

**"MEET THE METER"—By P. W. HARRIS**

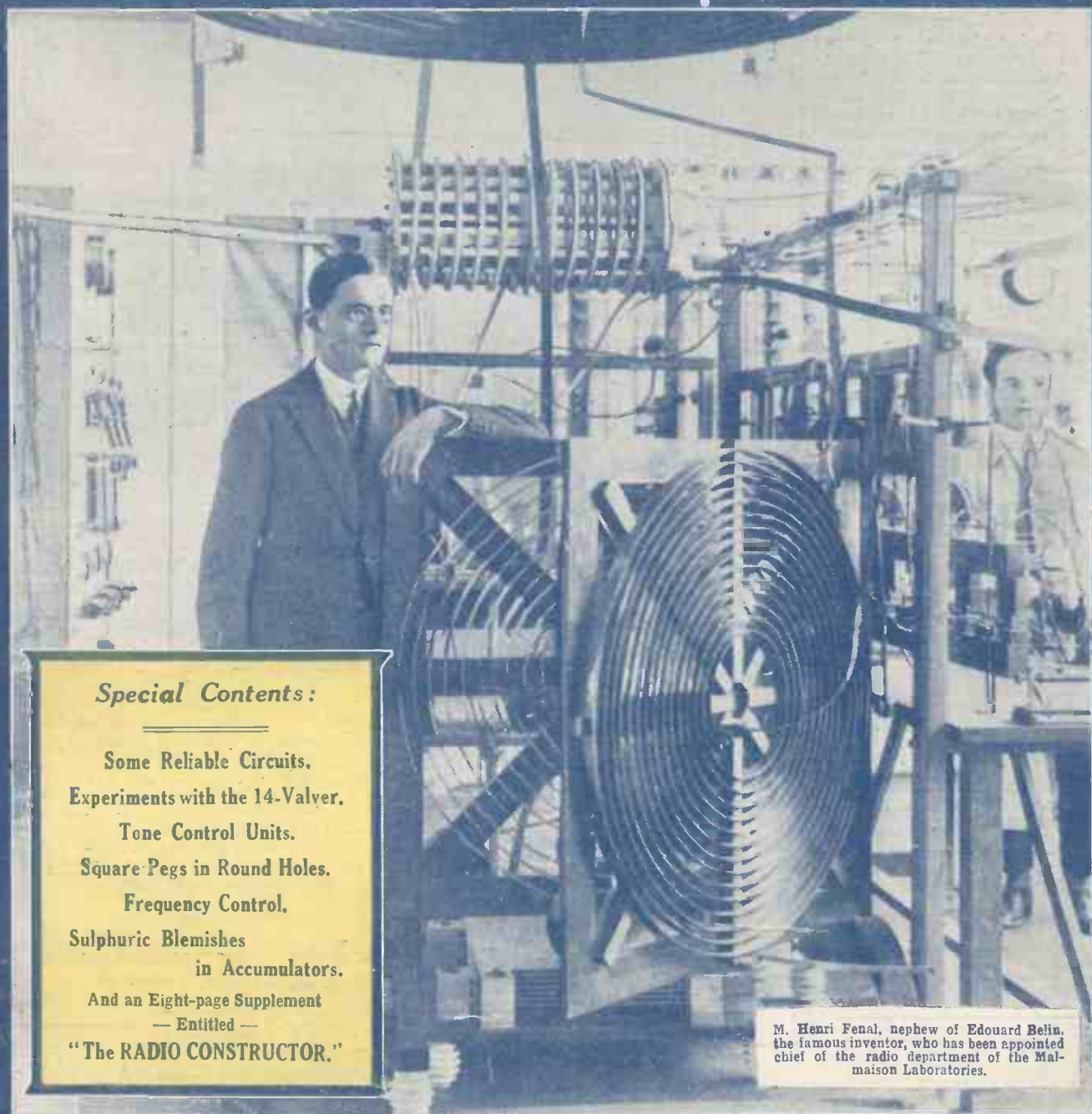
# Popular Wireless

Every Thursday  
PRICE  
3d.

No. 233. Vol. X.

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

November 20th, 1926.



## *Special Contents :*

Some Reliable Circuits.  
Experiments with the 14-Valver.  
Tone Control Units.  
Square Pegs in Round Holes.  
Frequency Control.  
Sulphuric Blemishes  
in Accumulators.  
And an Eight-page Supplement  
— Entitled —  
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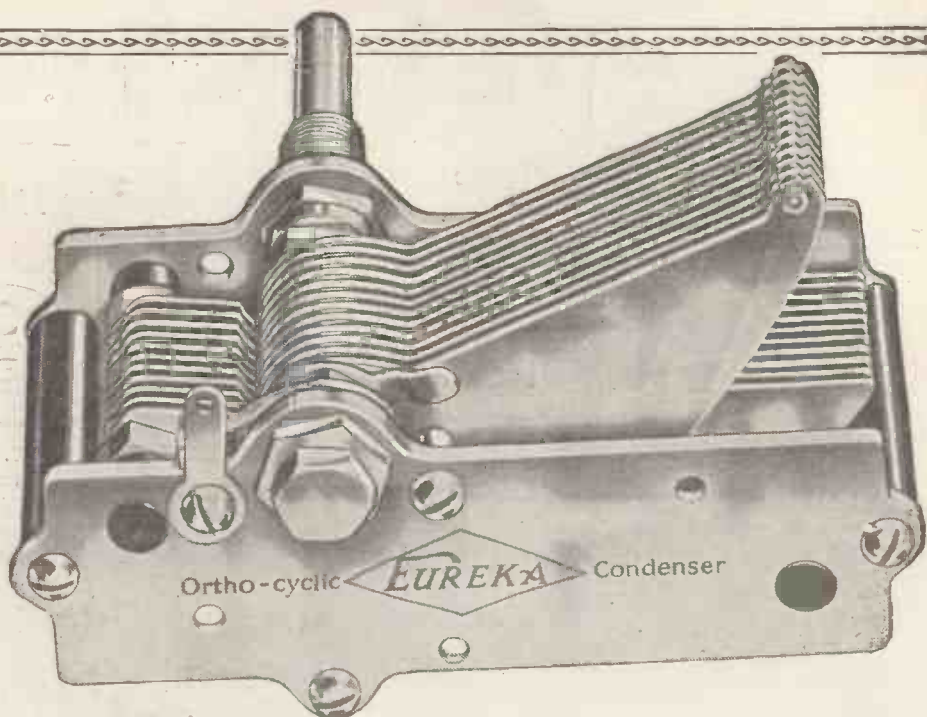
7 Generous and readily accessible soldering tags.

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9 Positive stops at both ends of scale.

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11 Highly polished and beautifully finished throughout—a perfect example of British craftsmanship.



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### Prices:

.0003 mfd. 14/6  
.0005 mfd. 15/6

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Price **14/-** each.

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Combination No.	Type of Marconi Valve	Position.	Filament.		Grid Bias Volts	High Tension.		Low Tension Battery Supply.
			Volts	Amps		Volts	M. Amps	
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6 .....	D.E.2 H.F. D.E.2 L.F.	Det. L.F.	1.8 1.8	0.12 0.12	+2 -4.5	60 80	1.0 1.2	2 v. acc.
15 .....	D.E.2 H.F. D.E.2 H.F. D.E.2 L.F.	H.F. Det. L.F.	1.8 1.8 1.8	0.12 0.12 0.12	0 +2 -4.5	60 60 80	0.8 1.0 2.0	2 v. acc.
17 .....	D.E.8 H.F. D.E.8 H.F. D.E.8 L.F.	H.F. Det. L.F.	5.8 5.8 5.8	0.12 0.12 0.12	0 +2 -6	80 80 100	1.1 1.6 3.0	6 v. acc.

Type D.E.8 L.F. Dull Emitter is for a 6-volt accumulator. It is recommended for L.F. Amplification when a steady negative grid bias of 6-7 volts is required while using an anode voltage of 100. It may also be used as a general purpose valve (Fil. volts 5.6-6. Fil. amps. 0.12. Amp. factor 7). The D.E.8 H.F. Dull Emitter has similar characteristics to the D.E.8 L.F., but is suitable for H.F. amplification and rectification and resistance capacity coupled amplifiers (Amp. factor 16).

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# Louden Valves



The Town Hall ROYTON



*"I have been running two Loudon Dull Emitters over 18 months . . . at a recent test . . . there was nothing to touch them."*

So writes Mr. O'Neill from Royton, and every post swells the number, now amounting to many thousands, of people who agree with his opinion. Loudon Valves cost less, they last longer, they consume less current, they are famous for "Silver Clear" reception, and they give greater volume. We could write you a treatise on the scientific reasons for all these qualities, but it's Results you want—not Reasons. Write to us for your Loudons to-night. This is Mr. O'Neill's letter:

"Gentlemen,  
"It might interest you to know that I have been running two Loudon Dull Emitters for over 18 months and they were second-hand when I got them. They also are 'still going strong.' At a recent test of various valves there was none to touch them.  
"Please furnish me with a catalogue.

Yours sincerely,

W. O'NEILL (Royton, Nr. Oldham)."

Louden Valves are made by British labour in a British factory with British capital and can be depended upon for the finest volume, range and silver clearness. They can only be offered at such low prices because of our well-known policy of selling direct to the public and cutting out the middleman's profit. The list below gives prices and full particulars. Order your Loudon Valves from us by post.

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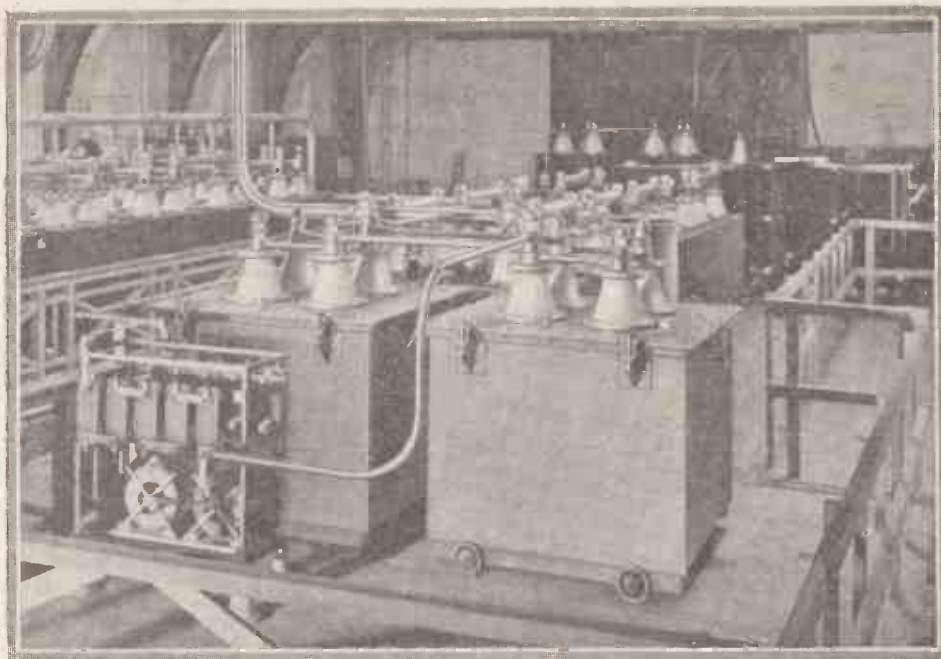
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They represent the very high standard of electrical efficiency to which modern science has brought the condenser, and it is interesting to note that these identical units, grouped in their tens of thousands, make up the Condenser Banks of the world's principal wireless stations.

In the Condenser equipment of the Government Radio Station at Rugby, of which we show a view above, there

are in each of the large "tanks" over half a million of such mica and metal plates grouped into hundreds of condenser units.

Each of the many millions of plates was individually selected and tested before being collected into groups, and each group was again subjected to frequent and stringent tests during the successive stages of assembly.

This ritual of tests, tests, and more tests is observed in the case of every single product bearing the Dubilier name. Our long experience has taught us that if we are to make condensers which will be satisfactory in service, whether they are designed for High Power Stations or for Broadcast Receivers, we must take precautions to eliminate every possible cause of failure. As Condenser Specialists we know these precautions to be not only desirable but essential. Governments and Manufacturers of Broadcast Receivers all over the world, agreeing with us in this matter, specify Dubilier.

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E.F.S.238

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This book contains straightforward, amply illustrated directions for constructing three of the latest valve sets. The first is a two-valve household loudspeaker set. A straightforward set of up-to-date design intended for the reception of quality signals from the local station and from Daventry. The second is a sensitive three-valver incorporating a novel reflex principle which will receive European stations with ease. The third set described is a four-valver including every possible modern refinement.

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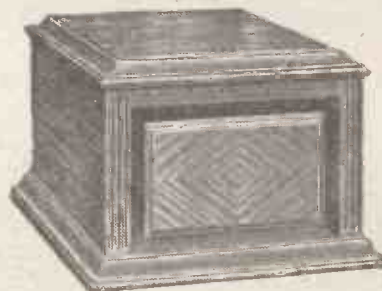
This book consists of an up-to-date and comprehensive range of blue print diagrams drawn in a simplified pictorial style so that the amateur constructor cannot possibly go wrong when building up a set on the lines of any of the circuits with which the book deals. There are 11 circuits in all.

Price **6<sup>D</sup>** Each.

*At all Newsagents and Bookstalls*

**CONSTRUCTORS USING THESE  
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ART and Science go hand in hand in the Brown Cabinet Loud Speaker. Beautifully finished in rich Mahogany or Oak, it will harmonise with the setting of any room, while in purity of tone and adequacy of volume it stands alone among Loud Speakers of this type. In resistances of 2,000 or 4,000 ohms. £6.6.0

Conscientiously made—for you

The careful, conscientious workmanship—the almost loving care with which Brown workers tend the instruments they make is almost akin to the pride with which the Craftsmen of old fashioned their work. This pride of work is distinctly reflected in the finished product—it will be obvious to you the moment you see a Brown Loud Speaker or Headphone.

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a Loud Speaker which will give the most faithful rendering of the Broadcast it is possible to imagine; one that, in purity of tone and adequacy of volume, sets a standard in reproduction unequalled throughout the World. Because we want to pass this on to you, we are determined that not by the slightest deviation from the high standard of workmanship, nor by a moment's relaxing in the discernment with which only the finest quality materials are chosen, shall the astounding fidelity of Brown reproduction be prejudiced.

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In addition to the Cabinet, there are eight other Brown Loud Speakers—a type for everyone from 30/- to £15 25/-



## 'Horse' power that gets nowhere!



### In three types

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For H.F. use  
18 volts 1  
amp. ... 14/-

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**Stentor Two**  
Power Valve  
18 volts 15  
amp. ... 18/6

THE merry-go-round—a symbol of wasted 'horse' power! In almost every branch of Industry waste plays a dominant part. The smoke pall which hangs over our big cities is wasted energy. Scientists tell us that in ten years' time the waste gases from our factory chimneys will be harnessed and converted into power. In your own home perhaps, you may have a grate which burns a lot of coal yet does not heat the room. Another case of wasted energy.

Again, take your own Wireless Set. Your valves may consume a lot of current and yet not give you good results. If they are bright emitters it will be necessary for the working temperature of their filaments to be raised to a white heat—otherwise the vital stream of electrons will not be emitted. Clearly a case of wasted energy because now a new filament has been invented by Cossor which gives off a terrific emission practically without heat. When the new Cossor Point One Valves fitted with Kalenised filaments are working not the slightest glow is visible.

Great heat, therefore, in a valve is no longer essential. Its destructive influence

has been eliminated in all the new Cossor valves. Heat causes crystallisation. After a little while the filament becomes brittle—the constant stretching and contracting has altered the molecular structure of the metal. Eventually it snaps—and your valve is useless.

The Cossor Kalenised filament is one of the greatest advances in valve manufacture. Not only does it mean an abnormally long life, but it cuts current consumption down to a tithe of what was necessary a year ago. For example, the accumulator large enough to last a 2-valve Set for 10 hours with bright emitters would last more than 200 hours when Cossor Point One valves are used.

**Think! 190 hours free broadcasting every time your accumulator is charged. Charge your Accumulator once every two months instead of each week. Surely this worth-while economy will make you change over at once.**

But even economy and long life do not exhaust the advantages of these new Valves. You'll obtain a volume and mellowness of tone which will surprise you. Owing to the low specific resistance of the Kalenised filament, an exceptional length is used. This in turn means obviously a greater area of emission surface. And a prolific emission, properly controlled, means a better valve.

Remember, too, the exclusive method of Co-axial Mounting which guarantees a uniformity which has never before been possible. There is no gamble in choosing a Cossor Valve. All are alike—no deviation is possible. See your Dealer about them to-day.

# Cossor Point One



# Popular Wireless

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K. D. ROGERS.  
P. R. BIRD.



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

Consultants:  
Dr. J. H. T. ROBERTS,  
F.Inst.P.  
J. F. CORRIGAN, M.Sc.,  
A.I.C.  
C. E. FIELD, B.Sc.  
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## RADIO NOTES AND NEWS.

