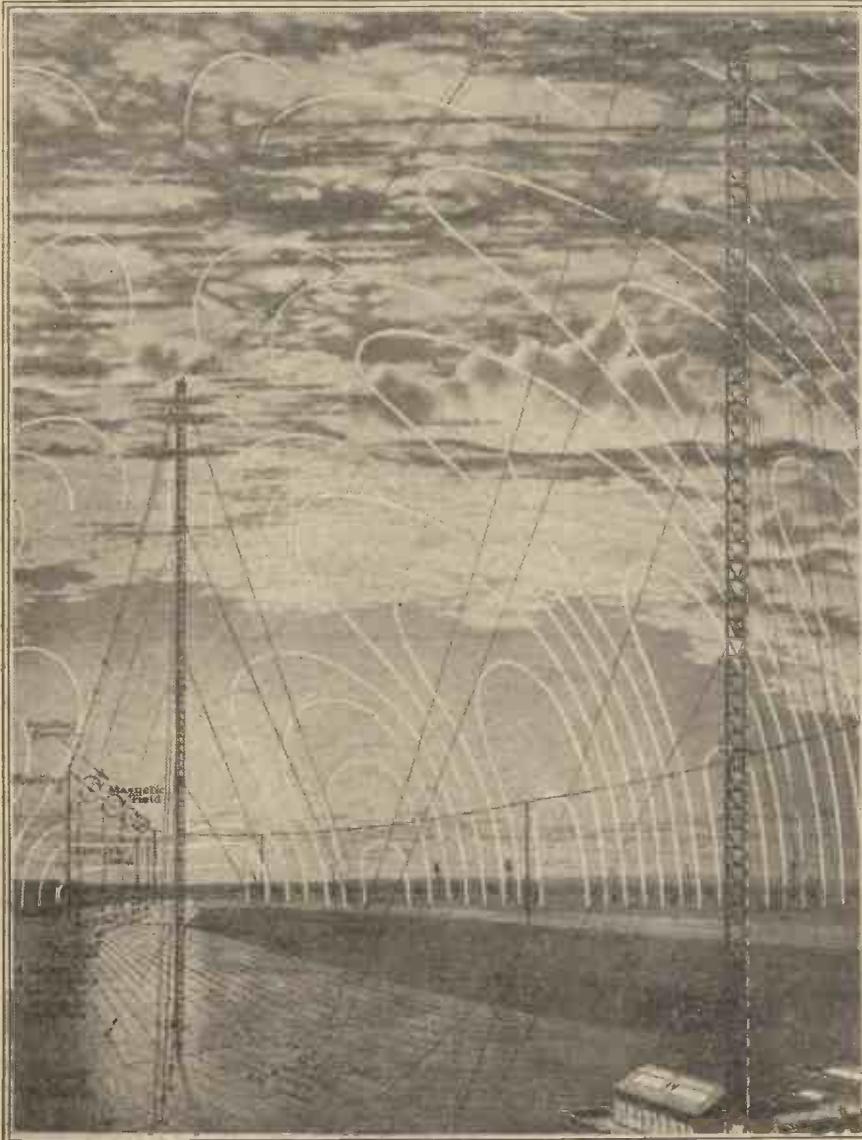
10 feet long, extending in opposite directions from the receiver, which was mounted in a special box at the centre; thus the receiver was in effect mounted at the centre of a 20-foot antenna. Moreover, the antenna could be rotated so as to be vertical, horizontal, or at any other angle.

By means of experiments of this kind, Dr. Pickard made a number of very interesting discoveries in connection with the “staggering” of short electro-magnetic waves, a full account of which will be found in the February number of “Q. S. T.”

### A Wonderful Aerial System.

The experiments of Dr. Alexanderson on the polarisation of electro-magnetic waves also represent a most important recent development in connection with the production of special types of waves, and it is likely that considerable use will be made in the future of the phenomenon of polarisation in connection with wireless transmission.

The progress of radio science indicates that a very great deal of research may yet be carried out with profit in connection with different types of antenna and different modes of wave-production. The wonderful aerial at the Rugby station (or perhaps it would be more correct to call it an aerial system, as it is of enormous extent and comprises a number of aeri-als linked together), by which an almost incredible amount of energy is hurled into the ether, represents, for the moment, the last word in high-power transmitting aeri-als, but progress has been so rapid in this most important subject that it would be very unwise to assume that in five years' time the same result may not be accomplished by means of an aerial or equivalent system much less vast. The Rugby aerial is a most imposing structure: it is like a great Druids' Circle of modern science.



This picture illustrates the manner in which ether waves are caused to radiate from the great Rugby station aerial system.

## RED LEAD.

THE writer recently heard of a peculiar failure of a receiving set which was finally tracked down to the use of a paint which had red lead as a constituent.

It appears that the cabinet containing the instrument had received two coats of the paint and had afterwards had a variable condenser mounted on it, there not being sufficient room on the panel. The set was a powerful one, and although it was anticipated that there would be some leakage owing to the component being mounted on wood, it was never expected that there would be little or no results, but such was the case.

After exhaustive tests it was eventually discovered that a tremendous leakage was taking place through the red lead, and on the cabinet being replaced, just for testing purposes, by one of plain wood, results were as good as anticipated.

The fact that leakage can occur through paint containing red lead should not be forgotten when loud-speaker or telephone extension leads are being run. On another occasion the writer was baffled for some time by a series of noises occurring in a friend's installation, which were ultimately proved to be the result of leakage between terminals mounted on a painted wooden skirting.



By E. J. W. STANLEY, M.A., B.Sc.

**J**UST as it is important to use only the best components in a set—such as variable condensers, crystal detectors, distortionless intervalve transformers, bi-duplex-wound anode resistances, headphones, and loud speakers—so is it important to take care of one's set and its accessories. This is particularly so now that the light evenings are on the ascent and signal strength on the descent.

**The Aerial and Earth.**

Aerial ropes should be renewed once a year, as winter weather always plays havoc with them. Aerial insulators should be washed at the same time. If the earth connection is soldered to a water-tap in the house, examine the joint only to see that it is not corroded and making bad contact. If an external earth is used, conc out the soil round the earth plate, or rod, and pour a can of water on to it in dry weather.

Whether a crystal or valve set is used, it is important to overhaul the earth switch periodically. This is best done by rubbing the switch-blade and the contacts with fine emery paper or cloth, care being taken to rub down the parts with a clean rag afterwards. The terminals and connecting wires should be treated in the same way. It is also a good plan to remove the milled terminal screws from the set and rub down the contact faces with emery, as well as the wires which they clamp. If one terminal is removed at a time, it obviates the possibility of connecting wires to the wrong terminals.

If a crystal set is used, the crystal should be washed periodically in petrol with a clean, stiff brush, and the end of the cat's-whisker should be held in a pair of tweezers and a very smooth file passed across the end which makes a contact to obtain a clean surface on the maximum area.

**Cleaning Variable Condensers.**

The headphones—even the best—require periodical attention, just as the clock or watch, which lasts for years if oiled and cleaned once a year. However, in the case

of headphones, it means electrical and magnetic cleaning and oiling, and this should not be attempted at home. It is far better, and cheaper, to let this be done by experts in tuning, repairing, and re-magnetising. They carry out the work well and expeditiously.

Valve-set users should carefully dust the plates of their variable condensers, even if they are enclosed in a cabinet. This is best done with a flat 1/2-in. paint-brush with, say, 1 1/2-in. bristles. A brush is better than a rag, as it avoids the danger of bending the plates out of shape. The panel should also be carefully dusted periodically on both sides, and the soldered connections tried to make sure that none of these joints are giving way. A corroded joint is often the cause of poor signals. Coil holders and plug-in coils should be examined to make sure that they make good contact.

Change-over switches should be cleaned in exactly the same manner as earthing switches. If quadrant type change-over switches are employed, it is best to remove the moving quadrant and to clean this with fine emery. The contact arms will have to be get-at-able, and these can be cleaned in the same way, care again being taken to wipe all contacts with a clean rag afterwards.

If a resistance-

coupled set is employed, it is well to have the anode resistance tested periodically. There are many inferior resistances on the market which alter in resistance with time, and therefore the signal strength diminishes. If, on test, these resistances are not what they are labelled, it will pay to scrap them and to buy permanent bi-duplex resistances, such as the Varley. These resistances are unaffected by weather changes or age, and are supplied in all values from 500 ohms to 250,000 ohms.

**The Loud Speaker.**

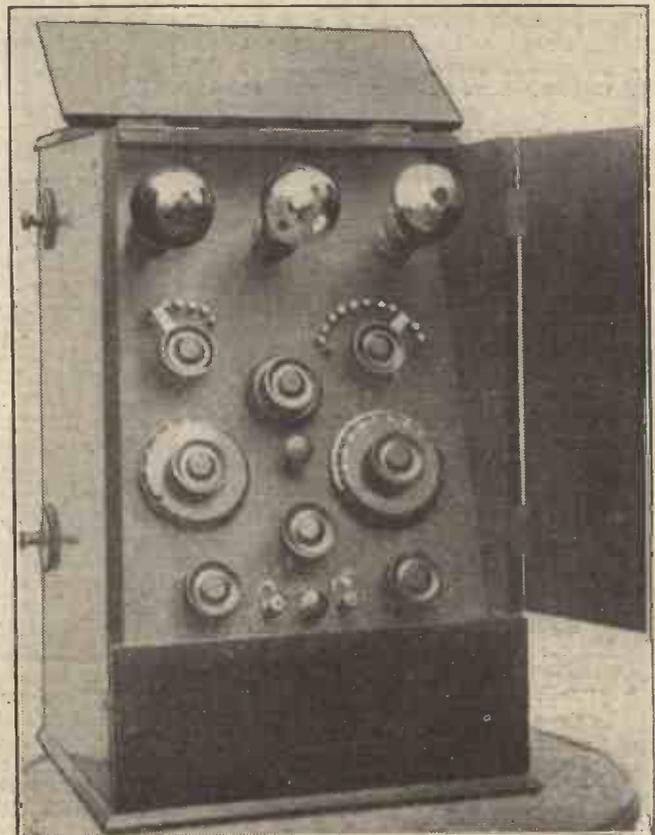
The loud speaker also requires periodical attention. Dust and grit get down the horn on to the diaphragm, and often the magnets weaken with time. The loud speaker is a delicate piece of apparatus on which so much depends, and it is best not to tinker with it. It will be found far more economical to send it to experts, who will bring it up to concert pitch for a few shillings. It is, of course, not necessary to send them the horn.

Low-tension batteries should occasionally be washed out with water and refilled with new acid of the correct specific gravity. If high-tension accumulators be employed, they should be given a charge not exceeding 60 milliamps once a month.

**Avoiding H.T. Leakage.**

When the set is not being used, the high-tension connection should be removed, as, if there is a slight leak on the set, it will not only help to run down your high-tension battery, but it may also damage your low-frequency intervalve transformer.

If the foregoing points are periodically attended to, the liability of the set breaking down will be considerably diminished.



An imposing three-valver, made by Mr. F. W. Phillips, of 41, Marine Avenue, Hove.

# BROADCAST NOTES.

"Eights Week" Experiments—"Spoon-Fed" Entertainment—The State of Emergency—Selecting the New Commissioners—A Canadian Programme—The Echo-Rooms.

By O. H. M.

I HEAR there is a strong probability of the great pianist Lamond being included in the B.B.C. programmes in August. He is now engaged in an American tour, but he has already expressed a desire to play again for British listeners as soon as possible. Lamond's previous broadcasts firmly established him in the esteem of millions of listeners, and his next engagement at Savoy Hill will be anticipated eagerly. That it should be in August is a sign that the B.B.C. will this year refuse to recognise anything in the nature of an "off-season" for serious broadcasting. Given such a policy at Savoy Hill, there is no reason why interest in wireless should not remain high throughout the summer.

## "Eights Week" Experiments.

Experiments are being made with a view to broadcasting some of the characteristic noises during a critical moment of the Oxford "Eights Week" this summer. I think this will provide much better material for a successful "atmosphere" broadcast than would the Derby. The reason is, of course, that people are so keenly interested in the result of the Derby that if they cannot have a running commentary with the noises they are apt to be profoundly dissatisfied. On the other hand, the actual results of the Eights Week races at Oxford are of keen interest to only a small proportion of people. It is the "atmosphere" that counts in a broadcast of this kind, and that is why, given its existing limitations, the B.B.C. should concentrate more on "atmosphere" occasions.

It is generally understood that the reason for the postponement of the Birthday Honours until July is to enable the Government to include a special list of those deserving of recognition for their work for the nation during the Emergency. Certainly no organisation did more than the B.B.C. for the country, and recognition of this in the Honours would be a very popular act. But I gather that there is some anxiety on the subject at Savoy Hill. The people there are quite rightly anxious to keep absolutely clear of the suspicion that they were in any sense partisan during the Emergency. On the other hand, it is interesting to note in the official organ of the B.B.C., that on the constitutional issue they were definitely on the side of the Government. I do not see how they could have been otherwise. Therefore, to the extent in which their efforts helped to preserve the authority of the Constitution they are certainly deserving of generous public recognition.

## "Spoon-Fed" Entertainment.

In the course of conversation with some of the B.B.C. programme officials the other day, I was told of an interesting controversy now going on in their inner councils. This relates to the degree in which listeners should be "spoon-fed." One group holds

that the art of broadcasting is still so undeveloped that constant spoon-feeding is necessary; they add that the average listener must be called upon for the absolute minimum of effort in following a programme. The other group maintains that the time has come when artistic effect should no longer be sacrificed for the purpose of making things over-easy for listeners. The particular problem of the moment is in connection with the presentation of serial drama. Should it be assumed that listeners will follow each part, or should each episode be so arranged that listeners will be given a self-contained effect? The spoon-feeders have had their way up to the present, but the other side has now gained the ascendancy, and we are to have some experiments in deliberately testing how much trouble listeners will take. My own view is that the



A new penny in the slot wireless set that is being installed all over America.

experiments will fail. The whole tendency of the age is to minimise exertion in entertainment. Most listeners would prefer to have the stuff "easy," even at an artistic discount.

## The B.B.C. "Editorials."

As I prophesied last week, the B.B.C. is endeavouring to retain some of the features developed during the Emergency. This applies particularly to the "Editorials," which take the place of the "Appreciations" of the Strike period. To my mind it is only right that the B.B.C. should endeavour to give the country a lead on pressing problems. Of course, it means entering the field of controversy, hitherto banned by the Post Office interpretation of the licence. The other day, I tried to get a reaction to this development from a Post Office official. He was characteristically cautious, and made a point of disclaiming

all responsibility for the Editorials broadcast during and since the Emergency. It seems that the Emergency is still "on," and that until Parliament calls it off formally, the B.B.C. has much greater freedom of action than under normal conditions. All I can say is that so far as broadcasting is concerned, I wish Parliament could arrange for a perpetual state of Emergency. I know it is argued that all will be put right with the new constitution of broadcasting next year, but it would be the height of folly to allow red tape to fritter away the wonderful prestige gained by the B.B.C. during the Emergency. And it is quite certain that something like this will happen if officialdom gets a renewed hold on the service for the rest of this year.

## The Broadcasting Commission

Mention of the future constitution of broadcasting reminds me that one important result of the Strike has been the creation of a general feeling that the B.B.C. should not be tampered with in any way, and should be given a clear ten years' period in which to continue its great work. There will be more heard about this in Parliament. While I imagine the Government has gone too far to recede from the policy of a Commission, I believe they will have to recognise the strength of this feeling when they come to the selection of the Commissioners. Before the Strike, it was generally believed that Mr. Reith would be Executive Commissioner and ex-officio Vice-Chairman of the Commission. Now it would seem probable that Mr. Reith will be made Chairman, and that someone else will be made Executive Commissioner.

## A Canadian Programme.

The B.B.C. is making special plans for July 1st, when a Canadian programme will be given in honour of Canada's Dominion Day. This will be the first of a new series. The special day of each of the Dominions will be similarly celebrated. If I could make one suggestion, it would be that for each of these special shows the B.B.C. should use as the announcer a member of its staff belonging to the Dominion concerned. I understand that all the Dominions are represented on the B.B.C. staff. If this were done, it would create an excellent effect throughout the Dominions concerned, and would lead to valuable publicity for the B.B.C. overseas.

## The Echo-Rooms.

Quite the most extraordinary recent development technically at Savoy Hill is the remarkable success of the new echo-rooms. As the result of experiments just finished, I understand that it is now possible to give almost any kind of echo and resonance to particular programmes. A parallel microphone in the echo-room, modulated and controlled in conjunction with the studio microphones, has solved some of the most serious problems in the way of the adequate reproduction of classical music.