The New Wave-lengths—Radio Programmes on Telephone Lines—Community Singing—Murder Trial Broadcast Stopped—Radio Fund to Go like Road Fund?—The Piccadilly Programmes.

### The New Wave-lengths.

WHEN announcing that the Geneva Wave-length Plan would come into operation upon November 14th, the B.B.C. notified listeners that reports upon the working of the scheme would not be required for two weeks. In other words, they expected a pandemonium fortnight, during which the black sheep amongst Europe's 200 broadcasting stations would stray off their own wave-length into pastures forbidden!

### "John Listener."

AT the end of the fortnight probably, we shall all have requests from our local stations for reports upon reception. Till then it's a waste of time to write, but as soon as the word "Go" is given, the reports from listeners will doubtless prove of very great value. For, however well the B.B.C. engineers do their job, they can never hope to keep such a sharp look-out as "John Listener"!

### "N" Circuit in N. Devon.

WRITING in praise of the 2-valve "N" circuit, described in "P.W." No. 224 (Sept. 18th issue), a Parracombe, N. Devon, listener says that for 5XX he uses a 525 coil (500 will do) in the N position, with a 200 in the ACE position. "In conjunction with B5 and B6 valves, the set produces far more volume from an Amplion A.R. 19 L.S. than any straight 2-valver I have come across," he says, "and the quality is very pure."

### Radio Programmes on Telephone Lines.

ANY Dutch telephone subscriber can now listen to broadcasting without a receiving set for thirty shillings a year. The Paris, Daventry or Hilversum programmes are picked up centrally, and "laid on" to all telephone users who subscribe to the service.

If, in the middle of the programme the

'phone is needed, the broadcasting is automatically cut off.

### Aerial Slashing.

"AERIAL slashing is still going on in Norwood," writes a "P.W." reader from that salubrious suburb. "But," he adds darkly, "if I find anybody trying to slash my aerial, I'll slash him to earth!"

### Community Singing.

COMMUNITY chorus singing, by an Albert Hall audience, is to be broadcast on Saturday next (November 18th). The concert is to inaugurate a National Community Singing Movement, and in addition to the chorus singing by the entire audience, there will be the added

with programmes being 15,781. A total of £25,436 0s. 4d. was subscribed, and every penny has been expended upon equipment, bar £128 13s. 9d., which balance is being presented to the Home Secretary for the wireless equipment of Borstal establishments.

Magnificently conceived, and brilliantly executed, the Fund proves that the spirit of Charles Dickens, founder of the "Daily News," still lives to alleviate suffering.

### Better Terms for Radio Artistes.

AS SCHEME has been evolved to make broadcasting artistes independent of the stage. In future, engagements may be made for a week's microphone "turn," instead of just for half an hour. The artiste's first night will be at, say, London, the next Glasgow, and so on, the salary paid being as good as the halls can offer.

### W P G.

SIT-UP-LATES who were combing the ether at midnight a couple of months ago, reported that W P G, the American broadcasting station, was coming over exceptionally well. The call-sign letters stand for World's Play-Ground, and the station itself is situated half a mile out in the Atlantic Ocean, at the end of the pier at Airport, Atlantic City, N.J. Just recently all the transatlantics have been more elusive, but even so I occasionally hear from "P.W." readers who can get W G P

quite clearly on a couple of valves.

### The Piccadilly Programmes.

DE GROOT'S disappearance from the programmes raised a controversy that continues to flare up. Recently Mr. J. H. Squire—whose Celeste Octet is another prime microphone favourite—came out with the statement that the B.B.C. had created him fairly enough. In fact, Mr.

(Continued on next page.)



A Presentation Wireless Set. The three-valve receiver presented to Mr. J. Eccles (right) on completion of 50 years' service as organist at Farnworth.

attraction of the Royal Albert Hall Orchestra under Sir Landon Ronald, Miss Florence Austral, Mr. John Goss, and Mr. Norman Allin.

### All London Hospitals Now Have Radio.

"HATS off" to the "Daily News" Wireless for Hospitals Fund. Opened in May, 1925, to provide wireless for each individual patient in the voluntary hospitals of London, it has equipped 122 hospitals, the total number of beds provided

## NOTES AND NEWS.

(Continued from previous page.)

Squire stated "the members of my Octet get for 30 minutes' broadcast three times the amount they would earn in a theatre for three hours' work. After all, fair's fair!"

## A Queer Coincidence.

A QUEER radio coincidence has just recently been reported from Antwerp.

A listener there switched on his wireless set (which was tuned to 5 X X), and then picked up a South African newspaper to read. As his eye took in the words "The Gila Monster wears a flashy suit of orange and black," those identical words were spoken to him by the loud speaker!

It gave the listener quite a creepy feeling, to sit in Antwerp and hear an English voice speaking exactly the same words as he was reading from the South African paper in his hand!

## The Explanation.

THE explanation shows how all the world is inter-woven nowadays. Originally the words were from an article by L.G.M. in the "Daily Mail," and the South African paper has quoted the story.

As L.G.M. himself is a once-a-week uncle at 2 L O and 5 X X, he also quoted his own work one day to the kiddies, with the result that a man sitting in Belgium, and reading a South African newspaper, heard by wireless the very words he was reading being spoken in England.

## "Ariel's" Announcements.

I HAVE been asked to make the following announcements:

A Radio Exhibition has been organised by the Canterbury and District Radio Society. It will be held in Canterbury on November 25th and 26th.

CALL-SIGNS: 6 N G, Mr. N. E. Haigh, 16, Fairfield Road, Bridlington, 45 metres, 10 watts; 5 X H, Mr. L. W. Hooke, 87a, Haverhill Road, Balham, S.W.13, 90 and 150/200 metres. (Now testing.)

## Radio for the Blind.

THE British idea of allowing blind listeners to receive radio programmes without a licence has been carried a step farther at Danzig. Here the fee is remitted, and the G.P.O. has organised a fund to provide sets for the blind. Boxes for voluntary contributions have been installed at the post offices.

## Silver Cup for Constructors.

TWO silver cups are being presented by POPULAR WIRELESS in connection with the Amateurs' Competition at the Hull Wireless Exhibition. This show is due to commence upon December 4th, and to close seven days later, and full details will be announced in due course.

## Hearin' Erin.

THE Irish Free State Minister for Posts and Telegraphs (Mr. J. Walsh) stated recently that within the next fifteen months every home in the Free State would be within crystal range of a broadcasting station. Cork Gaol, which has not accommodated prisoners for some time, has been chosen for one of the sites.

## It's All Wrong.

SIR THOMAS BEECHAM, despairing of English music, English opera, British audiences, concerts, *everything* musical, in fact, puts the whole trouble down to one thing—broadcasting!

"When the Government subsidises anything, what does it do?" quoth the good Sir Thomas. Not waiting for a true answer, he goes on: "It subsidises a mechanical invention. Broadcasting!"

As musical instruments are mechanical inventions, and the Government does *not* subsidise broadcasting, Sir Thomas seems to have "missed the boat" somewhere!

## Canada Calling.

THE total number of radio transmitters in Canada is now 543. Of these, 67 are broadcasting stations, another 67 communicate with points abroad or in the Dominion, and 356 are operated by amateurs or experimenters. The remaining stations are operated for communication with ships, or to provide an "aid to navigation" service.

## Murder Trial Broadcast Stopped.

EVEN American listeners were surprised when it became known that arrangements had been made to broadcast a murder trial there. The long-postponed trial of Mrs. Hall and her two brothers, for the murder of the woman's husband and Mrs. Mills—his "soul mate"—had aroused public interest to an unprecedented degree.

## SHORT WAVES.

"Mr. Henpeck has a filament switch on his four-valver. He makes full use of its cutting-off powers when a talk is being made by a lady lecturer. He says that it is the only means he knows of to cease female eloquence."—"Popular Radio Weekly."

A suggestion was recently made that London should have a radio theatre, in which one could dine and dance and listen to the wireless. We thought there would be a catch in it.

"A scientist says that plants can be tickled. A suburban correspondent asserts that his aspidistra laughed outright at something said on the loud speaker."—"Humorist."

"Cost of ruining a wireless set." (Headline in Electrical Paper).

A fairly cheap way is to give it to the youngest son to play with.

"Owing to lack of space, the radio programme is postponed until next week." (American Paper).

The American ether is a bit overcrowded.

The "Evening Standard" states that when asked to name his favorite piece to be broadcast, Lord Hawke confessed an affection for an old-fashioned ballad entitled: "Where is another so sweet as she?" adding: "I was a bit of a warbler myself."

Which bit?

Headline in "Glasgow Weekly Herald." "How you miss your stations." This would be a good title for a "Talk" to railway passengers.

"Not too familiar. It's all right to have a loud speaker in the house if you are not married to it."—"Cincinnati Enquirer."

"The licence fee is not a tax, but it is voluntary payment by the individual listener for the services which the Broadcasting Authority renders, and we feel that no Government has the right to take such fees."—"Newcastle Daily Journal and North Star."

That's just what we think.

"Somewhere a face is calling." (Headline in "Daily Mail.")

Even this might be preferable to some of the voices which do.

But although listeners were morbidly fascinated by the arrangements to put the trial "on the ether," it was generally felt that such a use of broadcasting was a debasement of the science of radio, so the proposal was dropped.

## Everywhere the Same.

THE Berlin magistrates recently fined nearly two hundred listeners for operating or owning wireless sets without licences. If the fine was not forthcoming because the listener could not find the marks, he had to go and mark time at the gaol for fourteen days!

## Radio Fund to go like Road Fund?

THE wireless League is doing good service in calling attention to the manner in which licence money is being appropriated. The League estimates that by the end of the year a little matter of £900,000 will have been retained by the Post Office, just at the time when all the licence money is really required to develop the service for which listeners have paid.

If a fraction of this amount were to be spent on a short-wave station, to keep our overseas kin in touch with Britain, it would not seem so unjust. But will the money be spent wireless-ly at all? It seems unlikely—and unfair.

## Wireless on the Coffee Stall.

AN enterprising stallkeeper in South London is attracting customers by radio. He has a wireless set and loud speaker mounted upon his coffee-stall—and no "grounds" for complaint the customers say.

## Welcome for Wrong Man.

QUITE a comedy of errors arose out of the visit to London of Dr. Richard Strauss, to conduct his own music at the Albert Hall.

B.B.C. officials were waiting at Liverpool Street for the boat-train, and later the German ambassador turned up and waited too.

When the train pulled in the ambassador welcomed a distinguished-looking arrival, and was taking him to the Embassy car when the B.B.C. officials approached and asked where Dr. Strauss was going. "This is not Dr. Strauss," explained the ambassador. So there was a rush down the platform, and eventually the great composer was found in company with a porter, struggling with luggage and the English language!

## TECHNICAL TERMS ILLUSTRATED.

## The Plate.

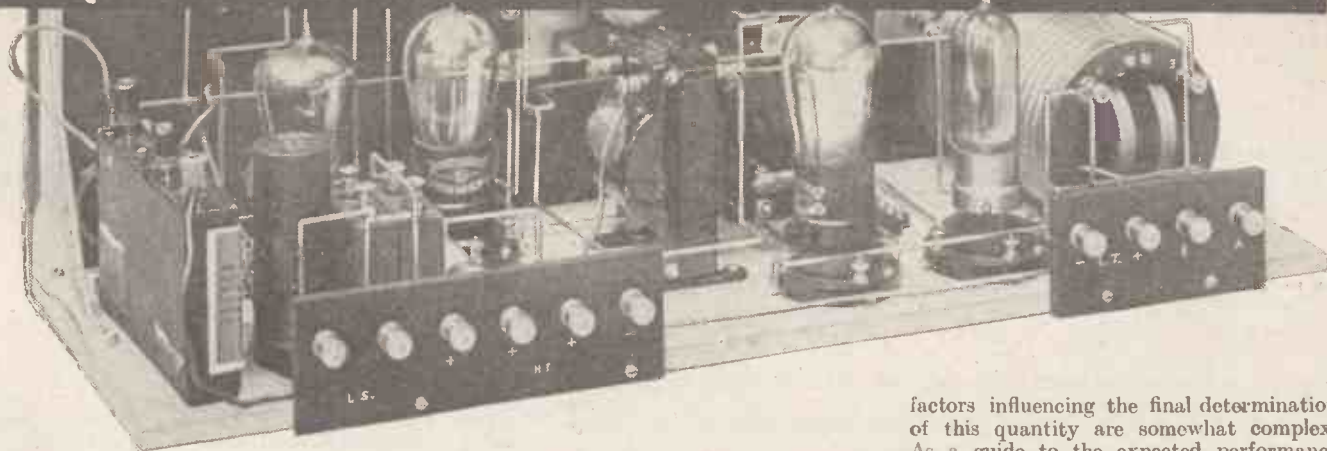
A LADY got very irate  
Because her old man  
Stayed out late,  
So she sat up one  
night,  
And gave him a fright,  
By hurling at him a big



ARIEL.



# SQUARE PEGS IN ROUND HOLES



HOW often we come across the phrase, "Square pegs in round holes," that

I have chosen for the title of this article. It obviously signifies that there is a misfit, either intentional or unintentional, and it is really surprising how many misfits we find in connection with the problems of wireless reception. It may be argued that a receiver is as good as its components, but this will not be true unless the components are correctly laid out and wired to a definite prearranged plan, and thus made to perform their respective functions in a satisfactory manner.

Each portion of your set must act in harmony with the other portions, and to further this ideal we must choose that all-important component, the valve, so that the work it is called upon to do will be executed efficiently. The beginner, or for that matter the average wireless enthusiast, is often at a loss to decide on the valves to purchase for use in his latest receiving set, and there is, perhaps, a justifiable excuse when we think of the vast number of valves on the market, most of which boast of particular markings or designations which give little indication of their specific purposes. However, this is mitigated to a certain extent by the more complete data now being furnished by valve manufacturers, and which should be studied carefully by all prospective purchasers of valves.

## Valve Characteristics.

Some designers prefer to choose the valves to suit the components incorporated in the receiver, while others vouch for the principle of designing the circuit, choosing the valves and then buying the components to match the valves. Whichever method is adopted, there are certain fundamental principles which must be clearly borne in mind in order to get the best results.

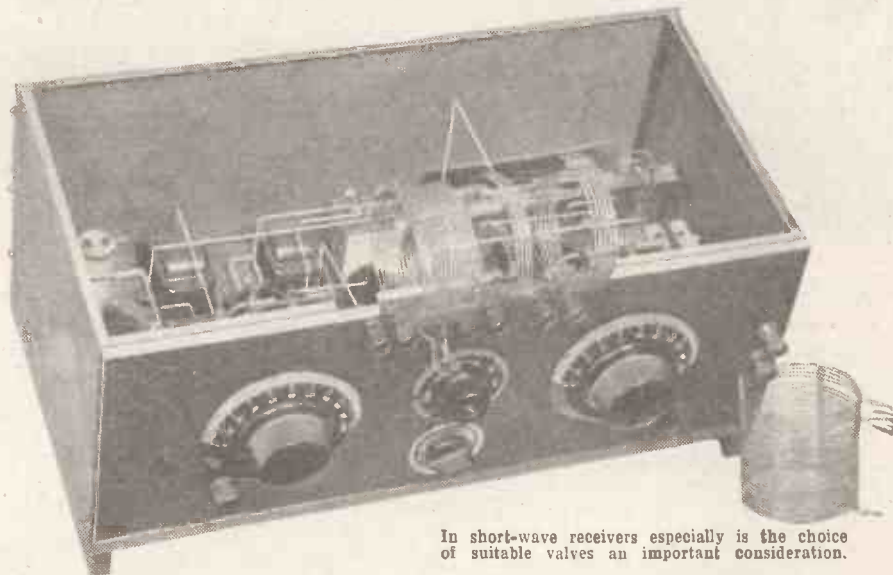
There are two main constants to consider quite apart from details of filament current and voltage, plate current and voltage, etc., although, of course, these last-named details must not be overlooked when the capacities of the batteries and accumulators have to be reckoned. The two terms which I have in mind are impedance and amplification factor, so let us digress for a moment to see what they actually mean. When a current is passed through a valve filament an enormous number of minute particles of negative electricity are "boiled off" from the

By **H. J. BARTON CHAPPLE**,  
Wh. Sch., B.Sc. (Honours), A.C.G.I.,  
D.I.C., A.M.I.E.E.

filament surface, and if the plate or anode is given a positive voltage with respect to the filament a large number of these minute particles will be attracted to the plate to form the plate current. Now this plate current is influenced by the voltage variations brought on to the grid when receiving the wireless signals, and this change in plate

factors influencing the final determination of this quantity are somewhat complex. As a guide to the expected performance of a valve both these quantities must be considered *together* in their proper relationship if the best results are desired.

Let us consider the main functions of valves—to detect wireless signals and also to amplify them either before rectification takes place (i.e. H.F. amplification) or after rectification (i.e. L.F. amplification). Dealing with the first-named, it is usually found with most British valves that they will detect best (if the grid leak and condenser method is employed) when the end of the grid leak remote from the grid is joined to the filament leg connected to L.T. positive. This brings the valve to its most sensitive condition.