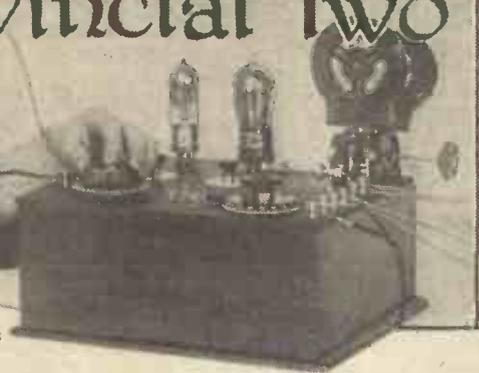
## READERS' QUERIES.

"Popular Wireless" offers its readers the best Technical Queries Service in the country. Turn to the Radiatorial page for full details, and don't fail to take advantage of the advice of experts if you are in trouble with your receiver.



# The "PW" "Provincial" Two

The Set designed, built and described by the "P.W." Technical Staff.



FOR a time the great popularity of reflex circuits, which employ a crystal detector and two valves, has overshadowed the merits of the corresponding straight circuit; but recently there has been a strong tendency amongst the two-valve-and-crystal owners to return to the

By means of a single-pole double-throw switch the last valve can be placed in or out of circuit as desired, the second valve's filament current in the latter instance being turned off by the second rheostat.



The complete set, ready for connecting up. With the switch as shown, the low-frequency valve is not in use.

### Easy to Construct.

When worked in this way as a "straight H.F. and crystal detector," the set is a very economical long-distance receiver. With an average aerial it should tune in anything from half a dozen to about a dozen stations, provided the local station is not too near to permit of distant reception.

When the desired station has been tuned in, the last valve—which acts as a straight L.F. amplifier—can be used to strengthen up the signals.

Unlike most reflex sets, both the construction and the operation are straightforward, and the set is generally successful straight away, even in the hands of an inexperienced constructor. The knack of tuning is soon gained, especially if a good crystal detector is used;

straight circuit, and its merits are once again winning it a place as a favourite.

Such a circuit will receive equally well upon the shorter or longer waves used for broadcasting. It will pick up 5 X X at good strength in any part of the country, and it is quite a common feat for a well-operated set to receive ten or a dozen other stations as well.

### Good Long-Distance Set.

It is, moreover, a cheaper circuit to build than the two-valve-and-crystal reflex, as it entails the use of only one L.F. transformer, instead of two. The resultant volume is necessarily reduced, and except at short distances the receiver will not work a large loud speaker; but it is an excellent set for loud headphone results at long distances, and will work two, three, or four pairs quite easily.

with an adjustment that seldom requires handling when once the sensitive spot has been found.

Other points about the circuit can be seen from the theoretical circuit reproduced on this page. The aerial tuning condenser can be placed either in series or in parallel with the aerial tuning coil, so that suitable plug-in coils will enable the receiver to tune over a very wide band of wave-lengths.

For the shorter waves, series tuning generally gives better results, and this requires a 75-turn coil for the A.T.I. To place the condenser in series, the aerial lead should be connected to the terminal marked "Series," and the terminal marked "Parallel" is left without an external connection. For the higher wave-lengths the condenser should be placed in the parallel position in conjunction with the appropriate aerial coil (35 or 50 for main and relay stations, 150 or 200 for 5 X X.)

Parallel tuning requires the aerial lead to be placed on the "Parallel" terminal. In this instance the "Series" terminal is joined to the

### LIST OF COMPONENTS.

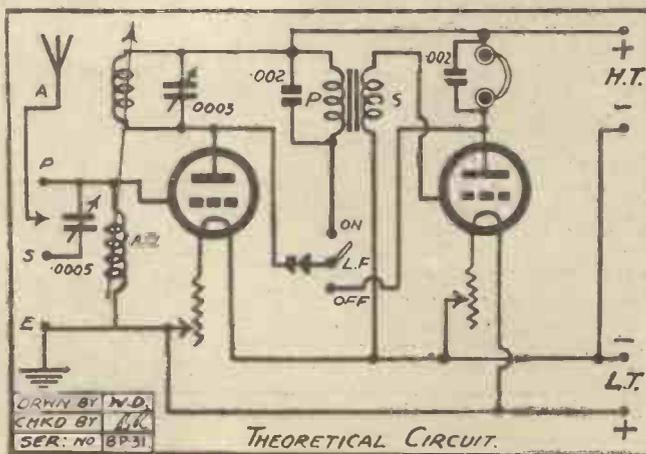
	s.	d.
1 Panel, 12 x 10 x 1/8 in. (Peto-Scott)	7	6
1 Box to fit, 4 1/2 in. deep (Peto-Scott)	10	0
1 1st stage L.F. transformer ("Gol-tone")	17	6
1 Two-way coil holder ("Lotus")	7	0
2 Valve holders (Peto-Scott)	1	0
2 Filament resistances	6	0
1 .0005 variable condenser (Lamplugh)	12	0
1 .0003 variable condenser (Wates' "K")	7	9
2 .002 fixed condensers (Clarke's "Atlas")	4	6
1 Crystal detector ("Lion")	3	6
9 Terminals	1	1 1/2
1 S.P.D.T. switch	1	6
Wire, transfers, screws, etc.	1	0

### ACCESSORIES.

- 1 H.F. valve
- 1 L.F. valve
- H.T. and L.T., to valve makers' specifications
- 1 pair of 'phones
- Two or more tuning coils, according to wave-lengths desired.

"Earth" terminal by a short strip or wire. (For both positions the earth-lead is connected to the "Earth" terminal.)

(Continued on next page.)



**THE "PROVINCIAL" TWO.**  
(Continued from previous page.)

Reaction effects are obtained by coupling the aerial and tuned anode coils in a two-way coil holder. Either bright or dull-emitter valves can be used with H.T. and L.T. batteries in accordance with the specifications of the valve maker. (The correct voltages, etc., are generally stated clearly upon the box in which the valve is purchased.)

**The Parts in Use.**

The list of components used in the set shown in the photographs is given on page 509. All these are of standard size, so that similar components of different make can be used instead, if desired, without the necessity of modifying the size of panel and case.

Construction is commenced by preparing the panel. The position for the various components is shown by the photographs and back-of-panel diagram, and by the dimensions on the drilling lay-out.

The terminals should be mounted first, and filled ready for soldering. Then the S.P.D.T. switch, valve holders, and crystal-detector should be mounted and prepared. Finally, the rheostats, transformer and variable condensers may be placed in position, as shown in the back-of-panel diagram.

**Simplifying Construction.**

There is no need for the fixed condensers that are placed across the 'phone terminals, and across the primary of the L.F. transformer, to be attached directly to the panel. Instead of utilising separate fixing screws for these small components, they may be supported quite adequately by their own wiring.

This obviates the necessity for making special holes in the panel for the fixing-screws, so most constructors will prefer the condensers to be self-supporting.

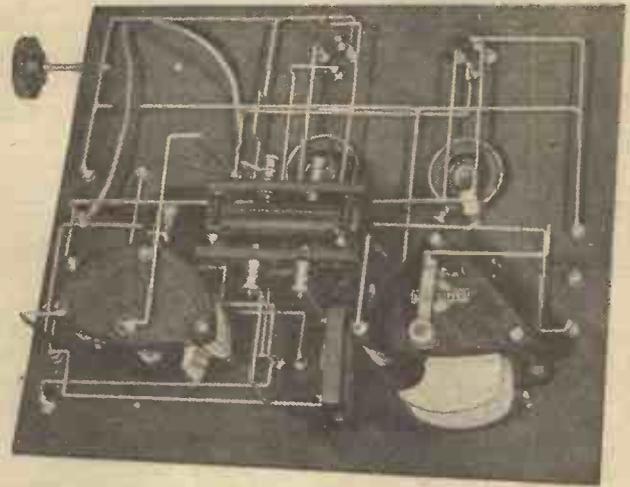
**The Wiring.**

The wiring is carried out with any suitable stout wire, of about gauge 16. In the actual model constructed in the "P.W." laboratory, and shown in the photographs, square-section tinned copper wire was used, but if preferred, glazite or similar covered wire could be used instead.

For the benefit of those readers who have not previously tried to construct a wireless set from blue print or wiring diagram, it may be necessary to emphasise the fact that a certain latitude is permissible in the choice of components. For instance, although the rheostats shown in the photograph and on the blue print are of the wire-wound type, it is not essential to employ this class of filament resistance. If desired, the more compact form which relies for its operation upon the compression of carbon pellets may be utilised, and as these components are generally quite small and compact there will be ample room for them upon the panel.

**Concerning the L.F. Transformer.**

Similarly, one of the "hedgehog" type low-frequency transformers can be employed instead of the type indicated in the photographs. It is, however, important to use a transformer which has been designed for "first stage" work. Generally the ratio of such a transformer is between 3 and 5



How the parts are arranged under the panel is clearly shown by this photograph

to 1, and the function it has to perform is different from that of a second-stage low-frequency transformer in which the ratio of the windings is equal (i.e. one to one).

From the foregoing it follows that slight variations in the components themselves do not affect the action of the receiver, provided they are of suitable design for the work they have to perform. Such variations as a vernier adjustment on one or both of the variable tuned condensers can be left to the discretion of the constructor.

Generally speaking it is decidedly advantageous to employ a vernier control, especially on the anode condenser. Owing to the fact that this circuit is coupled to the aerial for purposes of reaction, correct adjustment of the anode tuning is particularly effective when trying for distant stations. So if only one vernier can be employed, the anode condenser should preferably be fitted in this way; but if both condensers can embody vernier adjustment so much the better.

**Testing the Set.**

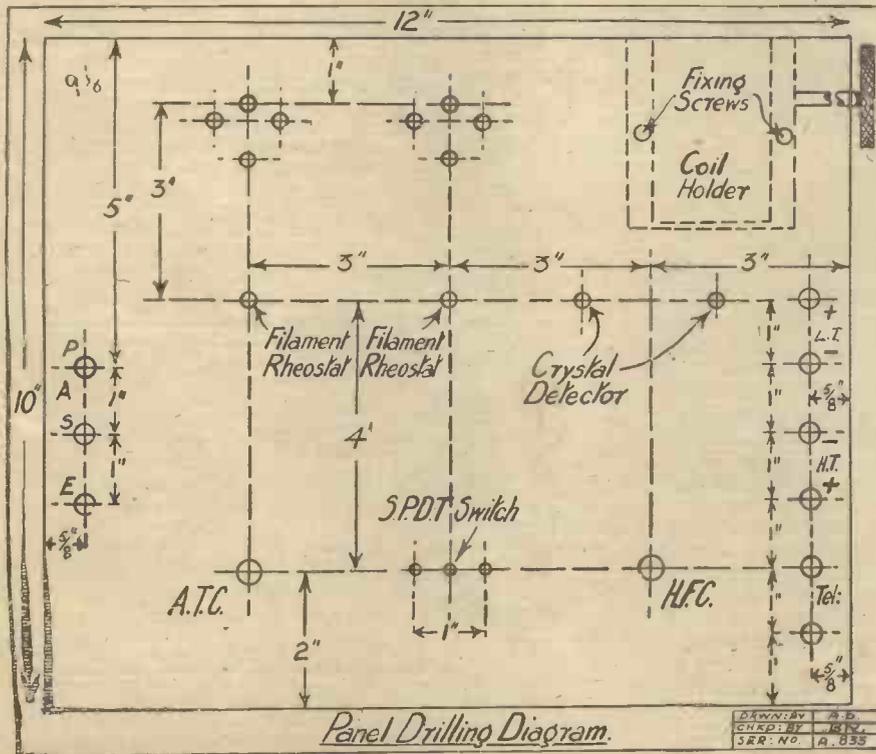
The valve holder shown in the photograph is of the countersunk type, but if those of the solid block type are already on hand, or are preferred, they can be used instead.

There is no need to describe the wiring in detail, as this is shown by the wiring diagram on this page. It is interesting to note that this diagram is a small-scale reproduction of part of the "P.W." Blue Print, Number 16. The "Provincial Two" is one of the popular sets made up direct from this blue print, so readers can, if desired, obtain the blue print from the Query Department for 6d. (See the announcements under "Radiatorial.")

**Correct Components.**

It will be found that, in addition to the enlarged wiring and theoretical diagrams, the circuit is given in pictorial form upon the blue print. This being the case, the most inexperienced constructor need not fear to tackle the making of the set with the aid of these instructions and photographs and "P.W." Blue Print, Number 16.

Like all sets in which H.F. amplification is employed, great care must be taken, when soldering, that no flux is left adhering to the wiring. Unless it is wiped off at the proper time it is extremely difficult to



(Continued on next page.)





By A. W. HULBERT.

A FRIEND of the writer's who owns an accumulator charging station, and through whose hands hundreds of wireless accumulators pass every week, made the interesting statement that practically 60 per cent of these accumulators were neglected by their owners, and their life reduced in some cases by 50 per cent through ill usage.

In this article the writer will endeavour to describe the way to make the wireless accumulator last longer, hold its charge longer, and give better all-round service.

As the majority of readers are aware, the wireless accumulator consists of a number of pairs of lead plates immersed in dilute sulphuric acid, and usually mounted in celluloid or ebonite cases, with the sets of plates connected to two terminals on the top of the containing case.

By passing a current of electricity through the accumulator a rearrangement of the chemical components of the plates is made to take place and, on disconnecting the accumulator from the mains and wiring it up to an electric bulb or a wireless valve, it will be found that a current of electricity passes from the accumulator, causing the lamp or the valve filament to glow.

#### Concerning Capacity.

One of the causes of accumulators giving trouble is allowing them to run right down until they are absolutely exhausted. This is very bad for them, and as soon as they show signs of running down they should be taken to the charging station. The frequency with which recharging is necessary will depend upon two things—the size, or ampere-hour capacity of the accumulator, and the number of valves used on the set. Obviously, the more valves in operation, the more frequent will be the recharging.

With regard to the capacity of the accumulator, when two or more valves are used, this should never be less than 20 actual ampere hours. In a one- or two-valve set, a 4-volt 20 or 4-volt 30-ampere-hour accumulator will be suitable; but when three or more valves are in use, 6-volt accumulators of 40 to 60 ampere-hour capacity should be used, the voltage across the valves being cut down by means of the usual filament rheostat.

Quite a number of wireless "fans" fail to appreciate the fact that by cutting down the voltage slightly, not only will the life of the valve be prolonged, but the accumulator will last longer for one charge. The reproduction, either in the 'phones or

loud speaker, will be considerably clearer in most instances, and far less harsh than if the valve filaments were glowing at full brilliancy.

#### "Sulphating."

The greatest and most frequent trouble to which accumulators are prone is sulphating. Sulphate is caused by overcharging, by charging too rapidly, by discharging them at too high a rate, or by leaving them too long in a run-down condition. It consists of a hard white substance on the surface of the plates, and is really sulphate of lead. The presence of sulphate is most detrimental to the accumulator, as the act



Among the interesting exhibits at Marconi House can be seen some of the earlier types of variable condensers used by Senatore Marconi.

of scraping it off the plates invariably results in a certain amount of the active material being brought away from the plates at the same time, with a consequent loss of ampere-hour capacity.

It is a good plan to keep two accumulators in use and to put one on charge directly it shows signs of running down. Nothing ruins an accumulator quicker than leaving it in a discharged condition. Even if an accumulator is left standing idle, it should be given a freshening charge once a month to keep it in good condition.

#### Charging Batteries.

If the reader has no facilities for charging accumulators from the house mains he should use discretion in selecting a firm to do this work for him. Many firms are springing up in large towns, advertising that they will collect, recharge, and deliver wireless accumulators of any capacity the same day; this, of course, is absurd, because to do them properly and at the correct charging rate, at least two days are necessary.

The most reliable people are those who run large car battery service stations; they take care to see that all accumulators are properly charged at the correct rate, and will arrange to clean out and refill with acid whenever necessary. Never let an inexperienced man tinker with an accumulator; careless handling will do more to shorten its life than any amount of ordinary hard work.

#### Charging at Home.

If the reader is living in a district served with a direct current supply, it will be perfectly easy for him to charge his accumulators at home at practically no cost at all. In the present article, however, we are dealing with the actual treatment of the accumulator itself.

On the side of most accumulators will be found a printed slip, giving special instructions for charging, the specific gravity of the acid, etc. These instructions should be most carefully adhered to.

The terminals on top of the case should be kept clean and bright with emery paper, and covered with vaseline to prevent the acid fumes corroding them.

#### Refilling with Acid.

Acid should be added only if the electrolyte has been accidentally upset. If the level of the solution has sunk below the top of the plates, distilled water should be poured in until the tops of the plates are well covered with electrolyte. When acid is used for refilling an accumulator, it should be diluted in the proportion of one part sulphuric acid to four parts distilled water. In mixing, always pour acid into the water, never water on to the acid.