In short-wave receivers especially is the choice of suitable valves an important consideration.

current is greater than would be the case if the signal voltage was applied in the plate circuit.

## The Valve's Three Functions.

It is this increased change which gives us a measure of the amplification brought about by the valve and its associated apparatus, and has been popularly called the amplification factor.

The impedance may be regarded as the "resistance" offered to the flow of these minute particles of electricity between the filament and the plate, and although it is just a simple value expressed in ohms, the

## Useful Rectifiers.

Valves which are included under the heading of general purpose valves are frequently used for the rectifying position, and the amplification factor varies between about 6 and 10, with an impedance generally within the limits of 17,000 to 30,000 ohms. If the rectifier is followed by a transformer-coupled L.F. amplifier of low step-up ratio use the higher impedance valve, but if the step-up ratio is high, then a lower impedance can be chosen. For the anode current or anode bend method of rectification, which is

(Continued on next page.)

**D**URING the past month the reception conditions on short waves have been passing through a period of great irregularity characterised by periods of intense atmospheric interference not usually experienced at this time of year, and the "skip" distance phenomena has also been modified in an unusual manner.

Observers have often noticed the great weakness of received signals from local stations transmitting in the 30 to 40 metre band, and this is the normal conditions to be expected from such frequencies. Take, for

## SHORT-WAVE NOTES.

By E. J. SIMMONDS, M.I.R.E., F.R.S.A.

(Staff Consultant.)

example, the test signals which have been sent out from the writer's station, G 2 O D, on 32.25 metres for some considerable time.

The large volume of reception reports to hand indicate that the signals are practically inaudible in this country after a range of from 15 to 20 miles from the station, and doubtless the reception obtained within the 20-mile area is by virtue of the horizontal

ground wave, which, as we know, is quickly absorbed.

Beyond the range of 20 miles, therefore, there comes a wide zone where normally no reception of these signals is possible, until

the zone is reached where the first reflection of the angular ray from the Heaviside layer occurs. This distance from the transmitter varies seasonally from approximately 500 miles in full summer to 2,000 miles in mid-winter, the reason being that during the winter months the ionised upper layers of the atmosphere which bend the angular wave from the transmitter back again to the earth, are normally much higher and this condition favours longer "skips" and better reaching out for low-power transmitters. Now, during the past month, these conditions have been considerably modified and reports have been received from stations in the British Isles outside the 20-mile zone, who normally hear nothing of the 32-metre transmissions from G 2 O D.

### DX Difficult.

Many of these reports are on telephony transmissions, which is all the more remarkable, inasmuch as they emphasise the extreme clarity of the speech, and strength.

All this points to a reflecting ionised layer very close to the earth, which has temporarily cut out the usual "skip" distance, and it is also worthy of note that during these conditions the writer has had considerable difficulty in working over long distances, say, to New Zealand, Australia, etc.. We do know that during this period electrical storms have been unusually active throughout Europe and also Northern America, and there may be some obscure connection between the recent abnormal behaviour of these high-frequency radio waves and the electrical storms. Incidentally, those readers who so kindly from time to time forward detailed reports on my transmissions will see how useful they are under these circumstances.



A portable crystal set that was used with great success during a recent test—underneath 5 X X's aerial.

## SQUARE PEGS IN ROUND HOLES.

(Continued from previous page.)

sometimes employed when strong signals are possible and greater purity is desired, special valves are generally used of the Q.X. and D.E.Q. class, but for the more usual method of rectification many come to mind such as the D.E.R., D.E.11, B 3, H.L. 310, D.E.8 H.F., A.R. '06 (red line).

Coming now to H.F. amplification, it is safe to say that the chief requirements are a comparatively low self-capacity and a fairly high impedance to avoid uncontrollable oscillation. Too high an impedance is somewhat of a disadvantage, as it necessitates the use of high plate voltages, but on the other hand too low an impedance renders the set unstable unless special precautions are taken, so that a happy medium is generally chosen between 30,000 to 50,000 ohms. The amplification factor rules higher

than in the case of the general purpose valves, since the object is to secure the maximum amplification of weak signals, and most of the valves will be found to fall within the limits of 10 to 17. Suggested valves are the D.E.2 H.F., D.E.8 H.F., A.R. '06, S.P. 18 (green spot), H. 512, etc.

It now remains to deal with L.F. amplifiers, and perhaps the main problem is the avoidance of distortion. To this end it should be borne in mind that a good power valve should have a low value of impedance and amplification factor. It is often thought that a "power" valve is one which will make signals very much louder, but the true conception is that the valve will deal with louder signals without any accompanying distortion.

### Resistance Coupling.

The application of grid bias is essential to bring the working point of the valve to the condition when no grid current will flow, otherwise the incoming signal will be upset, and the valve must possess a long, straight portion of the characteristic to deal with the powers handled. By making the

impedance low the resultant anode current is of sufficient magnitude to operate the loud speaker. For transformer-coupled low-frequency amplifiers the amplification factor usually lies between 5 and 7, with an impedance between 5,000 and 8,000 ohms, and suitable valves are P.M.4, L.525, B.4, L.S.5, S.P.18' (red spot), P.V.5 D.E., D.F.A.O., etc., with, say, an L.S.5A for very large powers.

In the case of resistance capacity and choke-coupled amplifiers the problem is modified somewhat, as there is no transformer step-up effect present, and consequently the valve must be called upon to furnish a higher voltage step-up than in the previous case. For this purpose the valve followed by resistance or choke amplification should have a high amplification factor, but the impedance must not be too large, otherwise the H.T. value becomes excessive. The amplification factor is generally of the order of 20, with an accompanying impedance of about 30,000 ohms or slightly higher, and suitable valves may be chosen from the D.F.A.4, D.E.5.B., D.E.3.B.; etc.





**L**ISTENERS who anticipate a time when it will be possible to enjoy any programme, far or near, without interference, are apt to overlook the fact that this is not simply and solely a question of further improvement in the design of super-selective receiving circuits. With the present state of congestion in the ether, the limits of clear-cut reception depend to a very large extent upon what is happening on the transmitting side.

This does not mean to say that selec-

**The Importance of Stabilising the Carrier Wave at a Constant Frequency is Dealt with in this Interesting Article.**

**By SEXTON O'CONNOR.**

only been made feasible by the discovery of ways and means for ensuring that once a station has been allotted a given carrier-wave it shall be definitely stabilised once and for all at that constant frequency. The wave-length scale is now divided up into such narrow zones that even slight fluctuations in frequency are bound to give rise to serious heterodyning with other stations and consequent disturbance over a wide area.

#### Mechanical Methods.

It is a curious fact that the most efficient methods so far discovered for stabilising the frequency output of a transmitter depend, not upon purely electrical methods of tuning an oscillatory circuit by inductance and capacity,

but upon some form of mechanical vibrator, such as the use of a standardised tuning fork, or the peculiar oscillations of a piezo-electric crystal.

In the case of an ordinary valve oscillator with tuned input and output circuits, it might be expected that so long as the inductance and capacity values of the external circuits were kept steady, a constant frequency output would be maintained. In practice, however, any variation in the supply of plate or filament voltage, or any alteration of the load on the H.F. generator due, for instance, to modulation at audio-frequency, or to the effect of rain or wind on the aerial, will inevitably cause slight variations in the frequency output unless some automatic form of frequency control is applied to the circuit.

One type of mechanical constant-fre-

quency control still used in high-powered transmission is the tuning-fork system due to Professor Eccles, shown in its simplest form in Fig. 1.

The two legs of the fork actually form a mechanical back-coupling link between the grid and plate-circuits of a valve, with the result that the frequency of the oscillatory current in the plate circuit is maintained in step with the bodily movements of the fork. It will be seen from the Figure that the prongs of the fork are located between two magnets, one in the grid circuit and the other in the plate circuit.

#### Using the Harmonics.

As the upper prong moves nearer the poles of the grid magnet, the magnetic flux through the pole windings is increased, giving rise to a voltage "kick" on the grid. This causes a corresponding increase of plate current which, as it flows through the plate magnet, causes the latter to attract the lower prong, thereby maintaining the vibration of the fork. The operation of the system as a whole is thus bound up with and controlled by the vibratory movement of the tuning fork.

It is, of course, obvious that no tuning fork could be made to vibrate at anything approaching the enormous frequencies used in wireless transmission. This difficulty is overcome by designing the fork so that it will vibrate at an absolutely constant rate

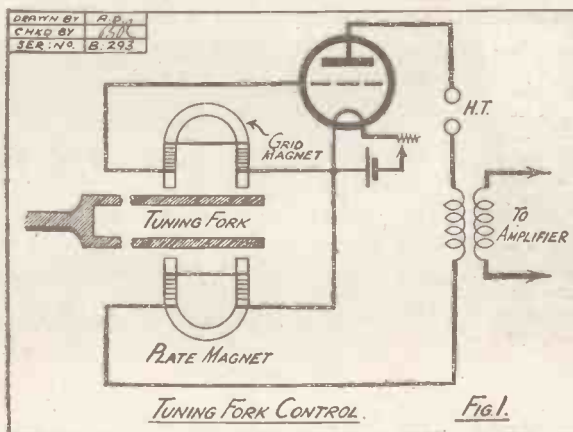


Fig. 1.

tivity on the receiving side has now reached high-water mark, although it must be admitted that no very startling developments have been made in this direction within the last twelve months or so. It is rather intended to emphasise the necessity and value of the work at present being carried out by the International Broadcasting Bureau in reorganising and standardising the wave-lengths used by the various transmitting centres at home and on the Continent.

In this connection it must be borne in mind that the proposals of the Bureau have

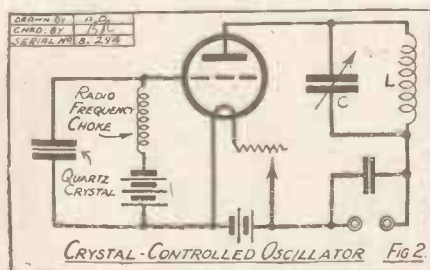
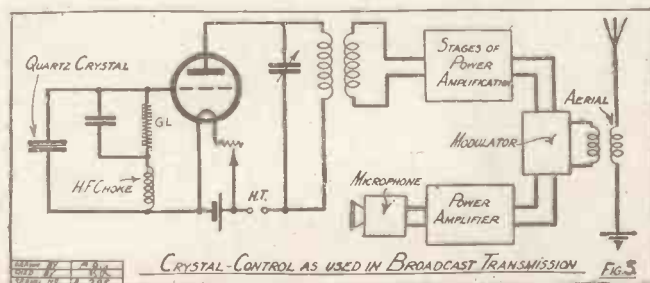


Fig. 2.



CRYSTAL-CONTROL AS USED IN BROADCAST TRANSMISSION

Fig. 3.

of, say, 250 times per second, and then building-up harmonics of this fundamental vibration until the desired frequency is attained.

For instance, by taking the eighth harmonic of the 250-cycle fork frequency oscillations of 64,000 per second are obtained, corresponding to a wave-length of approximately 5,000 metres. Similarly, if the tenth harmonic is chosen, the wave-

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## FREQUENCY CONTROL.

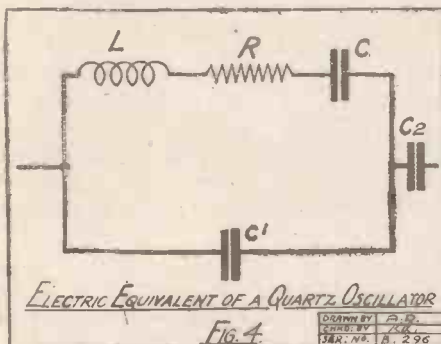
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length is reduced to a constant value in the neighbourhood of 1,000 metres.

In practice, harmonics are produced by applying the fundamental frequency to a valve, the grid potential of which is adjusted near the lower bend of its characteristic curve. In these circumstances the output current of the valve instead of being a pure sine curve is converted into a wave form extremely rich in harmonics. The required harmonic is separated out by means of a suitable filter circuit and is then amplified by a series of power amplifiers until it reaches the aerial.

### The Quartz Crystal.

The elastic vibrations of a quartz crystal, under the influence of an applied oscillating E.M.F., form a still more efficient system of master control, particularly for the shorter wave-lengths used in broadcasting. The natural frequency of such crystals is so enormous that it is possible to cause them to vibrate at the actual radio-frequency



required, although for very short wave-lengths it is usual to select the first or second harmonic of a more massive crystal.

The crystal period is dependent upon the thickness of the quartz, and varies with different specimens from a wave-length of 100 to 150 metres per millimetre of thickness. When used as a frequency control, the action of the crystal can best be explained by saying that it sets up a vigorous voltage reaction, due to its piezo-electric property, at one particular frequency and at no other.

Fig. 2 shows an arrangement in which the crystal is inserted in the grid circuit in shunt with a biasing battery and a radio-frequency choke. The natural frequency of the choke should be very different from that of the quartz, so that it does not interfere with the selective action of the latter.

### Master Control.

When the plate circuit  $L$ ,  $C$  is tuned to the frequency of the crystal, sufficient grid current will flow to maintain the valve in oscillation at that frequency. If the plate tuning is altered, the "piezo" voltage response of the crystal ceases and oscillation immediately stops.

Fig. 3 shows a slightly different arrangement in which the crystal is shunted across a grid condenser and leak in series with a choke. The action is, however, identical with that previously described.

At a broadcast station the output from the master-control valve is passed through a series of graduated power amplifiers to be built up to the required output to the aerial, the audio-frequency from the microphone being applied to the modulating valve after similar amplification as shown.

### An Electrical Arrangement.

The action of the quartz oscillator has recently been thoroughly investigated at the National Physical Laboratory, where it has been shown to behave as the electrical equivalent of an inductance  $L$ , Fig. 4, resistance  $R$ , and capacity  $C$ , in series, and all in shunt to a capacity  $C1$ . The capacity marked  $C2$  represents the capacity of the air gap of the actual crystal mounting.

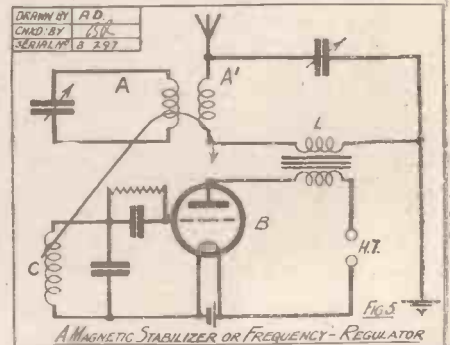
Attempts have also been made to devise automatic master-control systems which depend for their action upon purely electrical methods for stabilising the frequency output.

In the arrangement shown in Fig. 5 a steady source of oscillations  $A$  is coupled with the aerial system  $A1$  and also with the input coil  $C$  to a detector valve  $B$ . The circuit  $A$  is deliberately set to a slightly different frequency from that of the aerial circuit, so that a beat note is created which, in turn, determines the value of the current flowing in the plate circuit of the valve  $B$ .

The plate current passes through an iron-cored coil  $L$ , coupled to the aerial, and

normally saturates it, so that the winding offers practically no impedance to the flow of the H.F. currents in the aerial circuit.

If, however, the frequency of the aerial circuit alters for any cause, such as wind or rain, the beat note with the circuit  $A$  changes accordingly, and reduces the value of the current flowing through the windings  $L$ ,



below the point at which the core is magnetically saturated.

This at once tends to throw a larger effective impedance into the aerial circuit, because the H.F. currents flowing on that circuit must now vary the magnetic flux about the windings  $L$ . In this way the valve  $B$  acts as a brake to prevent frequency-fluctuation, or in other words it acts automatically to stabilise the system.

## A DUAL ADJUSTMENT DETECTOR.

By J. F. C.

CRYSTAL enthusiasts who are on the look-out for a ready means of delicately adjusting perikon rectifying combinations of all types will be interested in the dual adjustment detector which is illustrated in the diagram herewith.

A really first-class perikon combination of tellurium-zincite should, for ordinary use, require no dual adjustment. In such cases, it should be sufficient to allow the zincite element of the detector to remain in a fixed position, whilst the tellurium crystal cup only is made adjustable.

### Easy to Make.

With less efficient combinations, however, for very delicate work, and also for testing out the oscillation generating possibilities of new crystal combinations, it is very convenient to have at hand some apparatus in which both sides of the crystal contact are adjustable.

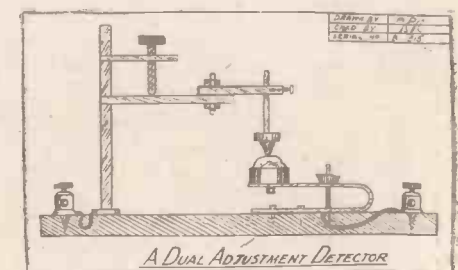
Such a condition of affairs may readily be achieved by the use of the present detector.

As will be seen from the illustration, the detector is based on the principle of the old heavy brass detectors, which were in common use in pre-broadcasting days. Such detectors comprised a metal pillar from which projected a support for the crystal cup, and also an arm through which an adjusting screw was placed.

Detectors of this type can still be obtained very cheaply from firms supplying second-

hand apparatus, and, on the other hand, the amateur with facilities for a little brass working will not find it a difficult matter to construct one for himself.

In the present dual adjustment detector, the bottom crystal cup is not fixed. On the contrary, it is mounted on a piece of



springy brass. An adjusting screw for this latter is provided, as shown in the diagram.

The instrument is a very useful one for serious work, and therefore its employment is recommended for the purpose of the amateur who is carrying out experimental work in the realm of crystal rectifying contacts.

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# TONE CONTROL UNITS



By O. J. RANKIN.

**T**ONE purity includes finding, by practical tests, the most suitable shunting capacity for the loud speaker, and not, as many beginners imagine, mere tinkering with plate voltages, grid bias, etc. Different loud speakers require different shunting capacities; this does not mean that a definite capacity may always be used with a particular type of loud speaker,

as shown, the upper ends being joined to a common lead which is connected to one of the terminals X, and the lower ends to the studs of a sector or fan-switch, the blade of which short-circuits any number of studs, and thus connects a corresponding number of the condensers in parallel. The switch blade is in contact with the spindle and panel bush, and a lead is taken from the bush to the other terminal X. These terminals are connected to the loud-speaker terminals.

## An Improvement.

The construction and successful operation of this type of switch presents certain difficulties, as many amateurs have no doubt discovered; moreover, it is not sufficiently selective, since, as we have seen, the only condenser which can be used independently is the first in circuit (on left), the second being added to the first, the third added to the

second and first, and so on. For example, the second condenser has a capacity of .002 mfd.; if we require this capacity, and no other, the only thing to do is to connect it up in place of the first condenser. Matters may be improved by using interchangeable condensers of the McMichael or "K" type. But let us consider another and better method of utilising odd condensers of any make which may be already on hand.

Glance for a moment at the arrangement shown in Fig. 2. Here the upper ends of the condensers are connected as shown in Fig. 1, but the lower ends are joined each to one side of a special switch consisting of a pair of springy brass clips and a flush type panel socket, the other sides of the switches being joined to a common lead which is connected to the other terminal.

The sockets merely act as guides for fairly long brass plugs which, when pushed well into same, short circuit the clips. Thus by using only one plug any one condenser may be selected; by

using two plugs any two condensers may be connected in parallel, and so on. By using only four condensers of, say, .002 to .006 mfd. capacity, and two plugs, we can select any one of ten different capacities—i.e., with one plug, condensers 1, 2, 3, and 4, and with two plugs condensers 1-2, 2-3, 3-4, 1-3, 1-4, and 2-4, whereas in the foregoing example we use six condensers, and only obtain six different capacities. The advantage of the Fig. 2 arrangement should therefore be obvious.

## Further Methods.

Juggling with capacity combinations is an extremely interesting pastime; it is also very confusing, and the reader would be well advised to avoid anything of a very complex nature. There is, of course, practically no limit to the number of condensers which can be used, and the different combinations of capacity obtained, with the Fig. 2 arrangement; four or five condensers will usually be found ample providing they are properly arranged.

Fig. 3 shows a unit of the baseboard type where the panel, on which is mounted a number of "K" condensers, is screwed down to a flat piece of board. The top ends of the condensers are all connected to one of the terminals by means of a sheet-brass strip which is clamped under the nuts of the bolts holding down the condenser clips, on the under side of the panel. The lower ends of the condensers are connected to a row of flush-type sockets. A second row of sockets is fitted as shown, these being all joined to the other terminal by means of another sheet-brass strip. The strips and connections to the upper sockets are shown dotted. The terminals, of course, are connected to the loud speaker; any one condenser may then be brought into use

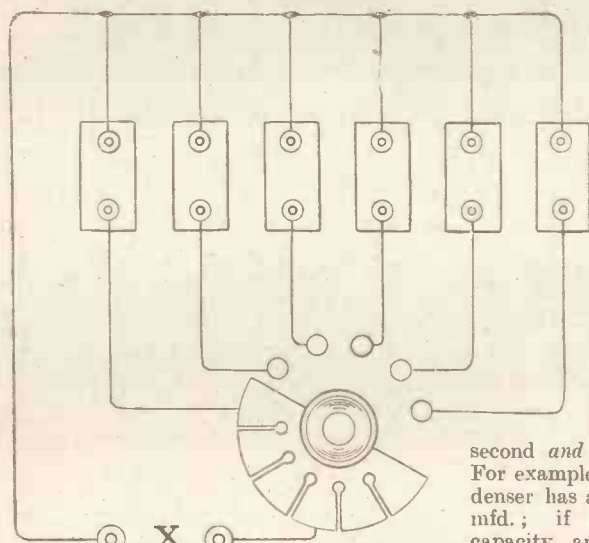


Fig. 1. A useful device which, however, is improved upon in Fig. 2.

for variations in volume often call for slight alterations in the shunting capacity. The best capacity for light speech, music, etc., is not always the best to use when receiving extra loud items such as brass band selections, and it is therefore advantageous to provide a variable capacity.

The most usual method of arranging such a unit is outlined in Fig. 1, where six fixed condensers, ranging progressively from .001 to .006 mfd. capacity, are connected

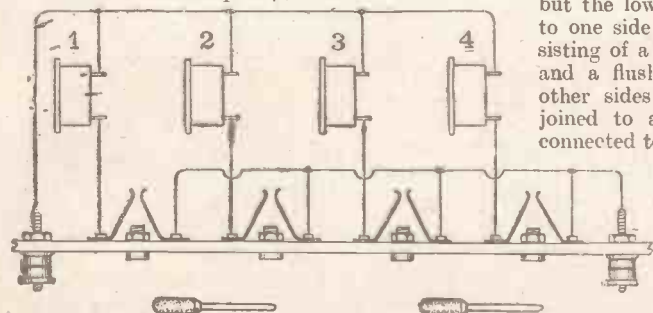


Fig. 2. An easily constructed tone control capable of wide variation.

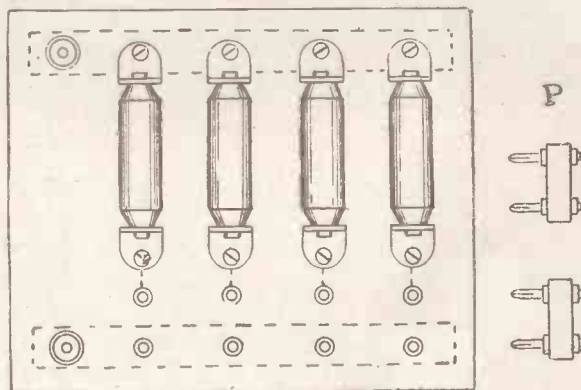


Fig. 3. Another form of unit that gives good results.

by placing a two-pin short-circuiting plug, P, into the corresponding pair of sockets, any two condensers connected in parallel by using two plugs, and so on. The plugs may consist of ordinary valve pins screwed into sheet-brass links, or the pins may be mounted on small pieces of ebonite and joined together with copper wire. A special plug, fitted with two clips and a condenser, may be placed in either pair of sockets so that this condenser is then in series with the selected condenser on the panel. Thus apart from its intended purpose this device can be made to serve as a very useful experimental component.

Another very simple and efficient arrangement is shown in Fig. 4. Here one side of

(Continued on next page.)

# POPULAR BROADCASTING.

From Another Point of View.

By SIR J. KENNETH D. MacKENZIE, Bt.

SO far as the technical side of wireless broadcasting is concerned there is really very little with which honest fault can be found. Captious and carping criticism will always be shown by those who expect and demand perfection, but that is not to be found in anything made by the hand of man, and never will be.

Thanks to the wonderful skill and energy of electrical engineers, their resourcefulness and ingenuity in overcoming obstacles which to the lay mind would appear insuperable, results have been achieved which are simply marvellous when one takes the trouble to think them over. But how many of the millions who use receiving sets every day do so, or try to think of anything but what they are hearing, and whether they receive pleasure or not in so doing?

The ingenuity of designers of instruments, professional and amateur, the enterprise and perspicacity of the wireless trade, have all helped incalculably to bring this baby science out of its swaddling clothes into trousers and coat within the marvellously short space of five years!

The fact is, the public is like a spoilt child who no sooner gets a rattle to play with than it demands a grand piano for its entertainment. The programme offered and achieved, mark you, by the B.B.C. at its birth was too good for a public who knew nothing whatever about radio except from what it had read, or heard from its friends who did know, and who also knew to what it might eventually lead.

## "Spoilt" Public.

It is true that such a wonderfully good start off gave a great impetus to the new entertainment, and helped immeasurably to rake in the licences to enable people to get it, and thus aided the enterprise financially; but the public was not educated proportionately nor concurrently for proper appreciation of the boon, the novelty soon wore off, and the result is what it is.

It is perfectly easy to understand that the B.B.C. wanted to give "the very best they could," and they did it so well that the public got "spoilt" at the beginning, and, like a child, has been "crying for the moon" ever since. In no other scientific or artistic achievement has progress and development been so rapid as wireless broadcasting has been.

All other inventions have taken many years to arrive at their present state towards perfection; while in the musical, painting, theatrical and kindred worlds their art has not become what it is in the course of five or even fifty times five years.

True, certain geniuses in them brought their own expression of their particular art to a very high state of perfection; but the arts as a whole developed slowly, and perhaps none more so than the theatrical. Wireless progress, however, advanced so rapidly that public capability to appreciate its wonders is not much more advanced than it was five years ago. The novelty and wonder soon wore off, and carping criticism has

taken its place because everything is not exactly what everybody wants.

The ubiquity of the receiving set, and the greatly increased use of the loud speaker, resulted in many owners of these instruments using them in a way that caused annoyance to neighbours, and consequently regulations for proper control had to be made in some places.

Tell your friends about the Radio Constructor Supplement, edited by Mr. Percy Harris, M.I.R.E., and appearing in "P.W." every week.

Thoughtlessness rather than malice is probably the cause of such inconsideration for others, which trait is also exemplified in the constant complaints one so frequently sees made regarding items in the programmes. People seem to think they are "the only pebbles on the beach," forgetting that it is

not possible for the B.B.C. or anyone to satisfy and please everybody.

As a matter of fact, however, that is just what they do; everyone is pleased at some time or another at what they hear, though not at the same moment. This would be humanly impossible to accomplish, for no two people are exactly similar in their likes or dislikes. I may switch off directly I hear the sound of modern dance "music," or a "sister Ann" trying to hold her top note from wobbling; but those sounds which may annoy me may set another on her feet again eager to dance, or even give her pleasure the more the top note quavers. "One man's meat is another man's poison," and that is what it must always be.

## Not Properly Appreciated.

Wireless broadcasting is in itself not merely a priceless boon to humanity which is not properly understood, but a marvellous discovery, underrated because it has become universal too rapidly for true appreciation. Everything becomes "commonplace" after a time, and the true import gets overlooked mainly because we are so apt to make our personal feelings the gauge by which a thing should be judged, regarding them as of more importance than the thing itself.

Does not the short history of telephony prove this beyond dispute? It will be the same with television when that also becomes general, and with all other undreamed of marvels yet to come. "Familiarity breeds contempt" in many more ways than one.

## TONE-CONTROL UNITS.

(Continued from previous page.)

each condenser is connected to a telephone type terminal, a connection being taken from the centre terminal to one of the main terminals. Normally the centre condenser (No. 2) is in use, this, of course, being inter-

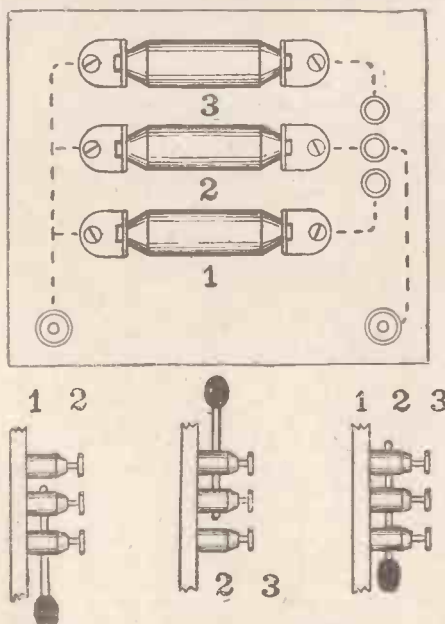


Fig. 4.—A very simple arrangement for three condensers.

changeable with the others. By using a simple brass plug, or a length of ordinary copper wire, the two upper, two lower, or all three terminals may be short circuited (see lower sketches); thus any two, or all three condensers are connected in parallel.

Where interchangeable condensers are used, the device should, wherever possible, be arranged on the flat baseboard principle as in Figs. 3 and 4; the board should be well recessed to accommodate terminal nuts, wiring, etc., and should this present a difficulty, owing to lack of tools, the panel might be mounted on two narrow wooden runners, or on a very shallow cabinet. In any case refinements of this description should be arranged as separate components rather than integral parts of receivers.

## Pure Output Essential.

Other methods can easily be devised by the constructor, but the foregoing will serve to show the kind of arrangement most suitable. It can be made into a neat unit, housed in a cabinet so that it can be placed either by the receiver or by the loud speaker.

All this, however, will not provide perfect reproduction if the output from the set itself is imperfect. It may, to a large extent, correct certain faults due to the loud speaker, but if the L.F. amplifiers are not working properly it is hopeless to expect the tone control units to clear up the distortion. These units should be used in conjunction with the other methods of obtaining pure results—proper grid bias, correct H.T., suitable valves and coupling devices, and then the constructor may reasonably expect really good reproduction of speech and music if he has a loud speaker worthy of that name.



**SIR THOMAS BEECHAM** has been criticising broadcasting. A few days ago he astonished the world by an angry outburst concerning the state of England and, incidentally, broadcasting. It is his opinion that people

who think that what they hear over the wireless is music are fools. Broadcast music to Sir Thomas sounds like the "most horrible gibbering, chortling and shrieking of devils and goblins"—from which it will be seen that Sir Thomas is not enamoured of broadcasting.

Up to a point we have a certain amount of sympathy with Sir Thomas Beecham. He has spent something like half a million pounds in an endeavour to make music more widely appreciated in this country, and he has failed abysmally. Now, any man who has spent half a million pounds in an attempt to foster art in this country must feel rather sore when a new form of entertainment comes along which, in the brief space of four years, can number its devotees in excess of two millions. Sir Thomas has supported opera in this country in a courageous attempt to make it pay, but broadcasting seems to be like the straw which broke the camel's back, and Sir Thomas has now declared his intention of "throwing up the sponge" and going to America.

#### Lack of Opportunity.

Sir Thomas says he objects to broadcasting of all music, because over the wireless all good music sounds bad and all bad music sounds good. This makes a nice little aphorism, but it is very far from being correct, and Sir Thomas probably knows it as well as we do.

It may be, of course, that he has never had an opportunity of listening in to a good concert received on a first-class wireless set. POPULAR WIRELESS has many times given famous musicians the opportunity of judging the merits of a really good receiving set. We regret that we have not been able to give Sir Thomas an opportunity. We feel confident that if he would accept our invitation he would very quickly revise his criticism because, despite his antagonism to broadcasting, we know Sir Thomas to be a fair-minded man, and also too big a man to stick to a dogmatic assertion in the face of evidence that he is wrong.

#### The Future of Music.

"The microphone," says Sir Thomas, "makes good music sound worse and the rotten stuff created by putrid minds is refined by this machine in a Mephistophelean way, so that there is no differentiation between the product of the great master and these horrible creations of to-day. The consequence of this will be that in ten years' time there will be only an audience in England for bad music, which is what these infernal degenerates want. Those of us who live for music will be hundreds of thousands of miles away playing for savages hanging by their toes from the branches of trees, who will be the only natural, unsophisticated audience left untainted by the modern appliances for killing the beauty of music."

## CURRENT TOPICS.

BY THE EDITOR.

Sir Thomas Beecham and Broadcasting—"Rotten Stuff"—"Millions of Fools"—The Wireless League.

Our readers will observe that Sir Thomas, in the above passage, reveals an unsuspected vein of humour. That many of his contemporaries do not agree with him is obvious, for, said Sir Frederick Cowen, in a recent interview: "I cannot understand why Sir Thomas should adopt this attitude at all. Surely he has nothing to complain of. He has always met with appreciation all round. There is nobody who has been so petted by the public."

Perhaps the fact of the matter is that Sir Thomas has been petted too much, and his outburst against broadcasting may be due to the fact that he sees a more popular rival in broadcasting.

It is extremely difficult to see on what grounds Sir Thomas bases his strong opinions. When a man like Sir Thomas Beecham



Mr. Victor Brooker, chief wireless operator of the ss. "Jervis Bay."

criticises broadcasting in the way he has, we have to listen to those opinions with attention and give them due consideration, but, however much we consider his recent criticisms, there seems very little sense in them at all. They are in the nature of a rhetorical outburst founded on a prejudice which has no rhyme or reason.

#### "Millions of Fools."

Whatever Sir Thomas may say, there will be undoubtedly a public for good music in this country; it is a growing public and there can be no gainsaying the fact that broadcasting has done a lot to increase the public's appreciation of good music: nor is there any gainsaying the fact that, famous conductor though Sir Thomas be, the "millions of fools" whom he criticises in this country would probably rather dispense with him than with their wireless receiving sets.