#### Hydrometer Test.

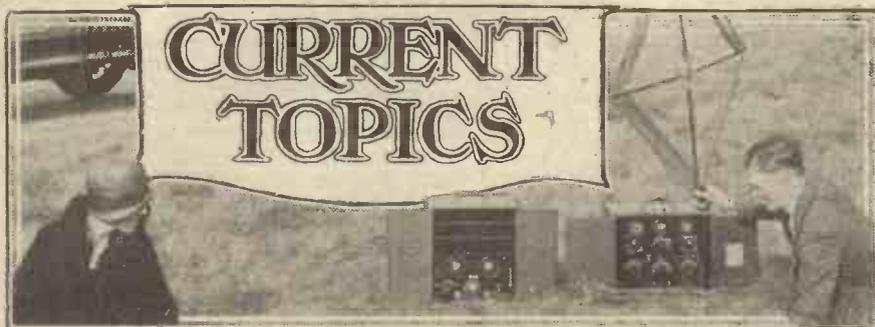
It is useless attempting to test as to whether an accumulator is fully charged by means of a voltmeter; the reading given on open circuit is entirely different

from when the cell is on discharge. The only reliable method is with the aid of an hydrometer. This consists of a glass tube fitted with a rubber teat.

Inside the glass tube, or body, is a small float marked with a scale and sometimes with the words "Fully charged," "Half charged," and "Battery exhausted." A reading is taken by inserting the end of the hydrometer into each filler vent in turn and squeezing the rubber teat. Then draw some of the acid up into the glass body of the hydrometer, and at the same time it will cause the small float to take up a position so that the reading is approximately 1.225.

Another sign that the accumulator is charged is when the acid in each cell assumes a milky appearance, the positive plates turning a rich brown colour and the negatives a slate grey.

On no account should an accumulator be short-circuited. Having practically no internal resistance, it will discharge itself almost immediately, in addition to which the plates will probably be badly buckled.



By THE EDITOR.

THOSE pessimists who have been cherishing the idea that broadcasting was only a craze will be interested to know that on May 1st the number of wireless licences issued was 2,012,000, according to the G.P.O. figures available. How many new licences were taken out as a direct result of the general strike cannot be gauged at the moment, but it is certain that many thousands extra can safely be added to the above figure. There is not the slightest doubt that the general strike created a boom in wireless hitherto unknown in this country.

Broadcasting has now definitely proved itself a national institution. Mr. Baldwin has given it his blessing, and Mr. Reith, as Managing Director of the B.B.C., has shown that in the right hands it can play an extraordinarily important part in the conduct of affairs in times of emergency.

**"Only a Game."**

But it is curious to note in the "Morning Post" a report that only just before the strike a distinguished politician observed, apropos of the broadcasting report: "Why bother about it; radio is only a game for children." That distinguished politician must be feeling rather foolish these days with the evidence of the importance of broadcasting so ably demonstrated during the general strike. And even though he made this remark before the general strike, if he did not feel foolish himself, other people must have thought how foolish he was, for broadcasting has revolutionised modern ideas of entertainment; it has brought beautiful music and an appreciation of other things beautiful into the homes of hundreds of thousands of British men, women and children, who, before the inauguration of the B.B.C., were deprived of such benefits.

**Growth of Popularity.**

It is a curious thing how people who pride themselves on being cultured and members of the *intelligentsia* adopt a snobbish and condescending attitude towards broadcasting. The explanation, no doubt, is that because a thing is popular it is not worthy of the serious consideration of "superior" serious people; but "superior" persons who adopt this attitude only betray their own narrowmindedness. Such people are really not worth criticising and their opinions on the subject are really of not much value.

The fact remains that broadcasting to-day stands higher in the esteem—and we might almost say in the affection—of the public than at any other time in its career; and however much the intellectual snob may deprecate it, how ever much the superior

person may pooh-pooh its influence, there can be no doubt that the Government have realised at last that in broadcasting there is a power for good or for evil of unprecedented strength; and a power which, if handled properly, can prove of the utmost benefit to the citizens of this country. 2,012,000 people have taken out broadcasting licences. That figure is an extraordinary indication of the growth of the popularity of broadcasting in this country and it is a figure which, during the next twelve months, will

**NEXT WEEK:**

**HOW TO MAKE A "P.W." TWO-VALVE AMPLIFIER.**

Crystal and one-valve set listeners who desire to employ a loud-speaker should construct this instrument. It embodies all modern refinements, including a switch for one or two valves.

**ORDER YOUR COPY NOW.**

undoubtedly be increased until it reaches a total—no one can say how far in excess of 2,012,000.

During the strike 2 LO increased its power and it had been calculated that 2 per cent. more of crystal users were enabled to get in touch with 2 LO and receive the news.

Valve users did not benefit much by this increase in power owing to over modulation, but even with the increase of power it was noticed that certain areas well within the range of 2 LO failed to hear the signals.

Every listener who makes fairly consistent use of his set is familiar with the fact that for no apparent reason at all wireless waves often fade in strength. This variation in the intensity of signal strength takes place chiefly at sunset, and is particularly noticeable on the broadcasting wave bands at distances of from 50 to 200 miles from a station.

**Cause of Fading.**

According to "The Times," recent experimental research has shown that this fading is due to interference effects produced between two waves which arrive at the receiving station from the transmitter. One of these waves is transmitted straight along the earth's surface and is sometimes termed the direct wave. The other wave travels upwards from the transmitter to the higher regions of the earth's atmosphere until at a certain height it is deflected down again, ultimately arriving at the receiving station.

It is thought that in the day time this wave, which travels upwards to the higher atmosphere, is quickly absorbed in the atmosphere due to the influence of the sun-

light, and therefore only the direct or earth waves reach the receiver. This latter wave gives a fairly consistent signal strength during daylight hours, but with the setting of the sun the absorption of the indirect wave is considerably reduced, and owing to the fact that this wave has had to traverse a longer path than the direct wave, it eventually arrives at the receiver in such a way that it detracts from or enhances the effect of the direct wave upon the receiver depending on the actual path or route difference of the waves.

If the two waves arrive together, or in phase, they add together and produce a strong signal, but if, however, the waves arrive at different times—although the difference in time is minute—the out-of-phase effects are noticeable in the form of reduced signal strength.

**Shielding Effects.**

It is thought that as a result of the passage of the indirect wave through the upper atmosphere, a continual changing effect occurs in the receiver so that signals heard vary in intensity. This is a form of fading over which the amateur can exercise no control. Other forms of fading can sometimes be counteracted. For instance, an amateur who erects his set in a low-lying valley surrounded by trees, may find reception, if not impossible, at least very difficult, but he can better the location of his set.

We, in the office of "P.W.," Fleetway House, Farringdon Street, find that distant reception is almost impossible even when using the most powerful receiver. This is due undoubtedly to the masses of steel and ironwork in the building in which the "P.W." rest room is placed, and for that reason we decided to erect an experimental station at Dulwich, a fairly open suburb of London, some seven miles from our London office. Here, with a good 60 or 70 feet aerial and using a receiver of one or two valves, we can obtain results incomparably better than those obtainable even with a powerful super-heterodyne set in the test room at the "P.W." editorial offices.

**Senatore Marconi's Set.**

On the whole, it is rather extraordinary that amateurs in London should obtain such very good results with their receivers when it is borne in mind that the amount of steel and ironwork, telegraph and telephone wires, etc., in the metropolis is very great. It would be thought that the absorption in the heart of London would be so great as to render good reception from distant stations almost impossible.

In this case it is interesting to relate the story of a powerful set which Senatore Marconi uses in his suite of rooms in a famous hotel in London. He finds that even with an outside aerial distant reception is rendered very difficult owing to the amount of steel, etc. in the framework of the building, but luckily there is one clear space facing one of his windows which points exactly in the direction of Rome, and from Rome he can get excellent results. He can receive other signals from continental stations, of course, but when his frame aerial is rotated in the direction of Rome he gets his very best results because in that particular direction, straight through the window, there are no tall buildings or other obstructions which would create fading effects.

# THE ETHER PROBLEM.

Latest Developments in a Great Controversy.

FROM A SPECIAL CORRESPONDENT.

THE scientific world is again in somewhat heated dispute over that most debatable and mysterious substance—the ether of space. Not, of course, that it has ever been in anything but dispute over the ether, but new impetus has been given to the argument by the statement of a well-known American scientist that he has discovered new facts about the ether—facts which tend to refute that portion of the Einstein theory which deals with this medium.

## The Einstein Theory.

It will be remembered that Einstein, in his *The Theory of Relativity*, says that, in effect, the ether is non-existent and is not required in the scheme of the universe. Einstein based his theory largely on the failure of the famous Michelson-Morley

experiment. In this experiment Michelson and Morley endeavoured to find the velocity of the earth through the sea of ether, but failed to find any indication of such motion or any trace of the ether.

## Wave Propagation Difficulties.

Thus the ether theory, of late years, has fallen somewhat into disrepute. In addition to this, about two years ago the late Dr. Steinmetz, basing his statements largely on Einstein's postulations, and on his own research into the matter, stated that light, wireless and other vibrations did not take place in the so-called ether, but in a magnetic field or flux, and that the ether was non-existent and the ether theory unnecessary.

Sir Oliver Lodge took up the cudgels on behalf of the ether theory, and pointed out

that the ether theory was only unnecessary to the Einstein theory, which fact did not make the ether non-existent. Regarding the Steinmetz theory of etherless wave propagation, Sir Oliver Lodge said that Steinmetz had only given the ether another name—that the substance in which Steinmetz had stated the waves took place was still the ether as they understood it.

Since the Einstein theory was put forward, however, the ether theory has gradually lost ground, especially in America, where scientists have shown that there is hardly a single factor pointing to the existence of the ether; and as far as wireless is concerned the Steinmetz theory has been largely accepted. The ether theory was advanced, they say, to explain the wave theory of light which now includes the wave theory of wireless energy.

For instance, if light or wireless energy be propagated in wave formation there must be some substance in which the waves can take place. Sea waves take place in their medium, the sea; sound waves in air, and so on. Obviously light waves could not take place in air, as light will shine through a vacuum—yet there must be some medium, and so this hypothetical substance was called the ether.

Furthermore, although the wave theory of light has been generally accepted for over a hundred years, there is now some doubt that light does travel in wave form, and the same applies to wireless radiations.

The wave theory was put forward principally to explain certain well-known phenomena in connection with light, such as interference. Interference, to explain briefly, occurs when two rays of light on being opposed to each other in a certain manner produce darkness by cancelling each other. The crest of one wave, as it were, fills up the trough of the other, and this can only be explained by a wave formation.

## "Ether Drift" Proved.

On the other hand, recent discoveries seem to indicate that light and wireless may travel in the form of particles or small bundles of energy known as quanta, and eventually this quantum theory, as it is called, may upset the wave theory.

So it will be seen that the ether wave theory hangs on a very slender thread. This thread, however, is now considerably strengthened by the statements of Dr. Miller, President of the American Physical Society, who claims to have discovered what is known as an ether drift, which means that he has found a slight but concrete proof of the existence of the ether. He has discovered what Michelson and Morley set out, but failed to do, forty years ago, namely the velocity of the earth through the ether.

If his statements are fully substantiated by scientific investigation a new era of science will commence, and the greatest secret of our time will approach revelation.

Such a revelation will of necessity be long in coming, for experiments upon such an intangible medium as ether—provided it does really exist—are extremely difficult to carry out, and research upon the subject must take place very slowly. The ether drift measurements need exceptionally delicate apparatus, and a large number of experiments extending over a considerable period of time will be necessary before any definite conclusions can be obtained and Einstein's theory be supported or disproved.



Part of the transmitting gear installed at W J R, a well-known American broadcasting station, which operates on 517 metres.



# The Principles of Wireless Tuning

By Sir Oliver Lodge F.R.S.

This is the fourth of a series of articles by our Scientific Adviser. In this instalment he deals with some special conditions characteristic of the "N" Circuit. THE EDITOR.

**T**HE primary object of tuning in wireless reception is of course selectivity; the aim being to listen to one station and to one station only, receiving and reinforcing the vibrations from that station, and excluding as far as possible everything else. To do that we must use a free vibrator accurately tuned, so that the slightest stimulus of its own frequency will make it respond, and so that it can only be forced to respond to other frequencies when their amplitude is exceptionally great.

No circuit can be quite immune from violent atmospheric disturbances, for they would force anything to vibrate in a momentary manner. Nevertheless, the smaller the connection between the collector and the resonating circuit the less likelihood is there of extraneous disturbances having any deleterious effect.

We cannot indeed use only the very summit of the peak of the resonating curve when that is very high and narrow, for there has to be a certain margin allowed for fluctuations of frequency at the sending station. The modulations of the carrier wave imposed upon it microphonically (which fluctuations must be received for good intonation, though they are extremely small) are not quite negligible. They are sometimes spoken of as "band frequencies," and a certain proportion of these must be admitted. Hence it is possible, though not easy, to get the tuning too sharp.

### A Free Vibrator.

In practice, however, this does not involve any real difficulty. The resonating curve, if very slightly reinforced, is broad enough to give all that is required, and yet is narrow enough to exclude stations of even a slightly different permanent wave-length.

In the N circuit arrangement therefore we use a very sharply tuned perfectly free vibrator, and the slight reinforcement needed is secured by a device which does not look like reinforcement at all. There is nothing that could be called reaction, and there has to be not a trace of magnetic coupling. The more any such coupling is avoided the better, for when that is introduced the circuit is not completely free.

Undoubtedly the circuit must be connected to the grid of a valve; but a single connection suffices, and it acts on the grid only when by resonance the oscillations

have been worked up to a sufficient amplitude. To prevent the easy transmission of inaccurately tuned impulses, the condenser in the resonating or N circuit is kept small, and the inductance part of the circuit is big, so as to act as a choke to anything which is incompetent to work up oscillations of the desired frequency in the N circuit.

### Connecting the N Circuit.

Then comes the question of how to connect the N circuit to the aerial collector. It would seem at first as if a single connection, with one and only one wire, between the aerial and the N circuit could not possibly work; and there seems no reason why the collected waves, having already a free path to earth, should give off part of their energy in a direction without any destination in rection, especially if the wire is interrupted by a small choke which puts a their obstacle in of lateral transmission.

Nevertheless, I found long ago in experiments on lightning

conductors that when oscillations were going on in a completely short-circuited conductor of perfect conductivity, even though it were a copper rod an inch thick, that a side flash could be taken from it, not only to something connected to the earth, but to a knob or sphere or other conductor which was completely insulated.

### Peculiarities of H.F. Impulses.

Such a side flash does not charge an insulated conductor: the flash consists of both charge and discharge; the potential is momentarily raised and immediately lowered again; so that even if the insulated conductor were a gold-leaf electroscope, receiving a spark (say) half an inch long, it would not be affected. The charge lasts so minute a fraction of a second, less than the millionth of a second, that gold-leaves have no time to diverge before they are neutral again.

In the same way it is known that very high-frequency alternations do not affect the nerves. Such a current can be transmitted to the human body, or can be applied to the nerve-muscle preparation of a frog's leg, without stimulating the nerve or producing any sensation, because the current is reversed again so quickly that the nerves have no time to respond.

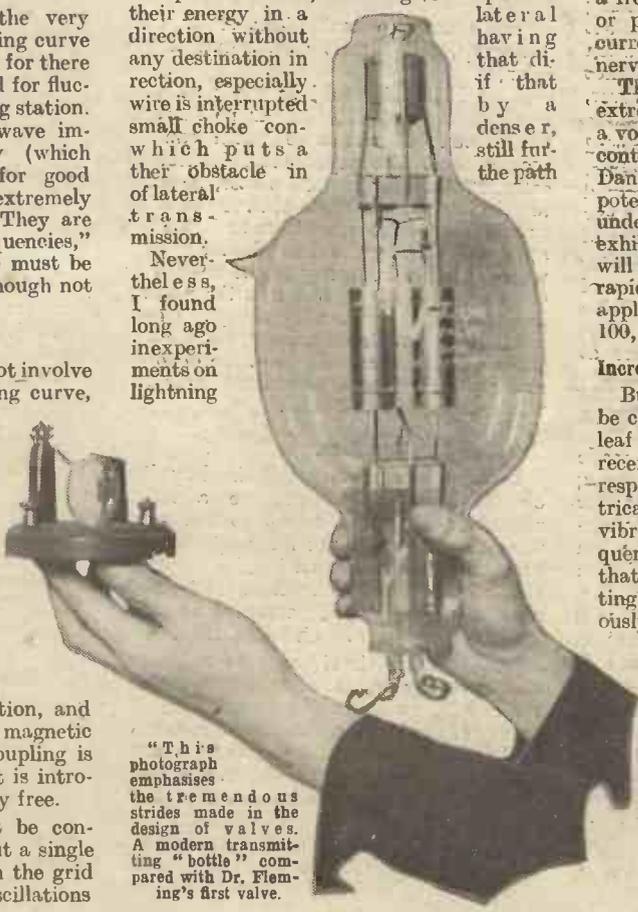
The nerve receiving the impulse may be extremely sensitive, even to the fraction of a volt; and the muscle attached to it would contract violently with a small fraction of a Daniell cell conveyed to it through a potentiometer. And yet the same nerve under the same circumstances will fail to exhibit any disturbance—that is to say will be unable to stimulate the muscle when rapid alternations of millions a second are applied to it, even though the potential is 100, or even 1,000 volts.

### Increased Amplitude.

But if, instead of employing what must be considered a slow responder like a gold leaf electroscope or a nerve, we employ as receiver a free resonator which has not to respond mechanically at all, but only electrically, then, when that free electrical vibrator is exactly in tune with the frequency of the applied alternations, then to that particular frequency the freely vibrating circuit will respond easily and vigorously.

The oscillations, being exactly in time, will accumulate and work up to an amplitude far beyond that of the disturbance applied. The applied alternations may be quite feeble, while the responding or worked-up oscillations are vigorous.

That, then, is the principle which we employ. The N circuit thus slightly connected as a lateral appendage



"This photograph emphasises the tremendous strides made in the design of valves. A modern transmitting "bottle" compared with Dr. Fleming's first valve.

(Continued on next page.)

**WORK AT  
2 D A.**  
The "P.W." Experimental  
Station.  
(By the Engineer in Charge.)

2 D A is now quite often on 45 metres and would be very pleased to have reports from readers who hear the signals on this wave-length.

Some trouble was at first experienced when it was decided to employ this shorter wave. As a rule, 90 m. is the normal wave-length of 2 D A, and it was found that the aerial used for 90 m. work was not at all suitable for the lower wave-length of 45 m. Since it was desired, however, to use not only the 45 m., but also the 90 m. and 150-200 bands, an aerial had to be employed which would work equally well on each of these wave-lengths. After several experiments, it was found that an ordinary inverted "L" aerial, 60 ft. high by 70 ft. long, single strand, was the most satisfactory. For the 90 m. wave, a series '0003 condenser is required, but no series condenser is needed for the other waves.

**Telephony Tests.**

To begin with, a "Hertz" aerial was tried. This aerial was excellent on all wave-lengths excepting the one it was designed for! It was designed for 45 m., being 22½ m. long, the nearest to 45 m. which it would function was 30 m.! Even when considerably lengthened, it would not oscillate much above 32 metres. However, on 90 m. it worked splendidly.

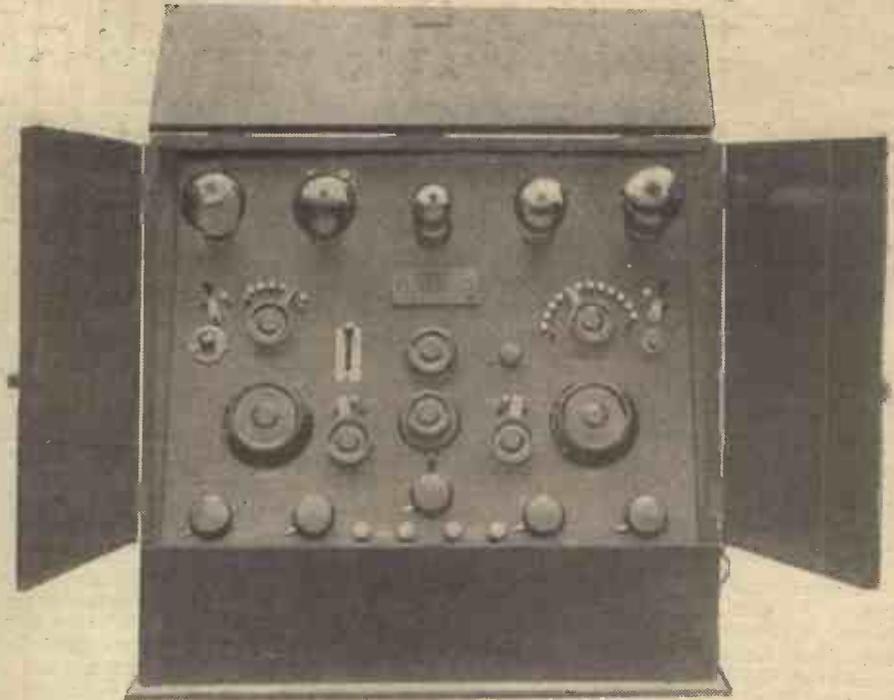
Several telephony tests are now carried out each week-end on 150 to 155 metres, and reports are particularly welcomed on these transmissions as only low power is used for the telephony side of the transmitter.

It is hoped soon to arrange a series of tests with several stations in U.S.A.; 90 m. will be the wave-length for these tests and will most likely take place at about 3.30 a.m. three days a week.

**Interesting Valve Experiments.**

Recently, several tests have been made with various well-known types of receiving valves, used as transmitting valves, for powers not exceeding 10 watts; the following valves are particularly suitable when only a low H.T. voltage is available: Osram L.S.5, Mullard P.M.3, B.T.H. B.4, B.T.H. B.6. All these valves work well on 200 volts H.T. and, with the exception of the L.S.5, they will take as much as 800 volts H.T., although the makers specify lower anode potentials. It is understood that the Mullard P.M.3 can also be had with a special base, making the valve even more suitable for a low powered transmitter.

By the way, 2 D A has cards for the following, which will be forwarded on application: G.610, G.5 S Y, G.2 A Y M, G.2 G C, G.2 B E R, G.2 X A S.



A five-valve set constructed by Mr. F. W. Phillips, of 41, Marine Avenue, Hove.

**PRINCIPLES OF  
WIRELESS TUNING.**  
(Continued from previous page.)

responds only to oscillations of its own frequency, and those by resonance it reinforces.

If an N circuit could be made without any resistance at all, there is no limit to the amount of resonance which can be accumulated. The response ratio is theoretically infinite; for in such a case, in order to calculate the amplitude of the responding or excited vibrations, we have to divide the applied E.M.F. by the denominator  $p^2 - n^2$ , where p is the frequency of the applied or collected oscillations, and n is the natural frequency of the resonating circuit. Hence when these two frequencies agree, that is when n is tuned exactly to p, the denominator  $p^2 - n^2$  is zero, and accordingly the whole expression is infinite.

**Practical Considerations.**

In other words, an infinitesimal applied oscillation will then produce a finite response; or, what comes to the same thing, a very small but finite applied disturbance will produce an infinite response. Hence an oscillating circuit with no resistance at all is infinitely sensitive to oscillations of precisely its own frequency.

That such a circuit of zero resistance could actually be made is not theoretically impossible, owing to the astonishing discovery of the late Dr. Kammerlingh Onnes, of Leyden, that certain metals at a temperature of liquid helium (only two or three degrees above the absolute zero of temperature) become perfect conductors. I fully anticipate that some day, as a curious laboratory experiment, a resonating circuit at a temperature close to absolute zero will

be tried; and I expect that such a circuit, however feebly stimulated, will respond and work up its oscillations to such a pitch that it will give sparks. Indeed, many remarkable experiments could be made if a really perfect conductor were available.

Returning to practical considerations, no such circuit is likely to be used, nor is it necessary. For, though any practical circuit must have resistance, yet that resistance can be kept small, and then a very small amount of regeneration will suffice to overcome the residual resistance and enable the circuit to work up its oscillations to anything short of self-exciting amount. We do not want a particular circuit to go on vibrating, any more than we want a piano string to go on vibrating when struck. We want it to respond and then cease, so as to be ready for the next impulse.

Hence there must be a certain amount of damping. The amount of regeneration must be kept slight, just enough to assist it to respond, and yet allow it to die out immediately afterwards.

The outcome of all this is that our N circuit is connected to the aerial in such a way that at first sight it would seem incompetent to respond at all, and it is regenerated in such a way that anyone would say there was no regeneration at all. We make use only of the feeblest lateral impulses, taking care that they shall never exceed a small value, and thereby obtain exceptionally clear and undistorted and selective results.

It must be understood that not every coil will oscillate satisfactorily as a free circuit without apparently adequate stimulus. If coils are tried at random, some will fail. In other words, some of the methods of winding in vogue serve the purpose, while others do not. To act satisfactorily, coils and condensers must be properly chosen, and other practical details attended to, on a basis of experience.

# The MILAN Broadcasting Station



A general view of the aerial at the Milan broadcasting station.

IN the very centre of Milan, forming the focus of the commercial life of that important and romantic city, stands the immense broadcasting station, located in premises loaned to the Unione Radiofonica Italiana, the great Italian concessionaire company for radio broadcasting throughout the kingdom. The station is situated in Corso Italia, in the same premises as those occupied by the Adriatic Insurance Company.

The aerial-earth system is formed of a tubular antenna and a counterpoise. The masts are 100 and 120 feet in height, and were built by Messrs. Pasqualin and Vienna, a local company specialising in this class of work. The aerial is about 80 feet long and the down lead 90 feet. The counterpoise is formed of 80 crossed wires held by four longitudinal conductors, forming a slender network which reaches to a height of 65 feet above the ground. The counterpoise is situated in the court of the building. Because of the height of the counterpoise from the ground, the radiation resistance was very high on a fixed wave-length of 337 metres. Several attempts were made to reduce this resistance to a normal value. This was afterwards achieved by fitting in its place the Alexanderson system—i.e. by supplying the aerial with another down lead at its free end, and connecting it to the counterpoise across an inductance of a convenient value. In this way the aerial works in the manner of two in parallel, and a normal transmitting intensity of 13.5 amperes is obtained, which can be increased to 15 amperes if necessary.

### The Transmitting Apparatus.

The transmitter, which is placed 65 feet above ground, is of the Western Electric 6A 1,000-watt type. A Kone loud speaker is employed for taking aural observations of the quality of the transmission, and is connected to a detector valve mounted on a small aerial in the same building. The water for cooling the transmitting valves is taken directly from the main distribution in the building; but, as a reserve plant, which, however, is not visible in the illustrations on pages 518 and 521, a group of motor pumps are adopted which bring the water into a small tank through a conduit furnished with a vacuum fan.

The conductors supplying the current for the transmitter are contained in iron tubes; these, earthed at the joints, descend to earth, and then pass up the elevator pit, and reach the transmitter in the adjoining building.

On the switch-board are mounted the starter, main switch, and various fuses. The instruments are not controlled in this room. "Tungar" rectifiers are supplied for charging the accumulators and heating the microphone amplifying valve. The cabinet mounted on the wall near the switch-board contains the switches controlling the above-mentioned batteries.

### The Generators.

The motor-generator set is for a high-tension supply; the power is 8 h.p., and the two generators give each 2,000 volts. The first generator delivers the high-tension current for the three valves of the transmitter, while the second provides the high-tension for the water-cooled power valve.

The most important commercial city in Italy is now possessed of one of the most complete and well-equipped stations in Europe.

FROM OUR SPECIAL CORRESPONDENT IN ITALY.

The 4 h.p. group supplying the filament current from the transmitting valves gives also negative grid bias.

The speech input equipment is composed of a 3-valve amplifier and a control panel.

### Studio Arrangements.

In order to reduce the intervals between producing one piece and another, there are two studios—one large for orchestral selections, and the other small for solos and speeches. In the smaller studio, placed in the middle of the partition-wall, is a lamp, which, when lighted, gives the signal that the microphone is connected in circuit. There is also a large ante-room, which serves as a waiting-room for artistes, and in which is fixed a loud speaker in the same circuit as that of the amplifier.

The studios are not "blanketed" indiscriminately; the draperies are arranged so that a certain amount of echo is allowed. This is, of course, essential if natural tones are to be transmitted. It will be noted in the photographs that the ceiling of the main studio is only partially covered with draperies in order to obtain the above effect.

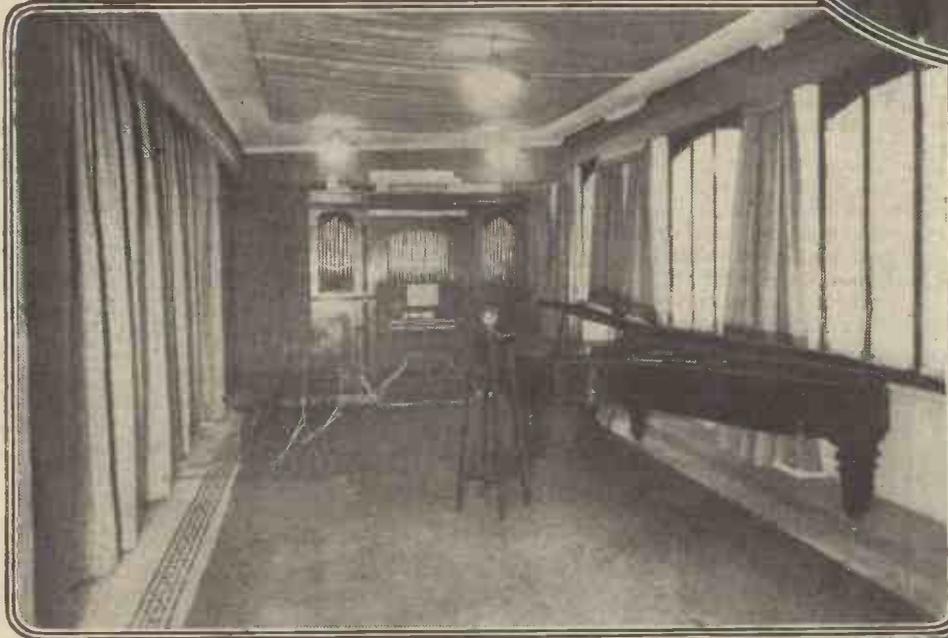
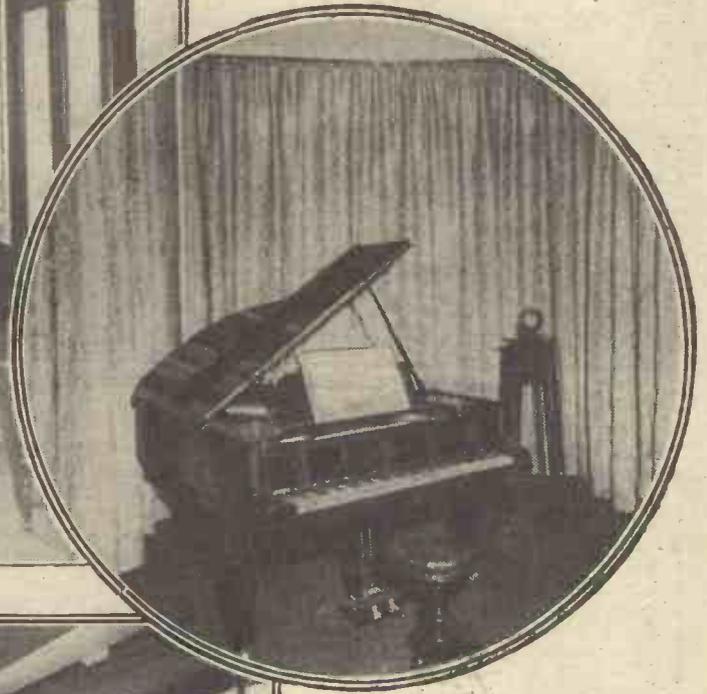


A view of the main studio at the Milan broadcasting station.



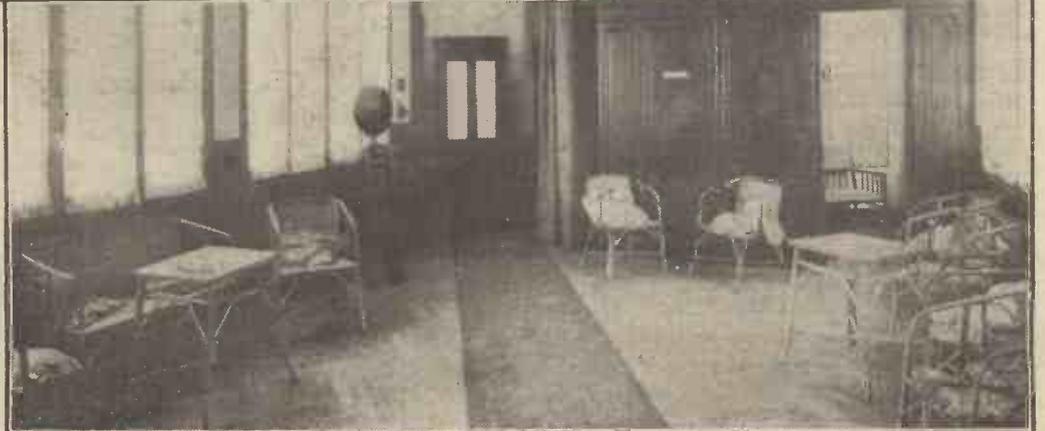
The artistes' waiting-room at the new Milan station.

The special piano studio. Special draperies are used for damping, and the piano microphone can be seen in the background.



Left, the main studio at the Milan station. A special organ for broadcasting has been installed.

Right, another waiting-room at the Milan station.