We hope that Sir Thomas, when he goes to the land which gave birth to popular broadcasting—America—will not be con-

strained to make such another outburst of indignation, otherwise we wonder where he will find a really musical home. Perhaps in the long run he will end up in the desert islands and there conduct a large symphonic orchestra played by coal-black

niggers on tom-toms, coconut cymbals, and other instruments which now, in their "refined" state, form the nucleus of the much criticised jazz bands.

#### Red Hot News.

The Wireless League has taken upon itself the task of issuing a wireless warning. A paragraph of this warning reads as follows: "Nothing could be more fatal to broadcasting and to the interests of the listeners than the existing method of financial limitation. The whole science and art of wireless is at present in its infancy (sic). It is not improbable that in the near future the discovery of simple methods of selection or of beam transmission may render the existing broadcasting set entirely obsolete. It is reasonable to imagine that wireless television may be developed to a point where practical and commercial success is obtainable. If it is the intention of the authorities to budget only for the maintenance of the present stations and programme policy, the service of education and amusement rightly expected by the public will be seriously restricted."

Ingenuously, the League also gives tongue to the fear that the £900,000 paid to the Post Office in fees from wireless licences will not be spent for the benefit of wireless listeners.

#### That £900,000!

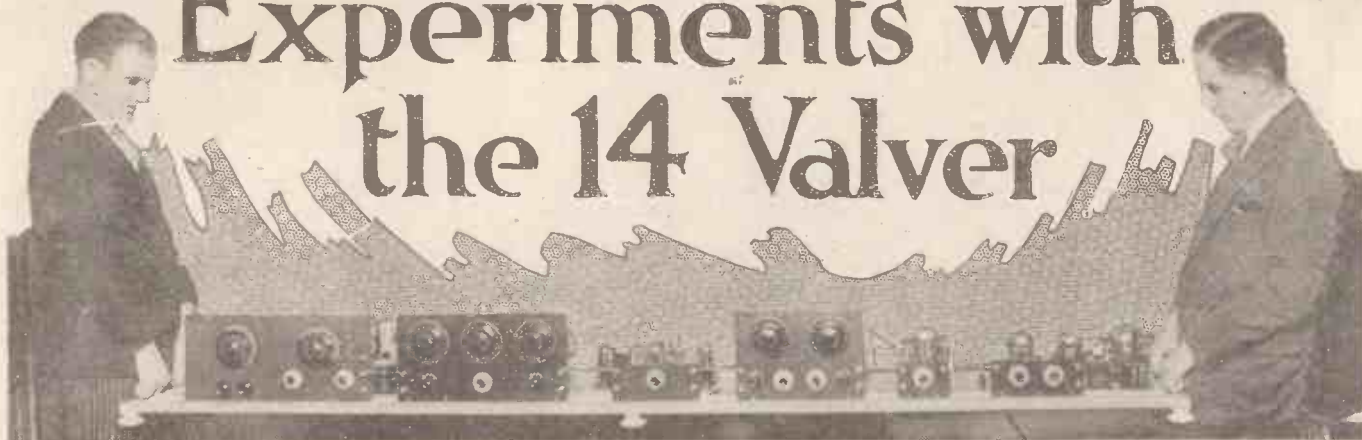
These profound observations have apparently just been discovered by those gentlemen who organise and run the Wireless League. Many, many months ago, POPULAR WIRELESS first drew attention to this scandal of the £900,000. But it is rather amusing to note that a League which claims to represent the listeners in this country should have just awakened to the fact that there is something rotten in the state of broadcasting.

However, we live and learn, and it is interesting, at any rate, to know that the Wireless League are now aware of this scandal. Mr. A. M. Low, who is Honorary Technical Adviser and Secretary to the Wireless League, has also enunciated the profound but by no means original theory that in the near future the "discovery of simple methods of selection or of beam transmission may render the existing broadcasting set entirely obsolete."

The idea that when the new Government Commission takes control they will remain blindly ignorant of technical developments is childish.

It has been clearly pointed out that this Commission will be advised by competent authorities. The Commission, in fact, is merely a figure-head; a well-paid figure-head, it is true, but then, figure-heads in this country are rather popular.

# Experiments with the 14 Valver



OUR fourteen valver is by no means a "freak" and, given the circuit employed, there is no doubt whatever but that many of our readers would be able to build similar sets and get similar satisfactory results. Actually, the circuit is quite straightforward, and it is reproduced here so that readers can examine it and see for themselves that there are no mysterious "wangles" in it.

### A Special Coupler.

Taken from the right of the first vertical dotted line it will be seen that it is quite a normal multi-valve long-wave receiver, with seven H.F. stages and three L.F. stages. In the last of the latter two paralleled valves are used.

The super-het unit is laid out on conventional lines with ample spacing and well-separated wiring. A special short-wave

In this article, Mr. Dowding, Technical Editor of "P.W.," gives some interesting details concerning the problems that had to be solved before "fourteen-valve results" were obtained with "P.W.'s" big set.

coupler, designed by Mr. G. V. Colle, of our Experimental Staff, can be used alternately to one suitable for the normal broadcast band.

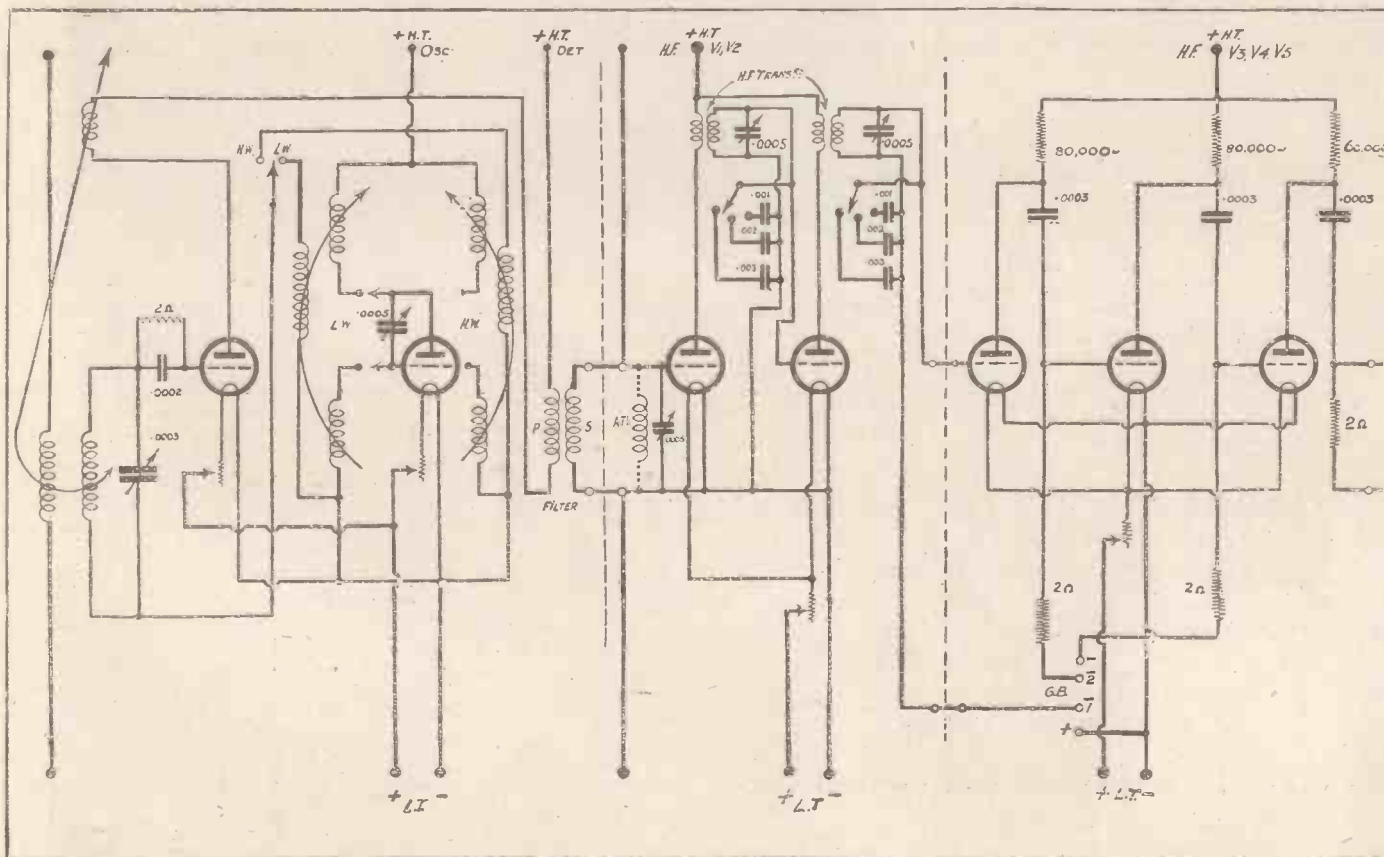
But building this big receiver was not quite as simple a matter as the circuit might at some, suggest. Right at the commencement we could see that our only hope of real success was to assemble the set in self-contained units, each unit consisting of, at most, four valves. Then any fault which existed or which developed, could be tracked down by a process of elimination.

Therefore, each unit was tackled as a separate instrument and got working as such before it was coupled to any other one. Naturally, this did not mean that all the units were certain to operate efficiently together, and many problems had to be solved before the whole assembly would give fourteen-valve results.

### An H.F. Hitch.

In order to reduce the lengths of the leads and to minimise the possibilities of interaction being caused by using common batteries, we decided to employ four H.T. batteries and four L.T. batteries. We had very little trouble with the L.F. unit—we hardly expected to in any case—and the detector stage was very docile. This latter functions on the anode bend principle and can, therefore, act as a limiter.

(Continued on next page.)





## EXPERIMENTS WITH THE 14-VALVER.

(Continued from previous page.)

The three-valve resistance coupled H.F. amplifier caused considerable trouble. In the first place, we wired it up in accordance with the practice of a certain large firm, who claimed that their system was "the last word," but we failed to obtain successful results. The unit would work fairly well by itself—i.e. working direct from an aerial tuner to a detector, but in the big set—well, it was all we could do to hold it down, and certainly results were better without it.

However, we reverted to more standard practice, and after a few experiments with component values the three-valve resistance unit took its place quietly and quite satisfactorily contributed to the long-wave amplification.

## Stations Everywhere!

Now it may have been noticed that the long-wave coil transformers used in the tuned H.F. stages are not screened. We did not find it necessary to screen them for, owing to their wide spacing and careful arrangement, no inter-action was observed. In preliminary tests we used screens, but finding we were able to dispense with them we were distinctly relieved, for even the most enthusiastic advocate of screens will admit that they must inevitably cause losses.

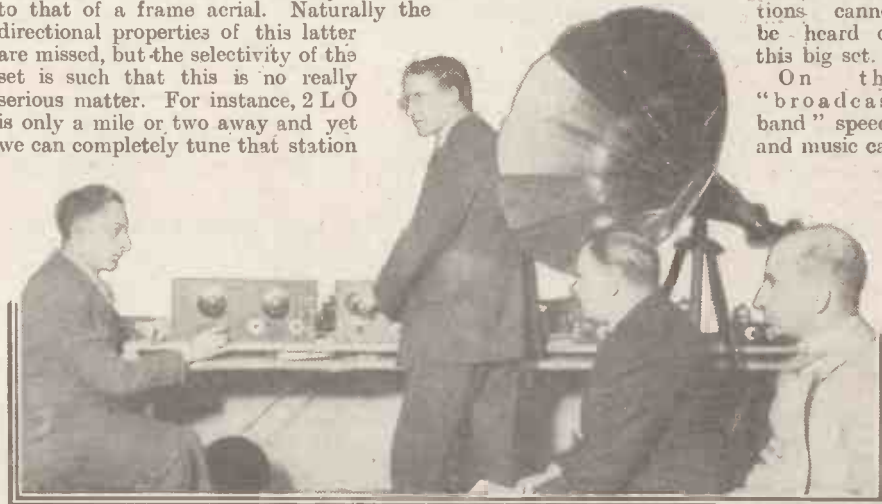
We are shielded against direct "pick-up" by the enormous amount of iron surrounding the building in which our laboratories are situated. To a certain

extent we are also shielded against "aerial pick-ups," and frame aerial work is distinctly difficult. However, even with the fourteen valver we use one of our outdoor aerials which, situated on the roof of Fleetway House, have very respectable effective heights. Of course, we employ a system of very loose coupling, although the "pick-up" with this is infinitely superior to that of a frame aerial. Naturally the directional properties of this latter are missed, but the selectivity of the set is such that this is no really serious matter. For instance, 2 LO is only a mile or two away and yet we can completely tune that station

To obtain quiet, efficient reception it is necessary, very closely, to adjust all the H.T. voltages and to tune accurately all the tuned intermediate stages. The process of calibration takes an hour or two, but once completed the set becomes very stable and not at all hard to handle. There is no point between 30 and 30,000 metres where

several stations cannot be heard on this big set.

On the "broadcast band" speech and music can

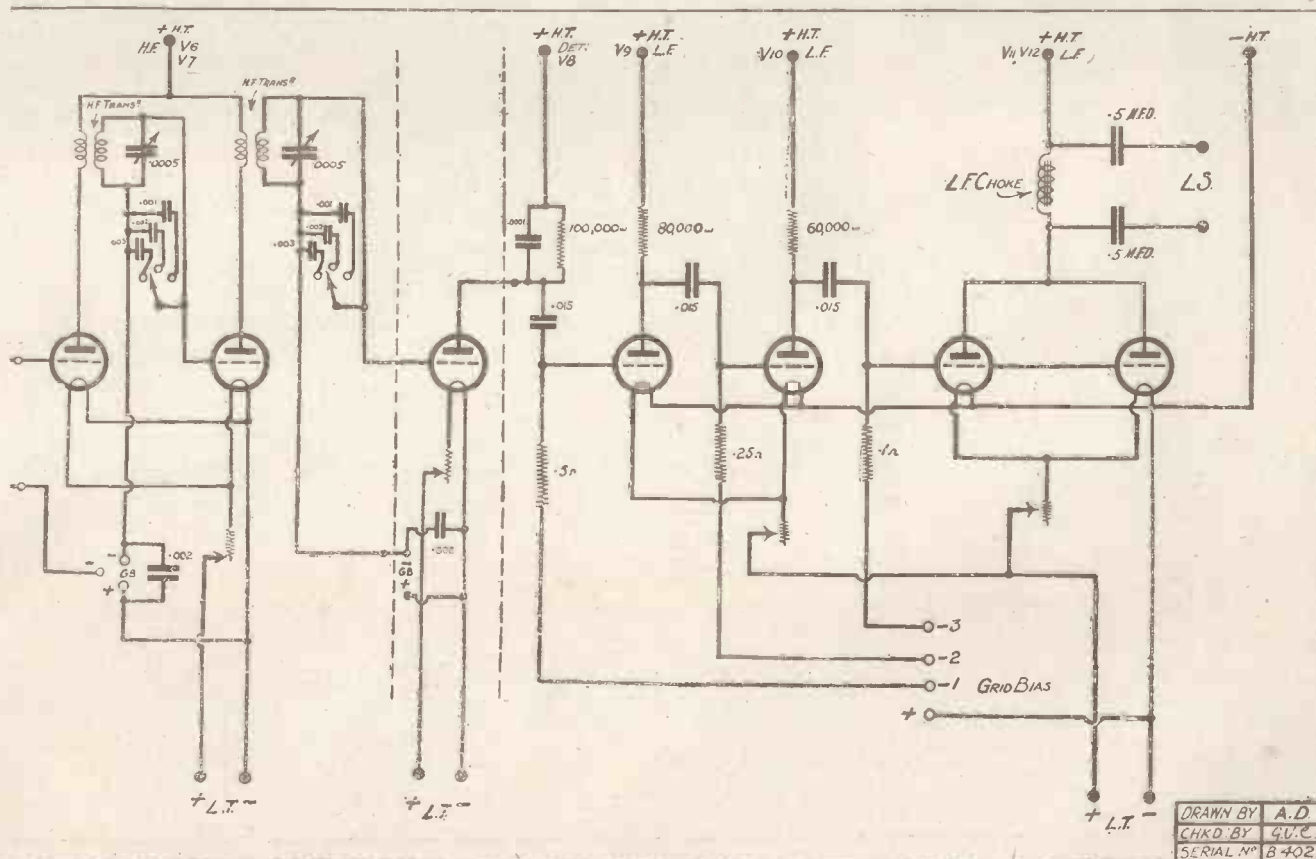


Mr. Dowding (standing) operating the "P.W." 14-valve set. Mr. Josephs, managing director of Radio Instruments Limited, is seated on the extreme right.

out in a degree or-so, and bring in others on to the loud-speaker.

The choice of valves was given very careful consideration, and after many trials we obtained a series of Osram's which answer our purpose admirably. D.E.V.'s occupy the super-het. unit, and D.E.8's and D.E.5a's the remainder of the receiver.

be heard at every degree of the oscillator variable, although it takes a few seconds to bring any one station up to full strength. It is quite a thrilling experience tuning this big fellow, and even hardened super-het. "fans" experience that "big gun" feeling when running over its controls.



IN the case of a receiving set in which the filament control of reaction is critical, you may have noticed a curious effect, which is as follows: When you switch on the set and adjust the filament rheostats to the correct position for the volume you require, afterwards adjusting the tuning dial and then, after some time, switch off the set and after a further interval switch on again, you may find that howling results, or in other words, the reaction limit has been exceeded. Considering that nothing whatever has been done to the set except switching off, then, after a certain interval, switching on again, this effect might at first seem rather puzzling. I have one particular set in which the reaction is very critical in relation to filament temperature, with the particular valves which I am using, and with this set the effect mentioned above is sometimes very noticeable.

#### L.T. Voltage Variations.

A moment's thought will provide the explanation. If the L.T. batteries are fully charged and in good condition, so that when working at the normal load imposed by the set they are able to maintain a practically constant voltage, the effect will not be noticed, for the conditions will not change appreciably either during a period of working or during a period of rest.

If on the other hand, the batteries are in bad condition or are run down, variations in their terminal voltage will occur. There will, for example, be a fairly rapid drop in the voltage on first switching on the set, but if you are then making the necessary adjustments this will probably not be noticed. On switching off the set, however, after the adjustments have been made, the battery will recuperate and its voltage will rise. If then, after a short rest period, you switch on the set, the result is as though you had reduced the resistance in your rheostats, that is, assuming the filament-temperature reaction-control to be critical, the reaction limit may be temporarily exceeded and the set may howl. If you left it for a minute or two (which, in the interests of your neighbours, I hope you will not) it would right itself and would resume normal working exactly as before you switched off.

Of course, although critical reaction control obtainable in this way has certain advantages, it is sometimes very inconvenient and is better avoided. It may be avoided by adjustment of the reaction coupling or by changing the valves about, as it will be found that valves vary considerably in this respect. If you have a set employing H.F. amplifiers it may be worth while taking one of the H.F. amplifier valves and interchanging it with the detector (assuming that the valves are suitable for interchanging in this way).

#### Enclosing the Batteries.

The mention which I made recently in these Notes of the possibility of damage to the wiring of a set by enclosing the battery within the cabinet has brought me a communication from Messrs. Siemens, Limited, the well-known battery manufacturers. They mention the experiences of battery users which go to support the view that there is no harm whatever in enclosing a dry battery within the cabinet. I am always pleased to be able to state all sides of any question of this kind where it

## TECHNICAL NOTES.

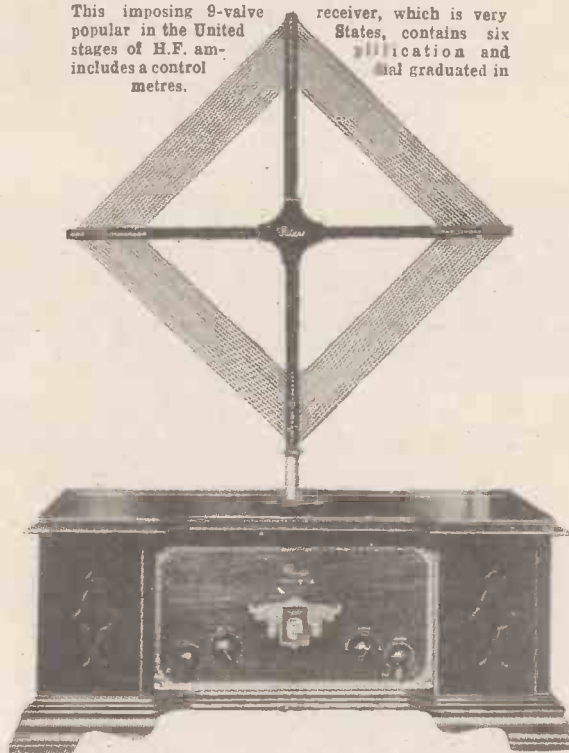
A Weekly Feature  
Conducted by

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

is a matter of public interest and have no object in advancing the views of one more than another.

My own view (on this, as indeed on several of these technical questions connected with wireless reception) is that a good deal of exaggeration has taken place by way of precautions to the amateur. I have myself used sets for a considerable

This imposing 9-valve receiver, which is very popular in the United States, contains six stages of H.F. amplification and includes a control dial graduated in metres.



A powerful multi-valve set just "out" in the States.

time in which both the dry H.T. battery and the L.T. accumulators were enclosed within the set and I have for years past used other types of scientific apparatus, in which both dry batteries and accumulators were enclosed, in a manner exactly analogous to that in which they are used in a wireless receiver, and I have never noticed any ill-effects. In this connection it may be interesting to mention that Messrs. Cleartron Radio Limited, who are now manufacturing and marketing the new Lodge "N" receivers, employ a cabinet which is specially designed to accommodate both the H.T. dry battery and the L.T. accumulators within it, and this may be taken to represent the latest and fully approved practice.

#### L.F. Transformer Interaction.

The amateur constructor is frequently warned as to the importance of avoiding

interaction between L.F. transformers by placing them at right angles to one another. It should be borne in mind that the mere placing of transformers at right angles to one another does not mean that they may with safety be placed in very close proximity. The object, of course, to be aimed at is to prevent the magnetic lines of force from one transformer entering the field of the other, and whilst the placing of the transformers with their axes at right-angles will do a great deal to this end, if the transformers are in close proximity to one another, there will still be, or there may still be considerable interaction between them. Many modern transformers are shrouded in a soft iron case which still further reduces the possibility of interference.

It will be seen from the foregoing that it is desirable to space the transformers as far away from one another as may be possible.

The constructor will sometimes find it inconvenient to place two transformers at right angles with their axes both in the same plane: for example, suppose he is using two transformers of the shrouded hedgehog type, provided with feet and intended to be placed with their axes parallel to the panel or baseboard, it might at first seem that there was no other way of mounting these than that indicated by the maker. This difficulty may become more pronounced in the case of three L.F. amplifiers being used, although, of course, the vast majority of constructors do not go beyond one or two. In the case of three transformers it is evidently difficult to place them all with their axes at right angles to one another unless a three-dimensional arrangement be used. Thus, the first two may have their axes parallel to the plane of the baseboard, whilst the third may be placed "end on" so to speak, that is, with its axis at right-angles to the plane of the baseboard. By this simple arrangement the three transformers have their axes mutually at right-angles.

#### A Question of "Lay-out."

The same arrangement may be used in the case of two transformers where it is inconvenient to mount them at right-angles to one another, and parallel to the plane of the baseboard. In the case of a "barrel" type of transformer, provided with feet and designed to be mounted parallel to the baseboard, the upright or "end on" mounting may be accomplished by the use of two brass-strip brackets or angle-pieces. These should be drilled with two holes in each of the two limbs; in the longer limbs the two holes register with the holes in the feet of the transformer. When these two brass strips are bolted to the transformer feet they provide a right-angle mounting which may be secured to the baseboard in the usual way. Alternatively, a brass "strap" may be used to go over  
(Continued on page 720.)



# Build your own loud speaker

GONE ARE the days of troublesome 'phones. The LISSENOLA brings loud speaker convenience to every home at a record in low price. For 13/6—less than the cost of headphones—you can buy this wonderful loud speaking unit, needing only the addition of a horn to make it a powerful, full-sized instrument yielding results equal to an expensive speaker. And you can build a horn yourself—with each LISSENOLA we give you full size exact patterns and clear instructions how, for a few pence, you can build a big horn of proved efficiency. In addition, the LISSENOLA will fit the tone arm of any gramophone. The secret of this efficiency rests in the remarkably effective manner in which the electro-magnetic sound-reproducing system is concentrated.

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—before you buy go to your dealer and make this test: Ask him to put on the best loud speaker he has in stock—then use the same horn on the LISSENOLA, and see if you can notice any difference.

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Now no home need lack a loud speaker.

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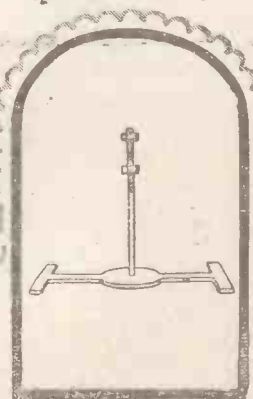
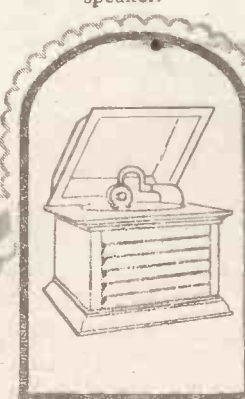
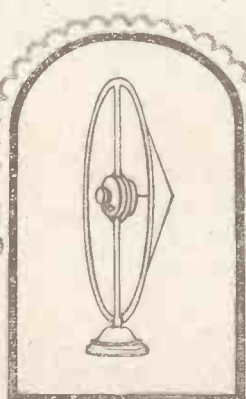
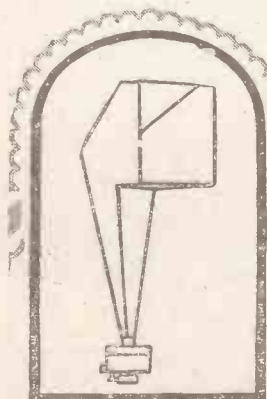
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L.7.

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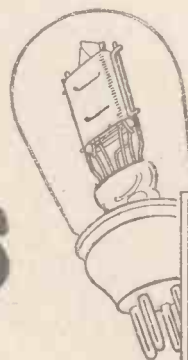
We commend the broadcasts of our two friends to all those listeners who seek the best from their sets.

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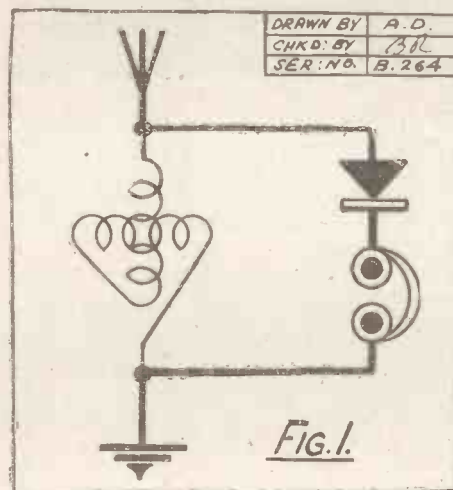
# Some Reliable Circuits

A Critical Examination of a few of the hundreds of circuits the amateur has to choose from.  
By C. E. Field, B.Sc.

WIRELESS receiving circuits may be reckoned by hundreds, and the amateur whose facilities, or finances, do not permit of extensive experimenting is frequently in a quandary as to which of the many recommended circuits he should employ.

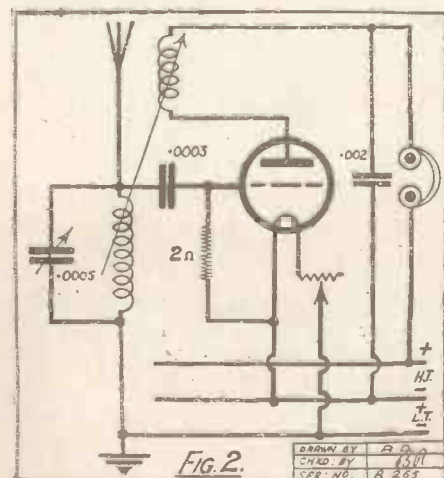
## Working on Averages.

The following notes are intended as a rough guide to those desirous of owning a set which can be relied upon to give good results within its own limitations, only straightforward circuits of proved merit being included.



In order to furnish an idea of the outlay involved, the price of the components shown in the diagram is given in each case, the figures covering valves and batteries, but not aerial equipment, headphones, or cabinet work.

In each case two prices are quoted—one



assuming the use of bright valves, and the other the use of dull emitters of the '06 amp. type. The employment of dull-emitting valves of the 2-volt, 0.3 amp. type will usually incur an intermediate figure.

It will be realised that the prices given are very approximate, on account of the enormous variations that exist in the amount which may be paid for any one component. For example, a three-coil holder, complete with three home-wound coils, may be constructed for a cost of about five shillings, whilst nearly ten times that amount might be paid for a high-class manufactured article.

The following prices have therefore been assumed in all cases: Bright valves, 8s.; dull emitters, 16s. 6d.; power valves, 22s. 6d.; variable condensers (.0003 and .0005 mfd.), 6s. and 8s.; fixed condensers up to .002 mfd., 2s. 6d.; coils and coil holders, 7s. per coil; crystal detectors, 2s. 6d.; grid leaks, 2s. 6d.; rheostats, 2s. 9d.; valve holders, 1s.; variometers, 7s. 6d.; L.F. transformers, £1; H.T. batteries, 10s.; accumulators, 3d. per volt per amp.-hour continuous rating; ebonite panel, terminals, etc., 4s. per valve.

## Using One Valve.

The results to be expected in each case refer only to reception from a main B.B.C. station, using an efficient P.M.G. aerial.

### No. 1.—Variometer crystal receiver.

This is the simplest and cheapest form of wireless receiver, and depends for its success largely upon careful attention to detail in the aerial-earth system and in the wiring of the set.

Satisfactory headphone strength should be obtained at distances of from fifteen to twenty-five miles from a station, according to local conditions.

Approximate cost, 12s.

### No. 2.—Single valve receiver, with reaction.

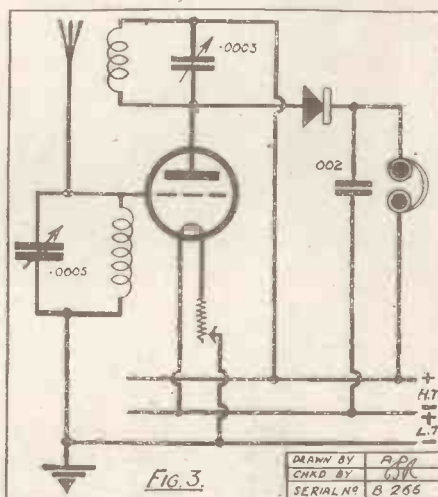
A very useful receiver, giving good headphone results up to a range of about forty miles. Under favourable conditions most B.B.C. and many Continental stations may be received, but these results cannot be relied upon. Great care should be taken in the use of reaction.

Approximate cost, using bright valve, £3 5s.; '06 amp. valve, £3 14s.

### No. 3.—H.F. amplifier and crystal detector, with reaction between anode and aerial coils.

This circuit will provide slightly louder signals than No. 2, and is particularly suitable for those living just too far from a B.B.C. station to obtain satisfactory results with a simple crystal set, and for those who are unable to obtain an efficient aerial system.

Approximate cost, using bright valve, £3 11s.; '06 amp. valve, £3 19s.



### No. 4.—Crystal detector and note-magnifier.

A circuit which can be recommended for use within twenty miles of a B.B.C. station. If signals are audible with an unaided crystal, good results may be expected, and loud-speaker reception may be obtained within eight or ten miles of a station. The circuit is not selective, and is suitable only for reception from the local station.

Approximate cost, using bright valve, £3 18s.; '06 amp. valve, £4 6s.

## Dual Amplification.

### No. 5.—Crystal detector and dual valve, with reaction between anode and aerial coils.

This is a very efficient method of utilising one valve, and, in view of the small outlay involved, is a circuit to be thoroughly (Continued on next page).

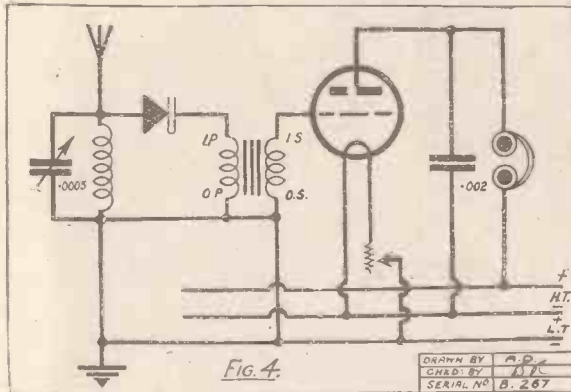


## SOME RELIABLE CIRCUITS.

(Continued from previous page.)

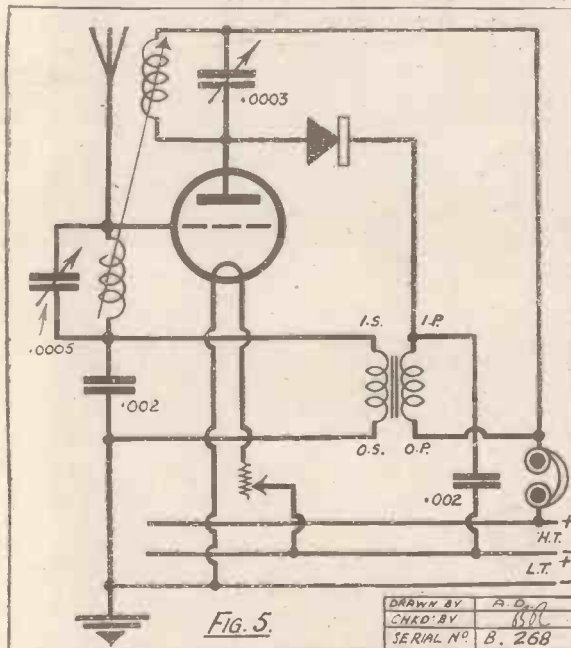
recommended. Care must be taken in the use of reaction, as the circuit is apt to be unstable.