# To 6-Volt Users -

BETTER RESULTS AT  
A SIXTH OF UPKEEP COSTS

## Osram D.E.8.

(H.F.) for 6-Volt Accumulators (L.F.)

Only 0.12 Amp. Filament  
current consumption at 5.6 Volts



**Characteristics :**  
H.F. Type.

Filament Volts	- - -	5.6-6.
Filament Current	- - -	0.12 amps.
Anode Volts	- - -	40-120.
Impedance	- - -	25,000 ohms.
Amplification Factor	- - -	16.

**Characteristics :**  
L.F. Type.

Filament Volts	- - -	5.6-6.
Filament Current	- - -	0.12 amps.
Anode Volts	- - -	20-100.
Impedance	- - -	8,000 ohms.
Amplification Factor	- - -	7.

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OUT OF YOUR SET

With a 6-volt accumulator, use  
D.E.8 OSRAM VALVES  
(D.E.8 H.F. as Detector).

Use an OSRAM D.E.5 Power  
Valve in the last stage.

THE introduction of the D.E.8, H.F. and L.F. OSRAM VALVES is a big advance in 6-volt valve construction. As D.E.2 OSRAM VALVES have established an unassailable reputation for better 2-volt reception, the D.E.8 types now come to the aid of 6-volt accumulator users.

D.E.8. OSRAM VALVES enable you to change over from extravagant bright emitter valves to dull emitter 6-volt valves consuming one-sixth of the current consumption with no alteration to your filament rheostat. They provide better characteristics which make for louder and clearer reception, and the maximum sensitivity for getting distant stations. Accumulator expenses are reduced to a fraction of what they ordinarily are with definitely a big increase in efficiency. It is NOT now necessary to maintain a bulky 6-volt accumulator to operate satisfactorily a 6-volt valve.

As a sensitive Detector the D.E.8. H.F. OSRAM VALVE is unsurpassed, and the addition of a "Neutrodyne" H.F.

Amplifier brings in the most elusive and distant stations with remarkable ease and volume.

For more volume, greater purity and lower running costs, use the D.E.8. L.F. as a low-frequency amplifier. It may also be used as an exceedingly economical small power valve.

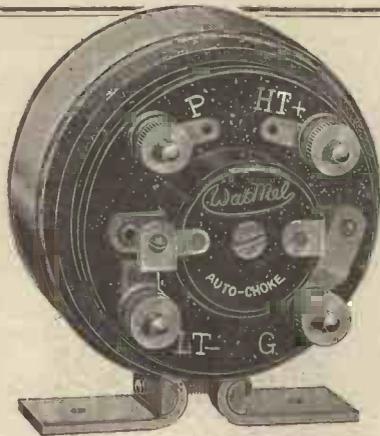
From the time D.E.8. OSRAM VALVES are first put into service until their veteran days, they give the same satisfying volume and tone. By using OSRAM Dull Emitter Valves you are assured of a constant unvarying electron emission throughout a long and useful life. Behind them is the longest experience in the manufacture of dull emitter valves in the country.

PRICE 22/6 EACH

# Osram Valves

for Broadcasting

The G.E.C. - your guarantee



**STRAIGHT AS A DIE!**

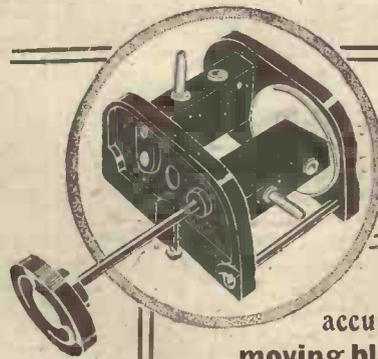
The amplification curve of the Watmel Auto-Choke — literally as straight as a die — speaks for itself. It tells of unsurpassed purity of tone — of whispers built up into voluminous sound. It reveals, as plainly as can be, the way to natural-toned reproduction without sacrificing an iota of volume. Unlike most chokes, the Watmel Auto-Choke, by virtue of

its patent core and specially balanced windings, gives a step-up increase in volume equal to a transformer-coupled stage of low frequency. Price 18/6.

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Two Types:—  
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 Two-way ..... 7/-  
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**Tuning is accurate because the moving block cannot fall**

Holds the heaviest coil securely in position and prevents the fading away of volume. The vernier movement consists of three sets of enclosed precision machine cut gears and reduces the speed of the moving coil block by eight times.

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**LOTUS**  
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**COIL HOLDERS**

**Garnett, Whiteley & Co. Ltd.**,  
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Makers of the new Lotus Buoyancy Valve Holder.

Bakelite mouldings for the side plates, coil blocks and knobs — heavy nickel-plating for the metal parts

**The NEW "BEST WAY" Guide for Wireless Constructors**



Details of the three splendid sets described in this "Best Way" Wireless Guide are given below. The book is amply illustrated with photographs and diagrams, and constructors will find the wiring directions most lucid and straightforward.

**The All-Station Loudspeaker Portable**

A remarkably compact six valve SUPER-HET. Aerial, batteries and loudspeaker all completely enclosed and permanently connected. This receiver will appeal strongly to motorists, Caravanners, River Parties, and seaside Bungalow-inhabitants.

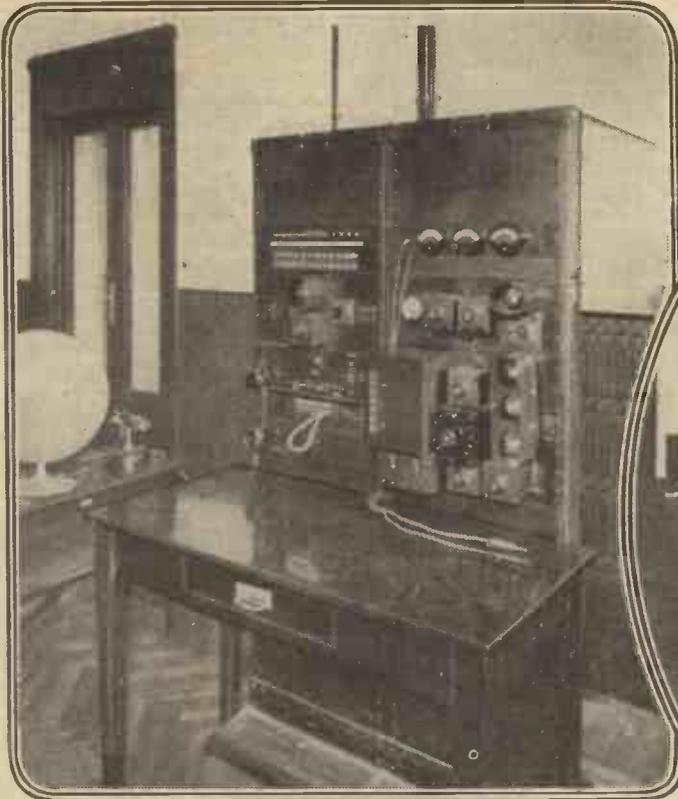
**A Three-Valve Portable**

Several stations on the loudspeaker and many on Telephone receivers can be obtained with this receiver. It employs a frame aerial which is built into the lid of its neat carrying case. It will prove popular among Motor Cyclists and other Road and River Tourists.

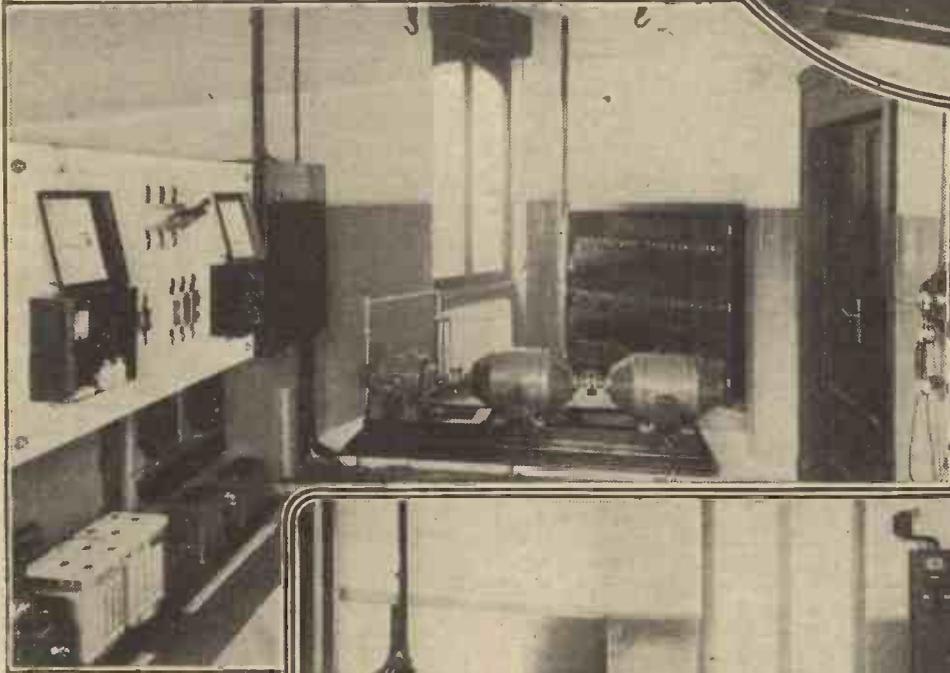
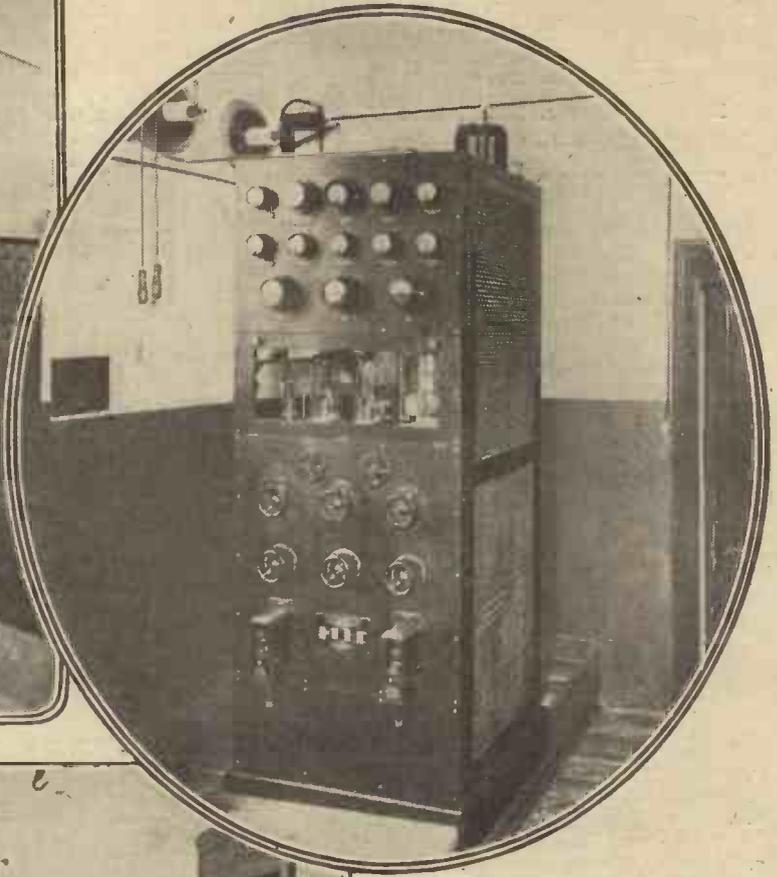
**The Baby Portable**

A two valve receiver contained in a very small attache case. Batteries and telephone receivers are enclosed and a reel of wire and earth pin for erecting temporary aeriels are provided. This is the set for the Cyclist Holiday Tourer.

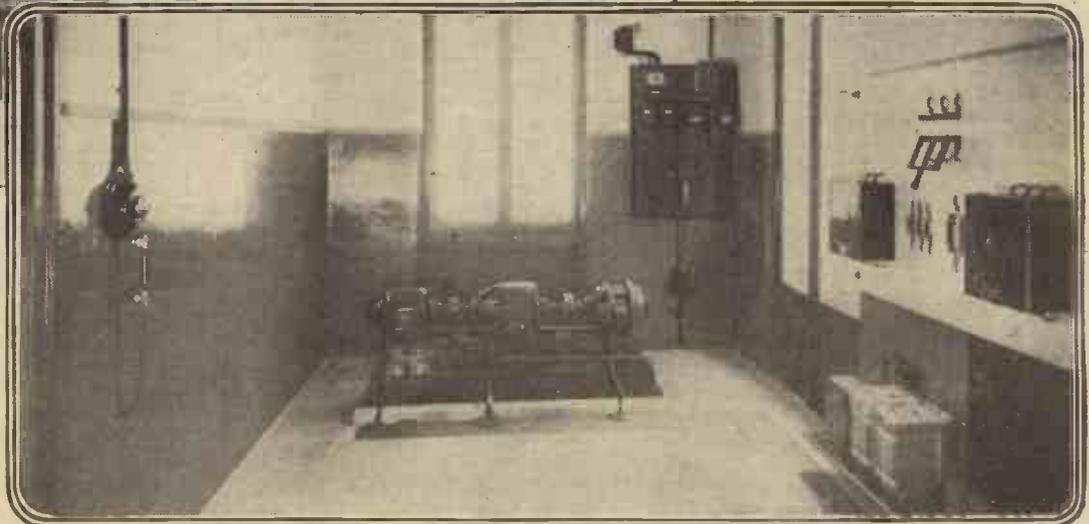
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The control switchboard.



Above, the transmitting panel and lead-in insulators. Left, the accumulator room and charging plant. Below, another view of the accumulator room.



These photos have been supplied exclusively to "P.W." by our special correspondent in Italy, Mr. P. F. Martin F.R.G.S.

## L.F. BY-PASS CONDENSERS.

An Article of Interest to all  
Amateurs.

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

MOST amateurs are familiar with the fact that a large "Mansbridge" type condenser should always be connected across the H.T. terminals of a valve receiver. The object of this condenser, is two-fold. First, to act as a "reservoir," the stored energy in which serves to smoothe out the direct anode current, and thereby to avoid the distressing "crackling" which is so apt to develop (and is often wrongly attributed to "atmospherics") as the H.T. battery gets past its first youth. Secondly, the condenser will often actually improve signal strength by affording a comparatively low impedance path to the L.F. impulses, which would otherwise have to overcome the resistance of the H.T. battery.

### When Using Separate H.T.'s.

For both these purposes a large condenser is required, and a capacity of 1 to 2 mfd. is generally recommended.

Although most sets nowadays are provided with such a condenser across the whole H.T. battery, it is not so common to find the really correct method of bridging each section of the battery employed. The old inefficient practice of providing but one pair of H.T. terminals on a multi-valve set is happily fast becoming obsolete. But many sets, though fitted with taps allowing of the correct voltage being applied to each valve, leave those of the detector and H.F. unbridged. A moment's thought will show that this is wrong. For the positive plate of the condenser across the L.F. (or highest) voltage is separated from the lower taps by a large section of, perhaps, high resistance, cells, and the smoothing effect (to say nothing of the by-passing) is therefore destroyed so far as those valves are concerned. The proper arrangement for a "standard" three-valver is as shown in the Fig.,  $C_1$ ,  $C_2$ , and  $C_3$  being the Mansbridge condensers for H.F., Det., and L.F. anodes respectively.

### Protecting the Loud Speaker.

Ideally, all three condensers should be as large as possible. But actually, the current to be smoothed in the H.F. and Det. stages being less, it is often quite satisfactory (and, of course, more economical, both in cash and space) to use smaller (say .25 mfd.) condensers here. But .25 mfd. should be regarded as a minimum, since smaller sizes do not by-pass the L.F. currents satisfactorily.

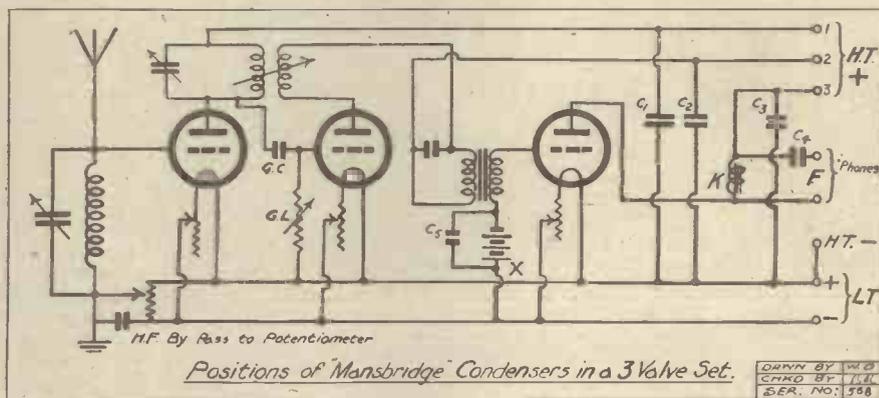
A second use for the .25 (or larger) Mansbridge condenser as an L.F. by-pass is in connection with a "filter" circuit. Where a high resistance loud speaker (or 'phones) is used on a multi-valve set, and with a high anode voltage on the last valve, such a filter should always be fitted. The arrangement is shown in the Fig. at F,  $C_4$  being the Mansbridge condenser, and K an iron-cored choke. Any high inductance coil

will do for the latter, the function of which is simply to allow the passage of the D.C. from the H.T. battery, while preventing, so far as possible, that of the L.F. impulses, which then travel through the condenser and loud speaker. The sound winding of a burnt-out L.F. transformer makes as good a choke as anything. In addition to protecting the delicate windings of the loud speaker from damage by the heavy D.C., the filter circuit serves to prevent distortion due to the magnetic saturation of the iron pole pieces. It will thus be found that surprisingly loud signals can be effectively handled, even by quite a small instrument.