Most B.B.C. stations should be received at headphone strength, and loud-speaker



results obtained at a range of twenty-five miles.

Approximate cost, using bright valve, £4 13s.; 0.6 amp. valve, £5 2s.



No. 6.—H.F. amplifier and valve detector, with reaction on aerial and anode coils.

This is perhaps the best 2-valve circuit for general use, as it is very selective, and under favourable conditions all B.B.C. and many Continental stations can be received. Great volume is not to be expected, and loud-speaker results will be limited to within a very close distance of a station. The circuit is apt to be unstable if not carefully handled, but the tendency to oscillation may be checked by the use of a small reaction coil, and small anode coil with correspondingly large condenser setting.

Approximate cost, using bright valves £5 4s.; 0.6 amp. valves, £5 11s.

No. 7.—Valve detector, with reaction, and note-magnifier.

Within a range of about thirty miles this circuit will yield louder signals than No. 6, and the loud-speaker range may be extended to fifteen or twenty miles.

Although with slight modifications this is a favourite circuit for long-distance, short-wave work, generally speaking, the preceding arrangement should be employed if it is required to receive many different B.B.C. stations.

This circuit, however, is moderately selective, and very simple to operate.

Approximate cost, using bright valves, £5 13s.; 0.6 amp. valves, £6.

No. 8.—Crystal detector and two-note magnifiers.

For good loud-speaker results within a range of fifteen to twenty miles from a station, this circuit has much to recommend it. It is extremely simple to operate, and if care is taken not to over-run the second valve, and good transformers are employed, the quality obtained should be excellent. The circuit is not selective, and should only be employed if it is not desired to receive from beyond the local station.

Approximate cost, using bright valves, £4 14s.; 0.6 amp. valves, £5 1s.

No. 9.—H.F. amplifier, valve detector, and note-magnifier, with reaction on the aerial and anode coils.

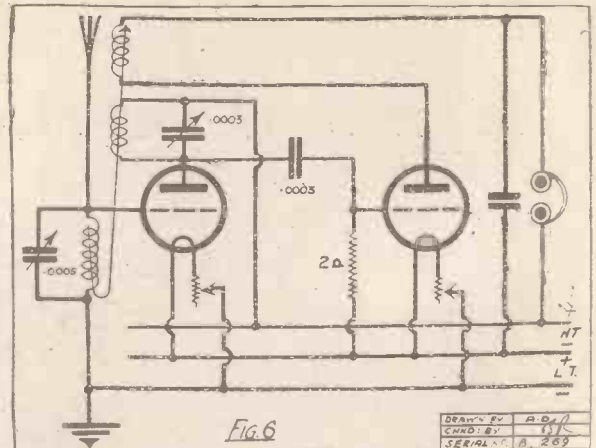
This is deservedly perhaps the most popular valve circuit for all purposes.

It is selective, far reaching, and capable of providing considerable volume.

Loud-speaker Sets.

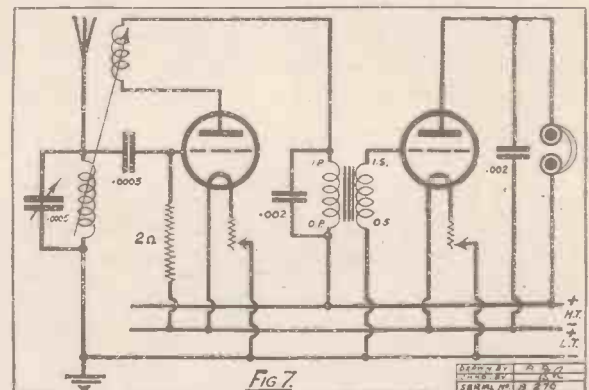
Most B.B.C. and many Continental stations may be expected at good 'phone strength, strong loud-speaker signals being obtainable in many cases.

It will be noticed that, from considerations of first cost, dull-emitter valves are now the most economical. This is because when more than two bright valves are



employed it is desirable to use a 6-volt accumulator of ample capacity, and it is here that the extra cost is incurred.

Results may be very considerably im-

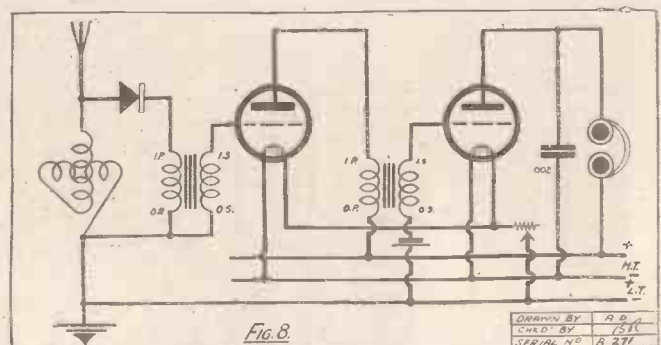


proved by the use of a power valve, with extra H.T. voltage and correct grid bias. The cost will be from 15s. to £1 in excess of the figures given below, but the additional expense will be fully justified.

Approximate cost, using bright valves, £8 8s.; 0.6 amp. valves, £7 18s.

No. 10.—Valve detector and two note-magnifiers, with reaction.

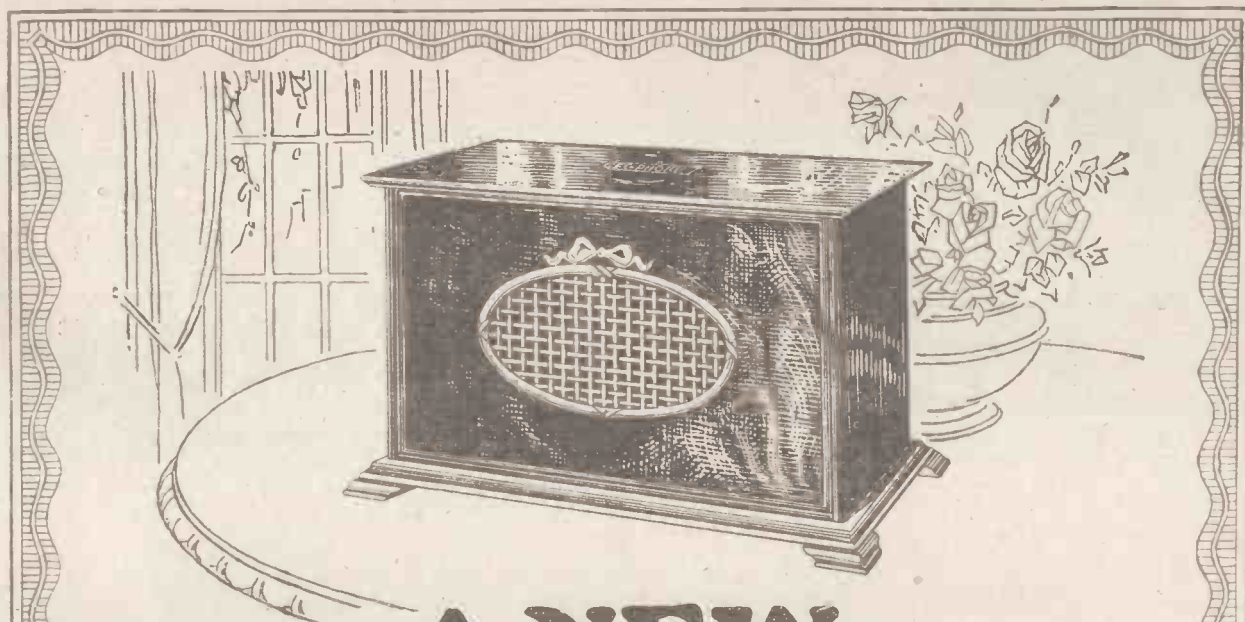
In cases where strong loud-speaker results are required from stations beyond the reach of circuit No. 8, this arrangement provides



considerable volume and is simple to operate. Care should be taken in the choice of transformers, the second of which should be of the low-ratio type. The prices given assume the use of a power valve, with extra H.T. voltage.

(Continued on page 681.)





# A NEW LOUD SPEAKER

*Cabinet Type.  
Rich Tone.*

*Choice Cabinet Work.*

NOTE these special qualities of the new "Four-Guinea" GECophone Cabinet-type Loud Speaker! Firstly, its rich tone is unrivalled; second, its unstinted cabinet work in either solid mahogany or oak; third, the neat Florentine bronze grill which gives it added distinction; and fourth, its extraordinary low price.

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# GECOPHONE

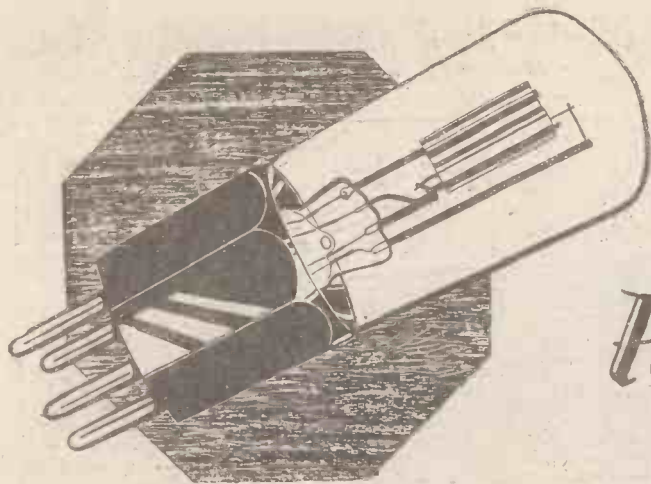
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SETS and LOUD SPEAKERS

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In the base of the Octron Valve—instantly recognised by its Octagonal shape—are embodied several features of importance. A hole is drilled through the bakelite cap which by air di-electric reduces self-capacity to a minimum. The leads from the plate, filament and grid—instead of being soldered at the top of the valve pins as in many valves—go right through a hole in the pin and are soldered at the point. Thus a perfect contact is assured without fear of damaging or disconnecting the leads. Finally, the Octagonal Base prevents the Octron Valve from rolling off when placed on table or bench—saving breakages.

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## SOME RELIABLE CIRCUITS

(Continued from page 678.)

Approximate cost, using bright valves, £10 3s.; .06 amp. valves, £9 5s.

No. 11.—H.F. amplifier, valve detector, and two note-magnifiers.

This is circuit No. 9, with the addition of

on the other hand, be highly specialised and suitable only for one particular purpose, but rather to assist the amateur who is undecided as to what type of receiver will give him the best results for the smallest initial outlay.

However, in view of the attention which is now being given to the design of receiving sets and loud speakers which are capable of very faithful reproduction, mention should perhaps be made of a type of circuit which is eminently suited for distortionless reception over comparatively short ranges.

This is the resistance-coupled amplifier, following a valve detector, no reaction or selective H.F. amplification being employed.

If, for example, the circuit shown in Fig. 10 were modified by replacing each intervalve transformer with a resistance-capacity coupling unit, and eliminating reaction, an almost distortionless receiver would be obtained.

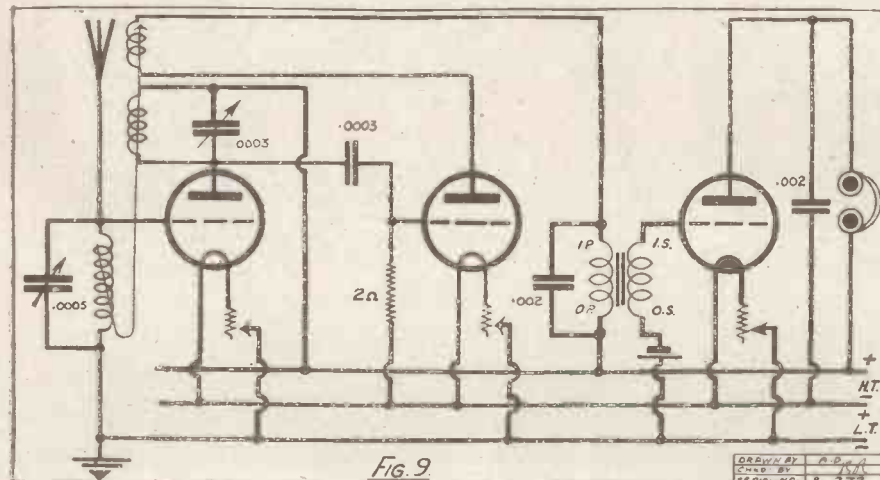
### Difference in First Cost.

The use of specially designed high-amplification valves as detector and first L.F. amplifier would result in a signal strength little less than that obtained in the transformer-coupled circuit, and any loss in this direction would be more than compensated for by the increased purity of tone.

Such a receiver is only suitable for reception from the local station, any attempt to increase the range or selectivity of the circuit introducing distortion.

The difference in first cost of the two amplifiers is negligible, for, although in the resistance-coupled set the somewhat expensive intervalve transformers are avoided, it is essential for good results that the components should be of the highest possible quality, especially when, as is usually the case, high anode voltages are employed.

The question of valves is a far more important one than it would seem that many amateurs and listeners realise. Most no



a power valve, and makes a reliable receiver for long-range loud-speaker work. All B.B.C. and many Continental stations should be received on the loud speaker under good conditions.

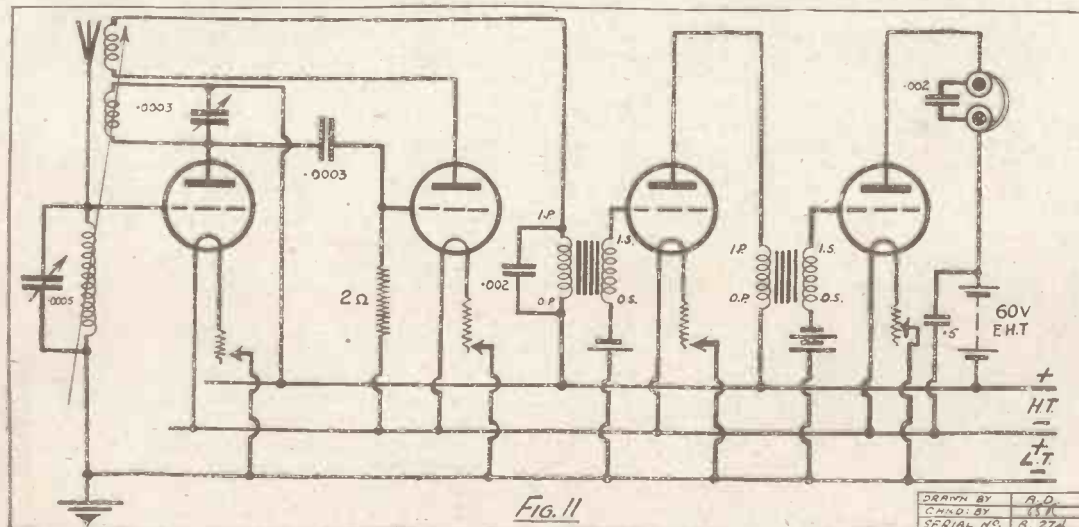
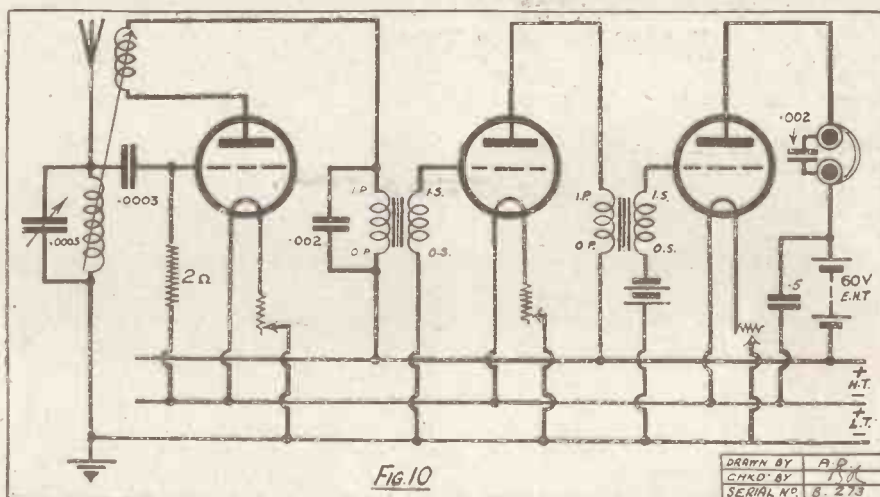
As in the preceding circuit, the second transformer should have a low ratio. The quality of reception may sometimes be improved by joining a resistance of about half a megohm across the secondary winding of the second transformer.

Approximate cost, using bright valves, £11 13s.; .06 amp. valves, £11 3s.

### A Resistance-Coupled Amplifier.

There are, of course, many excellent circuits which have of necessity been omitted from the foregoing.