### An Unusual Arrangement.

So much for the anode circuits. But there is one point in the grid circuit of an L.F. valve where a .25 mfd. condenser has not (so far as the writer knows) before been

advocated, but where he has found it of great service in improving both strength and quality of signals, viz., across the grid bias battery. It is assumed that every up-to-date amateur invariably uses grid bias for telephony reception. If he does not he cannot hope for good quality of strong signals. As a rule the cells are fitted in the position shown at X in the Fig. They are generally of small size, often old and of high resistance. So that the arguments for a by-pass condenser here are only less than for one across the H.T. battery because the number of cells is less. But with modern power valves the grid bias may be anything up to 25 volts or so, and the resistance losses in such a battery may be considerable. The writer now always (even with grid bias as low as  $4\frac{1}{2}$  volts) uses a .25 mfd. condenser in this position ( $C_5$  in Fig.) with markedly good effect.



## TRANSFORMER CONNECTIONS.

THERE are four different ways of connecting any transformer into an ordinary straight circuit, any one of which may be much better than the other three. This applies more especially to L.F. transformers, but cases often occur where a great deal can be gained by reversing the connections of an H.F. transformer, so if either of these components is in use in your receiver, it is a good plan to make sure that it is connected the best way round for results.

The importance of correctly relating the connections has lately been realised by manufacturers, and a good many transformers are now plainly marked before leaving the factory, to indicate how they should be placed in circuit. When the instrument is labelled "P.," "G.," "H.T. Plus," and "G.B." (in the case of an L.F. transformer) it is obvious that the corresponding connections are to plate (generally via the reaction coil), grid, H.T. +, and to the grid bias tapping. But when the transformer markings are merely "O.P.," "O.S.," "I.P.," and "I.S.," it is quite probable that it has been connected up in such a manner that, whilst it is now working as far as getting signals through is concerned, it might be working very much better.

Not everyone knows the meaning of O.P. and I.P., and even when the owner is

aware that these letters stand respectively for outside primary, and inside primary, he is not able to say from this which of these is the better to connect to H.T., and which to plate, nor whether I.S. or O.S. should go towards grid. There is no rule which can cover all cases, owing to the variations in manufacture, so it is as well to try all the four ways, to see which gives best results.

### Where Care is Necessary.

The easiest way of doing this is to provide the four transformer terminals with four suitable lengths of flex, and change the connections over systematically. Needless to say neither of the primary leads should be confused with the secondary ones, or you may short the H.T. battery, and possibly burn out a valve. To avoid this possibility, take out the H.T. negative plug before every change-over is made.

Commence by connecting O.P. to plate, and I.P. to H.T., and then complete the secondary connections first with I.S. to grid, and then with I.S. to L.T. (or the grid-bias tapping, if used). Having tried these two ways, and carefully noted which is better, alter the direction of current through the primary by transferring I.P. to plate and O.P. towards H.T. Then I.S. and O.S. should be changed over again as before, noting which way gives maximum results. Finally, the latter connection should be compared with the one giving best results when O.P. is connected to plate, and this comparison will decide which is the best connection for the transformer in your receiver.

IN spite of its many virtues, the valve amplifier appears to have a rooted objection to what may be called team work. Taken alone, or in the standard tandem combination, H.F., detector, L.F., it is fairly easily managed, but the addition of any further stages, particularly on the H.F. side, produces decided instability and a distinct tendency to get out of control.

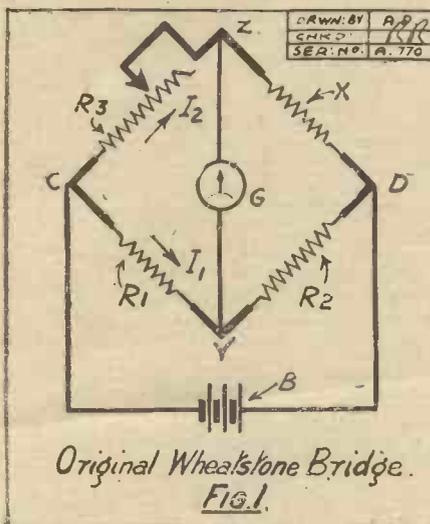
# RADIO-FREQUENCY BALANCERS.

## FROM WHEATSTONE BRIDGE TO NEUTRODYNE.

By **SEXTON O'CONNOR.**

### Action of the Bridge.

Until recently, two successive stages of tuned or transformer-coupled H.F. amplification made quite a formidable combination to handle, but the introduction of radio-frequency balancing methods, such as employed in the well-known neutrodyne circuit, has placed the whole problem on a



diagonal of the square, and a sensitive current indicator, such as a galvanometer, G, is connected across the other diagonal. The resistance  $R_3$  is made variable, as indicated by the sliding contact.

In using the instrument for measuring the Resistance X, the slider  $R_3$  is adjusted until the galvanometer G gives a zero indication. The resistance  $R_3$  is calibrated so that its adjusted value can be read off, and the value of resistance X then bears the same ratio to the resistance  $R_3$  as  $R_2$  bears to  $R_1$ . If the two latter are equal, X is obviously equal to the adjusted value of  $R_3$ .

Assuming for the moment that the indicator G is disconnected, then the current from the battery B divides into the two paths  $R_1, R_3$  and  $R_2, X$ . If the resistances  $R_1, R_2$  are equal, the voltage at the point Y, due to the passage of the current  $I_1$ , will be half that of the battery. Similarly, the point Z will be at half the battery voltage if  $R_3$  is equal to X.

Under these conditions the points Y, Z will be at the same voltage, and no current will pass through the indicator G when this is again connected up.

The important point to notice here is that when the balancing adjustment is once made, the indicator G and the battery B are "dissociated" one from the other. Any alteration in the battery circuit, such as changing its voltage or reversing its connection, will produce no effect on the indicator.

### Balancing Capacities.

If, for instance, the battery is reversed fifty times per second, thus converting it into an alternating source, there is still no effect on the indicator. Moreover, if other resistances or impedance elements, such as inductances or condensers, are substituted for, or connected in series with, the indicator G, these added elements will not be affected by any alternating potential applied in place of the battery B.

This is so because the voltage at Y remains equal to that at Z, and there is therefore no tendency for current to pass through any circuit connecting them. It is also interesting to note that the balance is reciprocal, voltages applied across the points Y, Z producing no effect on a circuit connecting the points C, D.

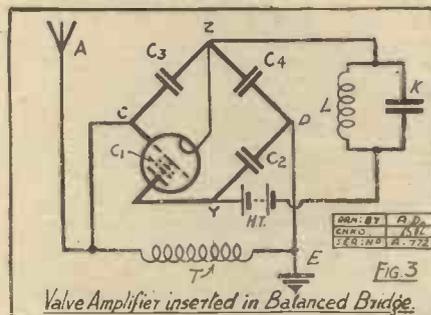
An equivalent capacity balance is shown in Fig. 2. Condensers  $C_1, C_2, C_3, C_4$  are connected in the sides of the square, whilst an alternating voltage (such as that from the secondary coil of a transformer T) is applied across the diagonal CD. As before, the alternating current divides into two branches,  $C_1, C_2$  and  $C_3, C_4$ . If  $C_1$  is equal to  $C_2$  and  $C_3$  to  $C_4$ , then the voltages at the points YZ will both be midway between

those at C and D. Consequently, there is no tendency to produce a current through any circuit (such as the tuned loop KL) connecting the points Y, Z. The condition for balance is that the ratio of  $C_1$  to  $C_2$  must be the same as the ratio of  $C_3$  to  $C_4$ . Precisely the same conditions hold good if the capacities are replaced by inductances.

The direct application of the balancing principle of the Wheatstone bridge

in the case of the neutrodyne circuit will now perhaps be clear from the following explanation.

It is well-known that self-oscillation is set up by the back-coupling of the plate circuit of a valve to the grid circuit, through the electro-static capacity existing between the electrodes inside the bulb. In order to



avoid this trouble, steps are taken to completely dissociate the grid and plate circuits.

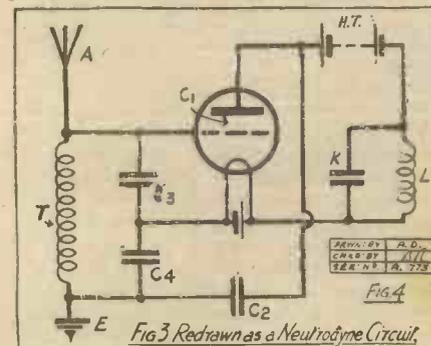
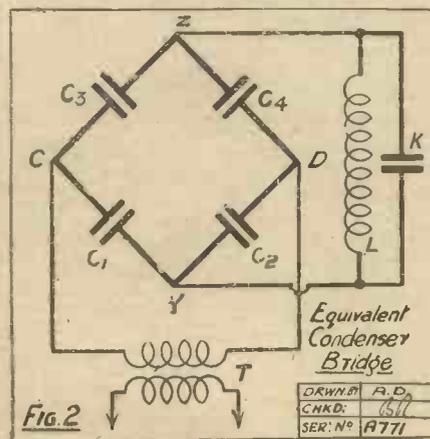
### Origin of the Neutrodyne.

With this object the grid input circuit, as shown in Fig. 3, is connected across one diagonal CD of the bridge (taking the place of the transformer T of Fig. 2) and the plate circuit across the other diagonal ZY (in place of the circuit LK of Fig. 2). The condenser  $C_1$  is replaced by the internal grid-to-plate capacity of the valve, the grid being connected to C and the plate to Y. As LK is to be the plate circuit and one end is already connected to the plate at Y, the other end must be connected to the

new footing. The new methods are, in fact, derived from the well-known principle of the Wheatstone resistance bridge, although the direct connection between the two does not at first sight appear obvious.

The resistance bridge was originally devised for the purpose of measuring resistances. Essentially it comprises three resistances,  $R_1, R_2, R_3$  (Fig. 1) of known value arranged to form three sides of a square, the unknown resistance X occupying the fourth side.

A battery, B, is connected across one



filament at Z. The presence of the H.T. battery in the plate circuit does not affect the balance of the bridge, as it has a negligible H.F. impedance.

The capacity  $C_2$  becomes the neutrodyne or balancing condenser, and the capacities  $C_3, C_4$  are connected in series across the input coil T. The circuit as redrawn in (Continued on next page.)

## RADIO-FREQUENCY BALANCERS.

*Continued from previous page.*

Fig. 4 can more readily be identified as one of the standard forms of the neutrodyne circuit.

The condition for balance is that the ratio of  $C_3$  to  $C_4$  must equal the ratio of  $C_1$  to  $C_2$ . Accordingly, if the condensers  $C_3$  and  $C_4$  are equal, then the balancing condenser  $C_2$  must be equal in value to the inter-electrode capacity  $C_1$ . In practice it is usual to add to the value of  $C_1$  by including a small additional condenser across the grid and plate, so that the neutrodyne or balancing condenser  $C_2$  is increased to manageable dimensions.

It should be remembered that the above considerations apply independently of the ordinary thermionic amplifying action of the valve, being concerned with the effects of capacity coupling only. The balance obtained is accordingly effective whether the electron stream is present or not—i.e. whether the valve filament is hot or cold.

### Preventing Interference.

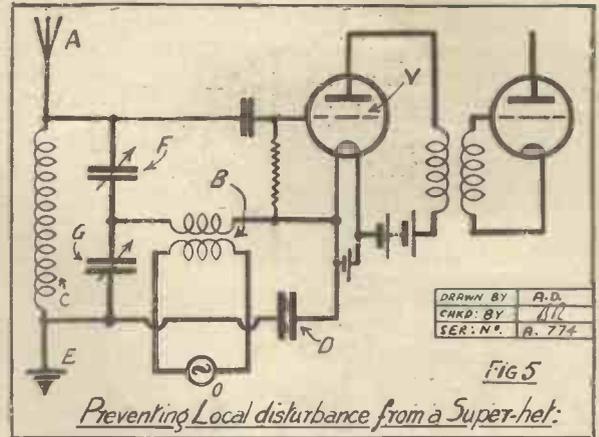
The "radio-frequency balance" is also used in the latest arrangements for preventing local disturbance from a receiving aerial due to oscillations generated in the receiving set for the purpose of heterodyning the incoming waves. This is a problem of particular importance in connection with superheterodyne receivers. The local

the grid (through the usual grid condenser and leak, if the valve is to rectify), and the earthed end of the coil, C, is connected through a capacity, D, to the filament.

This capacity should balance the grid filament capacity and may, in the case of a detecting valve, be shunted by a high resistance to compensate for the grid-filament resistance of the valve.

The circuit is redrawn in Fig. 6 as a balanced bridge, with the input coil, B, for the local oscillations connected across one diagonal, and the aerial-earth capacity and inductance coil, C, connected across the other. The condenser, D, is in one arm as a balance to the grid-filament capacity of the valve, and the divided capacities F, G form the other two arms.

If F and G are equal, then the condition



for a true balance is that the capacity of D should equal that between the grid and filament. Once this balance is struck, the aerial circuit is dissociated from the local input coil, B, and any H.F. energy flowing in this coil cannot be communicated to the aerial.

## 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.

### UNIDYNE SHORT-WAVE SET.

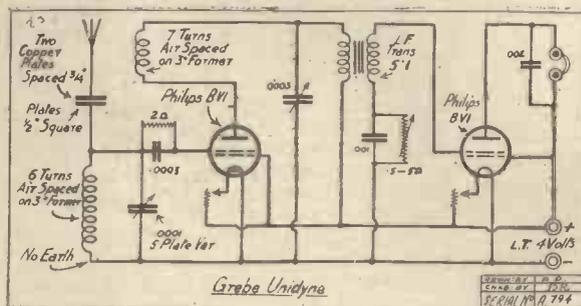
The Editor, POPULAR WIRELESS,  
Dear Sir,—During the course of experimentation I came across a very interesting Unidyne Messrs. Dowding and Rogers, as the originators of Unidyne circuits, will be interested.

Being a Unidyne enthusiast of the deepest dye, I have for some time now been considering the feasibility of building an ultra low-wave Unidyne. This became not only an obsession, but a dire necessity as H.T. batteries were a continued source of annoyance, and would simply not stand up to our climate. So I seriously thought of applying either Reinartz or Grebe types of reaction to Unidyne theory.

I tried her out on low-wave Morse a few evenings, and she worked O.K. My A.T.C. is a makeshift 5-plate with no provision whatsoever for vernier control, and tuning was decidedly tricky. Anyway, I got going on WGY and she excelled herself, and signal strength was R5-R6. This hook-up is still in the experimental stage. I am, however, expecting two Geo-

phone low-loss slow motion variables, and am adapting 2 O.D.'s 10-metre lay-out as the basis for my Grebe Unidyne, and when this is completed I expect a huge increase in efficiency.

Reception, I think, savours of a double record, viz. :



oscillator is, of course, an essential part of every supersonic receiving set, and the radiation of the waves generated by it is liable to cause interference with neighbouring receivers.

In the arrangement shown in Fig. 5, due to Mr. P. W. Williams, the aerial, A, is connected to the grid circuit of the first detecting valve, V, and the local oscillator, O, also supplies energy to this valve through the coils, B. Obviously, unless special precautions are taken, the local oscillations will circulate in the aerial and so get into the ether.

To obviate this, the tuning condenser for the aerial is divided into two portions, F, G, and the mid-point is connected to the filament through the secondary coil, B. The aerial end of the coil C is connected to

- (a) American telephony on 41 metres with Unidyne.
- (b) Telephony reception at any distance, using a 4-volt accumulator as sole juice supply.

Have run through 1926 Unidynes and they are real "hot."

I append theoretical diagram of Grebe Unidyne for your perusal and comment.

Wishing you all the best and thanking you for Unidyne circuits.

I remain, with best 73's,  
Yours faithfully,  
F. C. RETIEF,  
P.O., Bulwater, via Fraserburg Road,  
Cape Province, South Africa.

### THE "P.W." BLUE PRINTS.

The Editor, POPULAR WIRELESS,  
Dear Sir,—The following might be of interest to you. I built up a 1-V-1, from "P.W." Blue Print No. 19, got good reception from our local station right away. I am about two air miles from Cape Town. I tuned in Johannesburg, just on 1,000 miles, and got very fair loud-speaker results—this, mark you, whilst C.T. was on the air! Wishing POPULAR WIRELESS the best of luck. Needless to say I am a regular reader.

Yours faithfully,  
C. R. SLINGSBY,  
P.O. Box 367,  
Cape Town, South Africa.

### BATTERY ELIMINATORS.

The Editor, POPULAR WIRELESS,  
Dear Sir,—In consequence of the increasing use of eliminators operating from the electric lighting circuit in place of H.T. dry batteries, I should like to suggest the desirability of you calling attention in your paper to the importance of good insulation on headphones should headphones be used in association with an eliminator.

My reason for writing you is that I recently came across the case of a person who suffered a very severe nervous shock by reason of the fact that there was a low insulation between the coils on the head receiver and the metal headband.

Of course, an unpleasant shock might equally have occurred had there been an H.T. battery of 100 volts or over used, but as an eliminator on a 200-volt circuit was used, you can imagine that the effect was very unpleasant, and had the person had a weak heart, the results might have been very serious.

I hope that you will consider it desirable to call attention to the necessity of making certain that the insulation on the headphones is good before use.

I am aware that where eliminators are used it is generally in association with a loud speaker; at the same time in the interests of the wireless trade, it is necessary that attention should be called to the importance of good insulation of the headphones.

Yours faithfully,  
M. H. GOLDSTONE,  
Frederick Road,  
Pendleton, Manchester.  
(Continued on page 532.)



## Unexcelled in purity and richness of tone

ONE has heard Loud Speakers likened to the early gramophone with its harsh, metallic tone; one has, however, never heard the Brown spoken of in this manner. The name Brown is synonymous with all that is best in radio reproduction—its pure unadulterated tone and its faithful, accurate rendering of every phase of the broadcast is a byword among those who know this, the first Wireless Loud Speaker.

If you do not know the Brown, you have yet to hear true radio interpretation. See and hear the Brown at your nearest Dealer's. You will at once appreciate the unusual beauty of its outline; but *hear it* and you will know that such rich volume and purity of tone is available in no other instrument.

## Brown LOUDSPEAKERS

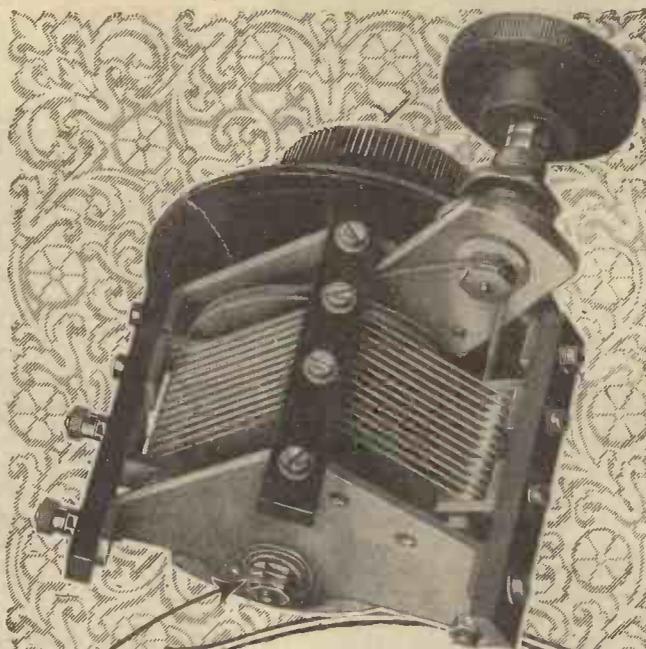
<b>Type H.1.</b> 21 ins. high. 120 ohms £5 5 0 2,000 ohms £5 8 0 4,000 ohms £5 10 0	<b>Type H.2.</b> Height 12 ins. 120 ohms £2 5 0 2,000 ohms £2 8 0 4,000 ohms £2 10 0	<b>Type H.3.</b> 15 ins. in height and in resistance of 2,000 ohms. £3 0 0	<b>Type H.4.</b> The smallest Brown Loud Speaker. Only 10 ins. high. 2,000 ohms £1 10 0
<b>Type H.Q.</b> 20 ins. high. Resistance: 2,000 or 4,000 ohms. £6 0 0	<b>Type Q.</b> 23 ins. high. In resistances of 120, 2,000 or 4,000 ohms £15 15 0	<b>Cabinet Type.</b> In Mahogany or Oak Cabi- net, 2,000 or 4,000 ohms £6 6 0	<b>Crystavox.</b> The only Loud Speak- er which works from a Crystal Set £6 0 0

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The condenser for fine tuning.

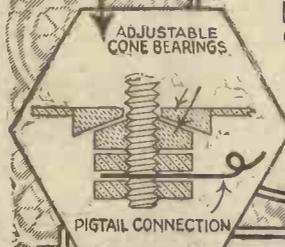
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R  
P39

# COSMOS



# Apparatus Tested

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

### JARS FOR H.T. UNITS.

OLD H.T. batteries should not be thrown away, for, providing that they were fairly well made, their small "sack" elements can be used to form a new battery. All that is required is a quantity of sheet zinc (about 26 gauge) and a number of small jars. The zinc can be obtained from almost any general ironmonger, and now the H.R.P. Co., of 46, St. Mary's Road, Leyton, E.10, inform us that they are prepared to supply glass jars especially made for the purpose. The retail prices are 1s. per dozen plain and 1s. 3d. per dozen with their tops waxed to prevent creeping. Samples were submitted to us and in our opinion they are quite suitable for the purpose and are priced exceedingly reasonably. The advantages such a battery offers are that it is cheap and that it can be renewed as many times

as necessary. Wet Leclanchés are indeed particularly suitable for supplying H.T., and the H.R.P. people should do a good trade with their neat little jars.

### THE "CLAREBEX" AERIAL.

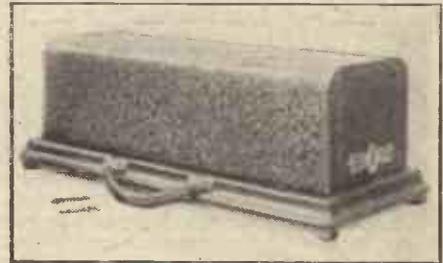
We recently received a "Clarebex" aerial for test from H. J. Saneto, of Ticehurst, Sussex. It consists of a square block of wood with holes at each corner to hold "T" pieces, and a large centre hole for mounting it on a pole. The parts are supplied unassembled but no tools are required to piece them together. The "T" pieces, ten in number, are lettered, as are the holes in the wooden block. The arms of the "T" pieces are slotted, two centre ones having six and the remaining eight three each.

When the wire, which is provided, is wound on the result is a cage aerial some-

what similar to a very much spread out frame. The design is quite logical and one that is theoretically sound. Naturally the higher the aerial is placed the better are the results. Fixed on the top of a 30 ft. pole reception was well up to standard. The "Clarebex" should prove popular among those amateurs whose garden space is restricted or who prefer not to have a visible aerial, for it can be erected in an attic or under a roof and will still act as a good "collector." The price is 17s. 6d. complete.

### AN ARTISTIC LOUD SPEAKER.

Wireless apparatus is ever tending to the artistic, and in these days both receivers and accessories are being modelled on



The commercial model of a wireless photograph receiver which, it is stated, is shortly to appear on the market.

decorative rather than on laboratory lines. Naturally, most people prefer an efficient piece of gear that is "camouflaged" to an efficient instrument that (Continued on page 528.)



## Where there's a child there should be cocoa

CHILDREN are brain-workers and manual workers too, and many overgrow their strength at school and play. Now Cocoa is food, and gives the children extra strength to keep pace with their growing bodies. It is the children's idea of a really delicious drink for breakfast and supper.

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**ENSURES PERFECT RECEPTION**  
**(NEGLECTIBLE RUNNING COSTS)**  
**A SILENT "BACKGROUND"**

Model	Tappings.	Set suitable for	Price.	Postage and Packing.
1	1	1 to 3 valves without power valves	35/-	1/6
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2	2	1 to 3 valves without power valves	47/6	
2A	2	3 to 6 valves with or without power valves	55/-	
3	3	3 to 6 valves with or without power valves	67/6	
3A	3 or 4	Marconi "Straight 8," Multi-valve and Super-net.	£6/8/0	

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## Two in One!

The new Dual Rheostat = a "Peerless" product in every way. Specially designed to meet the demand for a resistance equally applicable to bright or dull emitters. It has two windings—one offering a resistance of 6

ohms, whilst a continuation of this is of 30 ohms resistance. The resistance element is wound on a hard fibre strip under great tension. One hole fixing is provided and the terminals are placed in convenient positions. The contact arm has a smooth silky action, and all metal parts are nickel-plated.

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THE west is still luminous with the sunset's afterglow, and the "love-set" is abandoned for another.

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Youth will be served, and Ediswan Valves have given to the heart of youth the soul of music.

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**APPARATUS TESTED.**  
(Continued from page 526.)

resembles a lump of crude machinery, when it comes to introducing radio to the drawing-room. In studies and "dens" it doesn't matter so much, but "Lewis Cans" schemes of furnishing can be ruined by quite small divergences from the *tout ensemble*.

For this reason, the new "K" 'phone reproducer due to Messrs. Ellerphones, Ltd., of Beacon Buildings, New Road, Kendal, should prove distinctly popular. It is a loud speaker designed in a manner which will appeal strongly to all those listeners who desire to preserve the æsthetic compositions of their *salons* without sacrificing their radio.

No horn or even a bland disc figures in the "K" 'phone; it is quite unlike any other loud speaker. In fact, in appearance, it is an *objet d'art*, being a stately metal vase of Grecian simplicity and effectiveness. Placed on a high pedestal in a dining-room with concealed exterior leads, no one would suspect that it was anything else but a nice, tasteful piece of artistic furniture. In operation it is bewilderingly effective, for it does not appear to have any directional effect, and the music and speech might as well be coming from a table leg or door knob as the artfully designed "K" 'phone reproducer. And it is sensitive, too, and throws off enough volume to fill a large room with but a moderate input of power. Not like some

"camouflaged" loud speakers, it loses no efficiency in its artistic contours—indeed, it appears to gain in this respect. It has negligible resonance periods and reproduction is clear, and speech and music come through with commendable fidelity. Two models are available, one with an oxidised copper finish at £4 10s., and another, finished in oxidised silver, at £5.

If all "K" 'phone reproducers are up to the standard of the sample submitted us, and there is little reason why they should not be, Messrs. Ellerphones should have a busy time meeting demands for them. Anyway, readers of "P.W." contemplating the purchase of a new loud speaker should endeavour to see a "K" 'phone and hear it in operation; they will then be able to form their own personal conclusions as to the instrument's appearance and efficiency.

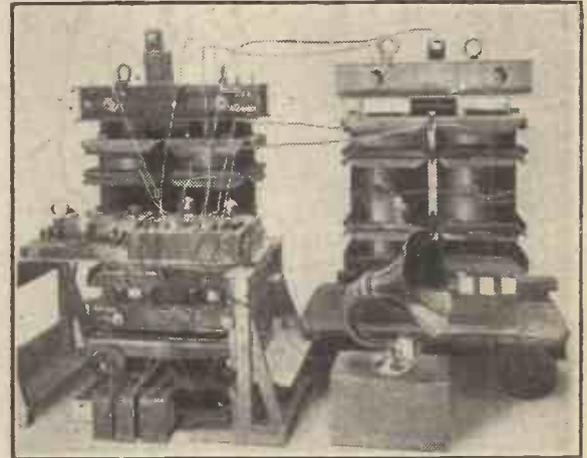
**A C.A.V. DEVELOPMENT.**

In view of the recent amalgamation of important electrical concerns, West Country readers will no doubt be interested to learn that ample stocks of all C.A.V. radio apparatus, including accumulators, are now obtainable at their usual terms from the branch of Rotax (Motor Accessories) Limited, 7, Temple Street, Bristol. Messrs. C.A.V. also inform us that they are endeavouring to give a similar service in connection with their wireless products as that which is being inaugu-

rated all over the world for their car productions.

**PHOTOGRAPHS.**

Readers are invited to submit photographs of wireless interest for publication in "Popular Wireless." Every photograph accepted and published will be paid for at the rate of 10/6 per photo.



These two 150 KVA Ferranti power transformers are being used in a receiving circuit. It is stated that nearly perfect results were obtained. The "components" are not suitable for portable sets!



**Get Rid of Valve Trouble**

Get rid of these disturbing microphonic noises—prevent the danger of breakage from shock. Ask your dealer for the new improved Lotus Buoyancy Valve Holder, which absorbs shock and protects your valves.

Valve sockets and springs are locked together by a mechanical process, making a definite and permanent connection. Bakelite mouldings, nickel silver springs and phosphor bronze valve sockets, nickel-plated.

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**A twelve months GUARANTEE**

Such good workmanship and care is used in making these Transformers that each one is fully guaranteed for twelve months. If it is not entirely satisfactory in use it will be exchanged without charge.

Ranges are made covering all wavelengths from 150 to 2,000 metres and up, as well as a special Neutrodyne Unit.

**9/**  
Each

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P.W. BLUE PRINT  
Number

1. DETECTOR VALVE WITH REACTION.
2. UNIDYNE DETECTOR VALVE WITH REACTION.
3. 1-VALVE L.F. AMPLIFIER.
4. CRYSTAL DETECTOR WITH L.F. AMPLIFIER.
5. H.F. (Tuned Anode) AND CRYSTAL, WITH REACTION.
6. H.F. AND CRYSTAL. (Transformer Coupled, Without Reaction).
7. 1-VALVE REFLEX WITH CRYSTAL DETECTOR (Tuned Anode).
8. 1-VALVE REFLEX AND CRYSTAL DETECTOR (Employing H.F. Transformer, without Reaction).
9. H.F. AND DETECTOR (Tuned Anode Coupling, with Reaction on Anode).
10. H.F. AND DETECTOR. (Transformer Coupled, with Reaction).
11. DETECTOR AND L.F. (With Switch to Cut Out L.F. Valve).
12. DETECTOR AND L.F. UNIDYNE (With Switch to Cut Out L.F. Valve).
13. 2-VALVE REFLEX (Employing Valve Detector).
14. 2-VALVE L.F. AMPLIFIER (Transformer coupled with Switch to Cut Out Last Valve).
15. 2-VALVE L.F. AMPLIFIER (Transformer-Resistance Coupled with Switch for Cutting Out Last Valve).
16. H.F. (Tuned Anode), CRYSTAL DETECTOR AND L.F. (with Switch for Last Valve).
17. CRYSTAL DETECTOR WITH TWO L.F. AMPLIFIERS (with Switching).
18. 1-VALVE REFLEX AND CRYSTAL DETECTOR, with 1-VALVE L.F. AMPLIFIER, Controlled by Switch.
19. H.F. DETECTOR AND L.F. (with Switch to Cut Out the Last Valve.)
20. DETECTOR AND 2 L.F. AMPLIFIERS (with Switches for 1, 2 or 3 Valves).

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All orders for these Blue Prints should be sent direct to the "Popular Wireless" Queries Department, Fleetway House, Farringdon Street, E.C.4, enclosing a stamped addressed envelope and a postal order for 6d. for each Blue Print Ordered.



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I've made—  
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1/2 Per Coil	Per Packet 1/4
1/18 swg.	4 Assorted Colours 1/4
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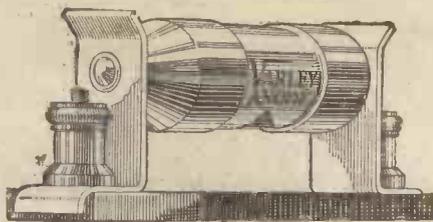
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The Editor will be pleased to consider articles and photographs dealing with all subjects appertaining to wireless work. The Editor cannot accept responsibility for manuscripts and photos. Every care will be taken to return MSS. not accepted for publication. A stamped and addressed envelope must be sent with every article. All inquiries concerning advertising rates, etc., to be addressed to the Sole Agents, Messrs. John H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. As much of the information given in the columns of this paper concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and the trader would be well advised to obtain permission of the patentees to use the patents before doing so.

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

**TECHNICAL QUERIES.**

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

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

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

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

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

Only a limited number of circuits are covered by 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 1/- 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.

high resistance of the loud-speaker windings. The actual figures will be  $\frac{2 \text{ volts}}{2,000 \text{ ohms}} = .001 \text{ amps.}$

This is only one milliamp, and is probably less current than the loud-speaker takes from the H.T. battery in the ordinary way.

The fact that the L.T. battery was of large capacity does not affect the issue, but that it could have gone on supplying the current for a very long time before the battery became exhausted is shown as follows:

Actual capacity of the half exhausted L.T. battery = 15 ampere-hours. Current flowing in the external circuit = .001 amp.

$\frac{15}{.001} = 15,000 \text{ hour's supply!}$

Your haste in disconnecting the battery was therefore quite unnecessary, as theoretically it would have been quite safe to leave it till the end of next year!

**AN EFFICIENT AERIAL SYSTEM.**

P. M. S. (London, S.W.19).—I am purchasing a 2-valve set (Det. and L.F.) with which I hope to get several distant stations besides London. What will be the best form of aerial to erect, and can I further assist DX (long-distance) reception by attention to the earth connection?

An aerial that is suitable for both local and distant reception is one of the single-wire type, 30 to 40 ft. in height and 70 to 80 ft. long, including the leading-in wire.

If possible, the far end—that is, the end farthest away from the house—should be higher than the leading-in end of the aerial.

The earth wire for best results must not be longer than 20 ft. and should either terminate on an earth tube driven into damp soil or else be connected to a main water pipe—one that goes direct into the ground.

(Continued on page 532.)

## Questions and Answers

**A SLOW DISCHARGE.**

E. J. E. (Cranbrook Park, Ilford).—Owing to a misunderstanding, my 2-volt accumulator was connected to the loud-speaker terminals and left for some hours. Fortunately it was not left all night, and it seems to have been uninjured. How is it that with such a large current available (the accumulator has a capacity of 30 actual ampere-hours) no serious damage was done?

The loud speaker is of the 2,000 ohms resistance type, and is generally worked on a 3-valve set. On the face of it, I expected to find the loud-speaker windings burnt out by the large current or else the L.T. battery run down, as it was about half discharged at the time.

The current which flows in a case of this kind (direct current) is very easily calculated from Ohm's Law—i.e., Current (amps.) =  $\frac{\text{E.M.F. (volts)}}{\text{Resistance (ohms)}}$

Applying this formula to your case, it will be seen that only a very small current will flow, owing to the

THE **H.M.H.** PHONE **18/6**

**SPECIAL NOTICE**

The closing date of this competition, which also appeared in this journal on May 8th, has, owing to the recent strike, been altered to June 19th, and Coupons from the earlier issue will also be accepted in connection with same, providing they reach us not later than June 19th, accompanied by P.O. covering the amount of entries submitted.

**Wear the finest British Headphones AND WIN A SIX-VALVE DE-LUXE RECEIVING SET or a large cash prize.**

In order to introduce to the public their wonderful new wireless invention, the makers of H.M.H. HEADPHONES offer three valuable prizes, together with 25 sets of Headphones as consolation prizes, for the best solutions received of the cross-word puzzle given below.

*Members of the Staff of the Company will not be allowed to compete.*

- First Prize - - A Six-Valve De-Luxe Receiving Set, or £50 Cash
  - Second ,, - - A Four-Valve ,, ,, ,, £25 ,,
  - Third ,, - - A Two-Valve ,, ,, ,, £10 ,,
- and 25 consolation prizes of a pair of H.M.H. Headphones.

*This Competition is also appearing in two other leading Wireless Journals, and a sealed solution is in the keeping of the respective Editors.*

CUT ALONG THIS LINE

1	M	2	A	3	G	4	N	5	E	6	T	7	E	8	N	9	C	10	A	11	G	12	E
13	E	14	A	15	R	16	A	17	R	18	S	19	E	20	A	21	S	22	T	23		24	
25	N	26	O	27	T	28	R	29	E	30	S	31		32		33		34		35		36	
37	B	38	I	39	D	40		41	V	42	O	43	E	44		45		46		47		48	
49	B	50	L	51		52		53		54		55		56		57		58		59		60	
61	B	62	E	63	S	64	T	65		66		67		68		69		70		71		72	
73	E	74	S	75	T	76		77		78		79		80		81		82		83		84	
85	B	86	O	87		88		89		90		91		92		93		94		95		96	
97	B	98	E	99	S	100	T	101		102		103		104		105		106		107		108	
109	B	110	O	111		112		113		114		115		116		117		118		119		120	
121	B	122	O	123		124		125		126		127		128		129		130		131		132	
133	B	134	O	135		136		137		138		139		140		141		142		143		144	
145	B	146	O	147		148		149		150		151		152		153		154		155		156	
157	B	158	O	159		160		161		162		163		164		165		166		167		168	
169	B	170	O	171		172		173		174		175		176		177		178		179		180	
181	B	182	O	183		184		185		186		187		188		189		190		191		192	
193	B	194	O	195		196		197		198		199		200		201		202		203		204	
205	B	206	O	207		208		209		210		211		212		213		214		215		216	
217	B	218	O	219		220		221		222		223		224		225		226		227		228	
229	B	230	O	231		232		233		234		235		236		237		238		239		240	
241	B	242	O	243		244		245		246		247		248		249		250		251		252	
253	B	254	O	255		256		257		258		259		260		261		262		263		264	
265	B	266	O	267		268		269		270		271		272		273		274		275		276	
277	B	278	O	279		280		281		282		283		284		285		286		287		288	
289	B	290	O	291		292		293		294		295		296		297		298		299		300	

**YOU HAVE ONLY TO SOLVE THIS PUZZLE**

**CLUES ACROSS.**

1. Pertaining to the lodestone.
6. Confine in a cage.
12. To draw under.
14. Where the sun rises.
16. Negative term.
18. One guilty of treason.
21. Denotes certain make of motor cycle.
22. To lower headlights.
24. A bay, or creek (Shetland).
25. Used for shooting arrows.
26. Furze, or gorse shrubs.
27. Four-footed animals.
28. A lump or ridge on metal.
29. Established (abst.).
31. The beak of a bird.
33. A girl's name.
34. Is unwell.
37. Anything round.
39. A soft bog or marsh.
40. An allowance or pension.
42. Lending desire.
44. (Prefix) meaning against.
46. A priest (ancient).
48. A meadow.
50. Negative term.

**CLUES DOWN.**

2. Near.
3. Obtain.
4. An aromatic plant.
5. Period.
7. Born.
8. To throw or fling.
9. Beast of burden.
10. Great (abst.).
11. To supply with.
13. Hoarded.
15. To cover by wrapping.
17. Lubricates.
19. First "Russian Emperor."
20. Beer (reversed).
21. Kind of motor car.
23. Pertaining to a metal.
25. Houses.
30. Flow of blood to the face.
32. Gives notice of danger.
35. Memorandum of debt.
35. Sergeant, abt. (army).
37. Ladies' neckwear.
38. A large quantity.
41. A widow.
43. Supreme happiness.
45. To reply to.
47. Italian coins.
48. Sediment.
49. A boy's name.
51. A wavelike moulding.
56. To irritate.
58. Despatched.
61. Fowl.
62. Measure of cloth.
63. Make brown.
64. Female animal.
66. Knock out (abt.).
68. Near (abt.).

**RULES OF ENTRY.**

1. Prizes are awarded strictly for the skill shown in the solving of this puzzle.
2. The first prize will be awarded to the competitor sending in the correct solution. Should more than one correct solution be received, prizes to the total value will be divided among the successful competitors.
3. Every purchaser of a pair of our H.M.H. Headphones (direct from us) will be entitled to 3 free entries in this competition. All other entries must be accompanied by P.O. for 1/-, made payable to H. Morser & Co. (Wireless) Ltd., and must be crossed " & Co."
4. Solutions must reach H. Morser & Co. (Wireless) Ltd., 67/68, Hatton Garden, London, E.C.1, not later than June 19th, 1926.
5. Solution and names and addresses of Prize-winners will appear in "Popular Wireless," July 3rd, 1926.
6. All prizes will be forwarded to successful competitors without delay.
7. No correspondence can be entered into, and the decision of the Directors of H. Morser & Co. (Wireless) Ltd. must be accepted as final and binding.

**P.W. To H. MORSER & CO. (Wireless) Limited, 67/68, HATTON GARDEN, LONDON, E.C.1.**

Dear Sirs,—I enclose P.O. value..... as Entrance Fee for the Enclosed Solutions.  
(Please use Block Capitals, in ink.)

Name..... Address.....

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# YOU CAN TAKE IT FROM ME!



That our Summer Catalogue contains the finest Radio Bargains ever offered. 600 Illustrations of a wonderful selection of unique apparatus.

Send 4d. Stamps.

**ELECTRADIX RADIOS.**

218, UPPER THAMES ST., E.C.4.  
Parrs Ad.

PLEASE be sure to mention **POPULAR WIRELESS** when communicating with Advertisers. **THANKS!**

**WET H.T. BATTERIES.**  
British-made Glass jars, 21 by 1 1/2, for making up wet H.T. units (Leclanché), 1/- doz., or waxed to prevent creep, 1/3 doz. Post extra. Phones re-wound and re-magnetised, 4/6 per pair. **The H.R.P. Co., 46, St. Mary's Road, Leyton, E.10**

**HEADPHONES REPAIRED**  
Re-wound & re-magnetised 5/- per pair. Loud Speakers repaired 5/-. Transformers re-wound 5/- each. All work guaranteed and tested before delivery. Write for Trade Prices. Phone: Clerk. 1795. **MASON & CO., 44, East Road, City Road, N.1.**

**LUSTROLOX**  
**WIRELESS VALVES**  
**THE ECONOMICAL COMBINATION**  
2v. '06 H.F. & L.F. each 9/-  
2v. '34 P.V. 11/-  
Obtainable from Lewis's Ltd., Liverpool and Manchester and Lustrorox Ltd., West Bollington, Nr. Macclesfield.

**CHEAP GOVERNMENT WIRE!!**  
Saves for gardens, fencing, greenhouse, training peas, fruit. Waterproofed, flexible, lasting! Small lots quoted, or 1916 mile. Samples free with list. 300 bargains. Postcard to-day.  
**GREENS, 297, ALBERT, LYTHAM.**

**H.T. Accumulators** —  
60 Volts  
3 Actual Amp-hour **37/6**

SOLD ON APPROVAL SYSTEM  
Obtainable only from:  
**ACCUMULATORS ELITE,**  
31, Waterhouse Street, HALIFAX,  
or from Messrs. **CECIL POHLMAN, Ltd.,**  
77, Great Portland Street, London, W.1.  
Trade Supplied Telephone 1304

## ADVERTISEMENTS.

As far as possible all advertisements appearing in "P.W." are subjected to careful scrutiny before publication, but should any reader experience delay or difficulty in getting orders fulfilled, or should the goods supplied not be as advertised, information should be sent to the Advertisement Manager, "Popular Wireless," 4, Ludgate Circus, London, E.C.4.

## RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from page 530.)

### EXCHANGING SETS.

J. N. E. (East Dulwich).—I have a two-valve set (H.F. and Det.) and am thinking of changing over to a three-valver for loud-speaker work. As I am not a "handy man" I should like to let the old set go in part payment for a new one. Is there any firm of wireless dealers who will take back the old set and make an allowance for it when a new one is purchased?

We believe that such terms are advertised by the Express Radio Service, Factory Square, Streatham, London, S.W.16.

### HINTS ON TUNING.

F. L. E. (Weston-super-Mare).—I bought a 1-valve wireless set during the strike, and now I have become thoroughly interested in it, and should like to hear other stations beside the local one (Cardiff).

I am hopelessly puzzled by "tuning" and should greatly appreciate a few hints about this function of the set.

Probably a method of series and parallel aerial tuning is arranged on it, either by means of the "three terminal" method or by a D.P.D.T. switch. The coils will be: fixed (A.T.I.), moving (reaction). Suitable sizes for 2 LO and other B.B.C. stations and 5 X X will be as follows:

- Main B.B.C. stations:**  
A.T.I. (series aerial tuning), 50-75.  
A.T.I. (parallel aerial tuning), 35-50.  
Reaction, 50-75.  
**5 X X and Radio-Paris:**  
A.T.I. (parallel aerial tuning), 200.  
Reaction, 100-200.

Best results in every case will be obtained when the station is tuned on the variable condenser at approximately 90 degrees. If the station is received with all the condenser in—that is, at 180 degrees—it denotes that a coil one size larger is required.

Similarly, if a station is received with all capacity out, a smaller coil must be tried.

Should the variable condenser be in the series position with all capacity out (0 degrees), parallel aerial tuning can often be tried to advantage, and this will probably save you the necessity of changing the coil (A.T.I.).

It may be necessary to bring the set to the point of oscillation to bring in distant stations, and the careful choice of a coil for reaction will help in this direction.

If possible, try and use as small a coil as possible. Control is best when oscillation takes place when the reaction coil is at approximately 45 degrees to the A.T.I. (aerial coil).

A fixed condenser of .001 to .002 placed across the phone terminals will assist in this respect and also help to "keep down" the size of the reaction coil.

Should the set not oscillate, we advise you to try the effect of reversing the leads to this coil. If, however, it still does not do so, more H.T. and a larger coil can be tried.

When a station is picked up (by rotating the variable condenser slowly) its carrier wave is first heard. This can be "resolved" by opening out the reaction until the silent point is reached, when speech will be heard.

It may then be necessary to slightly retune on the condenser, as any alteration of the reaction coil causes a slight loss (or gain) in wave-length.

It would be a good plan to get in touch with your local radio society. You can learn far more by discussion than by merely reading about wireless.

### THEORY OF WIRELESS.

B. E. M. (Radlett).—Having graduated from a crystal to a two-valve set, I have become very interested in the theory of wireless. Can you recommend me a good text-book dealing with the action of electric currents, and explaining such phenomena as rectification, inductive coupling, etc.?

The best book for your purpose is that issued by the Admiralty, for the instruction of officers and men of H.M. Fleet. It is called the "Admiralty Handbook of Wireless Telegraphy," and is published by H.M. Stationery Office. Copies can be obtained through any bookseller, or direct from H.M. Stationery Office, Adastral House, Kingsway, W.C.2, price 5s. net.

## CORRESPONDENCE. (Continued)

### SUITABLE DETECTOR VALVES.

[We have had a number of queries regarding the use of H.F. or L.F. Ediswan valves as detectors, and the following letter from the makers should be of interest to readers.]

The Editor, POPULAR WIRELESS.  
Dear Sir.—We thank you for your letter of the 20th ult., in regard to the most suitable type of valves of our manufacture for use as detectors.

From our own extensive testing, we have found that in circuits of the Hartley or Reinartz type, the L.F. Valves are much to be preferred to the H.F., owing to the fact that they oscillate more freely than the latter, whereas in straight circuits they are also slightly better although the difference is not very marked.

From these findings we have advocated the use of the L.F. type as detector, and we feel that we are advising Ediswan users, as a whole, correctly and to their advantage.

Yours faithfully,  
For the Edison Swan Electric Co., Ltd.,  
J. THOMAS,  
Joint Sales Manager.  
123-5, Queen Victoria St.,  
London, E.C.4.

## For the Constructor DRILLING & TAPPING SIZES.

Size	B.A.		WHITWORTH.		
	For Tapping	For Clear'nce	Size in.	For Tapping Clear'nce	
0	11	6	1/16	5/64	52
1	17	10	3/32	5/64	41
2	25	12	1/8	3/32	30
3	29	20	5/32	1/8	4m/m
4	33	27	3/16	5/64	12
5	39	30	7/32	11/64	2
6	43	34	1/2	3/16	6 1/2 m/m
7	47	39	5/16	1/4	8m/m
8	50	44	3/8	19/64	10m/m
			7/16	5/16	11 1/2 m/m
			1/2	13/32	14

### RESISTANCE COUPLING.

The Editor, POPULAR WIRELESS.  
Dear Sir.—May I reply to Mr. Honri's letter in regard to Resistance Coupling ("P.W." No. 202)?

Contrary entirely to Mr. Honri's presumption, the use of high anode resistances and leaks and small condensers does not render the receiver complicated or difficult to handle. The circuit, with the exception of the grid bias, is absolutely identical to the present popular and inefficient method.

It is not necessary to use special valves, although this is the ultimate aim.

Even using ordinary valves, the degree of amplification is much higher than by the present arrangement, the filaments of the valves, run at about half normal temperature, are practically everlasting, the cost of the condensers and anode resistances is considerably reduced; there is straight line amplification of a nature hitherto unobtainable—in fact, the advantages are perfectly obvious, and, moreover, directly contrary to what Mr. Honri states, the "greenest" amateur can use the set.

The remark re the Super-Het. is rather timely, since this is a line of experiment which one member of our society is already following, substituting the transformer method (ugh!) by the high amplification obtainable by the improved B.C.

In regard to the special values Mr. Honri mentions, I believe he must be mistaken. This method has been very carefully experimented upon by two German scientists, Von Ardenne and Hehnert, who, according to their recent work, "hope to construct valves having an amp. factor of 701!" The rights in Germany are held by the Loewe Audion Firm, Berlin (hats off to them!), but even these gentlemen do not hope to obtain valves having amp. factors of 80/90—at least, not yet.

The outcome of what I have said is: it is simple to handle, less costly to make run, and infinitely better.

Yours faithfully,  
R. G. TURNER,  
(Chairman Northampton and District Radio Society).  
4, Derby Road,  
Northampton.