It is not the purpose of this article, however, to provide a comprehensive list of circuits, many of which might differ from one another only in detail, or which might,



doubt know that there are different types of valves for different purposes available, but how many realise that the types extend to further than a mere H.F., detector, L.F. classification?

This has a very distinct bearing on the capabilities of receivers, for an L.F. valve which is suitable for transformer-coupled stages may give very poor results if used in a position preceding a resistance-coupled stage. And in conclusion, it is worth while to emphasise the fact that the last valve in any loud-speaker set should be a low-impedance power valve.

# BROADCAST NOTES.

FROM OUR BROADCASTING CORRESPONDENTS.

**St. Cecilia's Day—Sir Thomas Beecham—De Groot, Next Year—Trafalgar Day Trouble—More Gilbert and Sullivan—"Shock-Headed Peter"—Brahms' Requiem—"Love Adrift"—Florence Mills, a B.B.C. Blunder—Licences: The Danger Signal—Parliament: The Forthcoming Storm—A Broadcasting Genius.**

## St. Cecilia's Day.

NOVEMBER 22nd is St. Cecilia's Day, and a special programme is being introduced by Captain Ian Fraser, M.P.'s. The artistes will all be blind and will be drawn from St. Dunstan's and from the National Institute for the Blind.

## Sir Thomas Beecham.

The violence of Sir Thomas Beecham's attack on Broadcasting considerably discounted its effect. Curiously enough, it is a fact that he once dallied with the suggestion of becoming conductor-in-chief of all twelve of the B.B.C. National Concerts at the Albert Hall. He was offered a very attractive figure, and nearly yielded—but not quite.

## De Groot—Next Year.

The De Groot affair was unfortunate; but in point of fact, the B.B.C. were not particular whether or not he continued to broadcast. It is understood also that the management of the Piccadilly Hotel are not sorry that there is at least to be an interruption of broadcasting from there. What will happen will be a re-engagement next year.

## Trafalgar Day Trouble.

The B.B.C. organised a special programme from the decks of the "Victory"—Nelson's flagship—to mark the anniversary of Trafalgar Day. Apparently this was listened to on the Continent. The result is that there was a certain amount of heart-burning among a section of patriotic Frenchmen. A demand has been expressed in influential quarters for propagandist reprisals against "Perfidious Albion." One newspaper expresses French resentment in very decisive terms. It will be regrettable if broadcasting begins to take on a consciously nationalist tendency. The organisation at Geneva has so far prevented this, at least among the bigger countries. There is, of course, a certain amount of hostility as a normal affair between the broadcasters of some of the smaller Balkan and Central European States.

## More Gilbert and Sullivan.

There are bright prospects of more Gilbert and Sullivan in December. Negotiations are now under way which should enable the B.B.C. to broadcast excerpts from "The Yeoman of the Guard" and "Iolanthe."

## "Shock-Headed Peter."

Mr. Nigel Playfair will probably produce "Shock-headed Peter" as a Children's Hour feature during the special Christmas programmes. This should be an exceptional treat to old and young alike.

## Brahms' Requiem.

Brahms' Requiem is to be relayed from Canterbury Cathedral at 5.30 p.m. on December 16th.

## "Love Adrift."

A studio selection of this musical comedy will be given shortly. The play was not successful at the Gaiety, but it is regarded as successful musically, and therefore suitable for broadcasting.



The Grebe "Princess," an American completely self-contained cabinet receiver.

## Florence Mills—A B.B.C. Blunder.

The contretemps about Florence Mills had little real justification. When the B.B.C. stipulated a fifteen minutes' performance for the fee mentioned, they did not mean a continuous performance. Fifteen minutes was to cover the introduction, the announcements and reasonable intervals between items. The artist would probably not be required to render more than a maximum of three pieces. Thus there was a lot of fuss and exasperation about one piece. Mr. Cochran had said he would let Miss Mills do only two pieces. In such circumstances, there is a measure of blame on both sides, but most people "in the know" place the chief blame on the shoulders of the B.B.C. negotiators. Whoever represented the Savoy Hill authorities in this matter was guilty of curious inflexibility.

It is to be hoped that the approach of the new régime is not being reflected in a new attitude of arrogance on the part of a section of the "people" at B.B.C. headquarters.

## Licences: The Danger Signal.

The rate of increase of broadcast receiving licences has become practically stationary. A decline set in in early October and the curve has been getting more and more like a straight line ever since. The process is likely to continue until the public is definitely sure that the new régime is not going to ruin the service. Of course this decline in licence increase is of no practical interest to the B.B.C., because they do not benefit from extra licences, in any event.

## Parliament: The Forthcoming Storm.

It is certain that Parliament will be much more critical of broadcasting plans than the officials of the Treasury and the Post Office had expected. There is increasing evidence of restiveness, both with regard to the constitution and with regard to financial arrangements. There will have to be a Consolidated Fund Bill before the end of November to sanction payment for the new Governors and Chairman. Just before this is taken, the P.M.G. will lay papers, including the Charter and the Licence. He will have to outline the financial proposals, and will have to explain on what ground he is departing materially from the recommendations of Lord Crawford's Committee on Broadcasting. The Wireless League has stirred up a lot of interest throughout the country, and Members of Parliament are in no doubt as to the attitude of their constituents. There is keen general anxiety that the B.B.C. should carry on untrammelled and that there should be no withholding of funds for at least three or four years. With this attitude prevalent it is a pity the B.B.C. does not give more information about the details of its finances. This is a point on which B.B.C. policy has always been unsatisfactory, particularly from the point of view of its best friends. The Savoy Hill people are too apt to declare parrot-like: "There is no practicable limit to the money that can be spent usefully on broadcasting, but we cannot give you figures; you must trust us." This attitude is not helpful. Programme expenditure should be analysed and published under various headings, and all such accounts published with the authority of auditors. It is profoundly to be hoped the B.B.C. changes its policy in this matter in time for the parliamentary discussion.

## A Broadcasting Genius.

The appointment of David Cleghorn Thomson to be Director of all broadcasting work in Scotland and Northern Ireland marks another step in the romantic career of this brilliant young man. He is still only 25 years old. He is a distinguished product of Balliol. He has stood several times as a parliamentary candidate, and has been looked upon in Liberal circles as a potential Gladstone. He is temporarily out of politics, and he may indeed stay with broadcasting permanently. He is regarded by his friends as the natural successor to Mr. Reith in about five years' time.



## Who earns your money? Who spends it? Who chooses your parts for you?

No set published by any periodical could use only one make of parts or could use the same make of transformer, for instance—it would not be fair to advertisers if they did not all have a share in this kind of mention. **BUT YOU ARE FREE TO CHOOSE YOUR OWN PARTS.**

Your transformer, for instance. Never again pay a high price for your transformer no matter what may be specified—the new LISSEN has revolutionised all previous ideas of transformer price and performance.

So good is it, that all our own high priced models, which have been on the market and largely sold for several years past, have been unhesitatingly withdrawn in favour of this new LISSEN.

*The fine tone and great power of this new LISSEN Transformer have been proved by the trade—they are largely using it for their own built-up sets.*

It Fully Amplifies Every Note—Every Harmonic—Every Overtone. Choose the New LISSEN. First for its Performance. Secondly for its Price. **ACTUALLY TEST IT FOR 7 DAYS—IF NOT SATISFIED THEN TAKE IT BACK TO YOUR DEALERS OR SEND IT BACK TO US.**

Our new direct to dealer policy of distribution (which cuts out all wholesale profits), aided by our huge production programme and the special plant installed to turn it out have enabled us to sell this new LISSEN Transformer at an unheard-of low price.



# 8/6

AND GUARANTEED  
FOR 12 MONTHS.

TEST IT FOR 7 DAYS

Turns ratio 3 to 1  
Resistance ratio 4 to 1

Use it for 1, 2 or  
3 stages L.F.

*It will suit every circuit and every valve you will want to use.*

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

Managing Director: Thomas N. Cole.

*Many are using LISSEN Transformers in "N" Circuits.*

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Small energy-conserving condensers—note the new case which enables the condenser to be used upright or flat. At present the new case is available only in the most used capacities, but will quickly become a LISSEN standard.



Capacities—  
0001 to 001 1/- each (much reduced).  
002 to 006 1/6 each (much reduced).

Accurate to 5%—they never leak—they never vary.

### LISSEN Mansbridge Type CONDENSERS.

To a fine LISSEN quality condenser is added the specially moulded case—the condenser cannot short circuit on to its case. The new LISSEN case protects you if the condenser is used in any circuit connected straight on to the electric light mains. And due to our new policy of direct to dealer distribution this LISSEN Condenser costs no more than the ordinary type.



01 to 09	2/4
1	2/6
2	2/8
25	3/-
5	3/4
10	3/10
20	4/8

### LISSEN FIXED GRID LEAKS

A case of these was left on our factory roof during the summer of 1925, soaked in rain, baked by sun and the resistance value of these leaks never altered.

All capacities, previously 1/8, Now 3/- each.



Improve every circuit by using LISSEN parts wherever you can—save money too—for now you get keen prices as well as fine quality.

## SOME VALVES ARE VALVES

YOU try one valve after another in this or that stage, and listening critically you persuade yourself that the result is a little better or a little worse. Then perhaps by chance, or very likely on personal recommendation, you try a Cosmos S.P. Valve, and realize with delight that no straining of your ears or the exercise of supercritical faculties is required to recognize the immediate increase of pep and volume obtainable.

You say "Why is it?" All the materials used in the manufacture of valves to-day are known, common to all, there are no secrets about that. Presumably with firms of repute it may be assumed that the same manufacturing skill and supervisory care is exercised. How is it then that such a distinguishable difference, such a distinct improvement can be obtained?

The explanation lies in the unique Shortpath construction, which, without sacrificing anything in rigidity, reduces the path the electrons have to travel to a minimum impossible with other methods of construction, resulting in efficiencies and impedances hitherto unobtainable. It is not overstating the case to say that this scientific construction marks the most notable advance in valve manufacture since their earliest development.

Compare the specification of two of these valves with that of any known valve of other construction and similar price, and the reason for the increased pleasure you will derive from their use is obvious.

### S.P. 55/B Blue Spot High Amplification

5.5 volts	..	Filament voltage	..
0.09 ampere	..	Filament current	..
35	..	Amplification factor	..
0.65 mA per volt	..	Mutual conductance	..
55,000 ohms	..	Impedance	..
18/6	..	Price	..

### S.P. 55/R Red Spot Power Amplification

5.5 volts	..
0.25 ampere	..
6	..
1.7 mA per volt	..
3,500 ohms	..
22/6	..

There are Cosmos S.P. Valves with similar characteristics for use with a one-cell accumulator, also special valves like the Cosmos D.E.11, A.45, D.E.55, but ask your dealer for Folder 4117/3, which will give you complete information about all the Cosmos Valves at present on the market, and provides a table showing how and where they can be used to the best advantage. This is important and will be found very useful to the constructor.

To the non-technical user, simply wanting music and faithful distortionless reproduction, a Cosmos 5-valve set, fitted with Cosmos Valves, is the ideal. It has been called the "Musician's Set," and such eminent authorities as Sir Landon Ronald and Mr. Percy Scholes speak loudly in its praise.

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# The RADIO CONSTRUCTOR

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



This valuable eight page supplement, devoted to the interests of amateur wireless constructors, appears every week in POPULAR WIRELESS. Tell your friends about it, for it is only in "P.W." that they will find the radio articles by the leading constructor expert, Mr. Percy W. Harris.

IT is really surprising that in an art as new as radio there should be so many conventions and so much difficulty in persuading both manufacturers and home constructors to depart from them, even when it can be shown that the original ideas on which the conventions were founded are fallacious.

In some cases, of course, when the convention is connected with a standard, it is wise to adhere to the particular arrangement so as to simplify construction and to maintain interchangeability. For example, there are still many experimenters who believe that the object of the pin and socket in the base of a plug-in coil is to avoid the possibility of plugging in a coil "the wrong way round."

## The Coil Socket Fallacy

It seems to them that if the coil base had two pins and the coil holder two sockets, the user would not know which way round to plug in the coil so as to get the correct reaction effect. In point of fact, assuming that a coil has two pins on its base, and the holder two sockets, and that with a particular circuit the reaction coil is applied the correct way round, reaction will *not* be reversed by pulling out the coil and reversing it in the holder. The explanation is that, while we reverse the direction of winding by making such a change, at the same time we reverse the *connections* to this winding, so that we have a double reversal and the field direction remains precisely the same.

It will thus be seen that no advantage is gained by this pin-and-socket arrangement, so far as irreversibility is concerned; but as the plug and socket has been adopted by so many makers of plug-in coils, and as all coil holders of the conventional type are made to take such fittings, any change to a different form would be attended by far more disadvantages than advantages, particularly as efficient inductances not of the multi-layer type are evolving on separate and distinct lines.

Another convention which has many disadvantages and no advantages that I can see, is that of marking the primary and secondary windings of L.F. transformers I.P., O.P., I.S. and O.S. respectively. I.P. means "inner primary," O.P. means "outer primary," while I.S. and O.S. are "inner" and "outer secondary" respectively. Assuming we wind the primary next to the core, the I.P. will be the start of the winding and the O.P. the end of the winding which comes immediately next to the insulation separating the primary and secondary windings.

Assuming also that we wind the secondary immediately over the primary, the I.S. connection will be relatively close to the O.P., while the O.S. will be the end of the winding on the outer layer. If a transformer is wound in this way—i.e. by ordinary layer winding with primary next to the core and secondary immediately over.

it—it is distinctly better that the O.S. terminal should be connected to the grid, but transformers are now wound in so many different ways that it by no means follows that the O.S. is always the best grid connection.

## Some Transformer Problems

Some transformers, for example, are wound in section form so that primary and secondary sections are sandwiched between one another. Others are wound with the secondary next to the core and the primary outside, while sometimes the primary is in one section and the secondary in two.

In any case, the user can only be very mildly interested in which is actually the beginning and end of the primary and secondary windings. What he aims at is the best result, and unless he has a good knowledge of transformer design and, in particular, knows the method by which the particular transformer is wound, he has no means of telling which is the best connection by looking at the lettering.

A few transformer manufacturers are now marking their transformers: plate (or anode) H.T. positive, grid and L.T. negative, a far more sensible way and one which gives information of value and not merely of slight scientific interest. Obviously the transformer manufacturer knows which are the best connections for his particular instrument, and as these connections do not alter with different valves, they can be standardised.

But here again there is a danger of falling into another error in marking. Of those manufacturers who mark their transformers in a way showing how to connect them, quite a number mark the secondary ends "grid" and "L.T. negative" respectively. A far more sensible marking would be "grid bias negative" instead of "L.T. negative," for in practically every case grid bias will be used, and the terminal needed for this should be properly marked.

Have you ever thought of the absurdity of calling your accumulator your "L.T. battery," and your anode battery your "H.T. battery"? Nobody ever thinks of referring to house lighting voltages as "H.T." even when they are in the neighbourhood of 250 volts, yet a 60 or even 30 volt dry battery is referred to as "high tension." It is quite easy to fit up efficient circuits for reception with a 6 volts L.T. and 6 volts H.T., whereupon the absurdity becomes even more apparent.

As the L.T. accumulator is used simply for the purpose of supplying current to heat the filament, it would appear that "filament battery" is sufficiently explanatory and accurate for all purposes.



The success of the year! This Hale receiver in the form using Reinartz reaction. Have you built yours yet?

*Percy W. Harris*

# Building a Resistance Amplifier

A Further Article of the  
"Modernising" Series by  
the Editor of the Radio  
Constructor.

WHILE I do not agree with the people who say that pure reproduction is *not* possible with resistance-coupled L.F. amplification, it is true that in more than one stage of amplification high quality is easier to obtain with the resistance amplifier than with the transformer-coupled type.

So many readers have asked me to tell them how to modify their receivers in order to introduce resistance coupling, that the present article has been written as an answer to their request.

## Transformer Pros and Cons.

Many long articles could be written on the relative advantages of resistance- and transformer-coupled amplifiers, but however interesting the subject may be, we have not space here for such a discussion. Suffice it to say that on the transformer side of the argument greater amplification per stage is possible, and it is not necessary to use such high plate voltages as with resistance amplifiers. On the resistance side of the argument the important fact that stands out is that it is much easier to get satisfactory reproduction with two resistance-coupled note magnifiers than with two transformer-coupled magnifiers, and against the increased plate voltage required can be set off the considerably reduced plate current.

In view of the article in last week's issue entitled "The Assault on your Battery," readers may realise that the reduction in plate current is no inconsiderable advantage.

I have listened to sets with two transformer-coupled amplifiers, the quality of reproduction from which was indistinguishable from that of the best resistance amplifiers, but in obtaining these results the greatest care had been taken in choosing

the transformers, the lay-out of the set, and a dozen other points. I have also had some little experience in examining home constructors' sets, and have frequently found the builders thoroughly dissatisfied with the quality obtainable with two transformers. It is safe to say that such people, who seek good quality and do not object to the sacrifice of a little volume, will get all they desire by reconstructing the amplifier portion of their receivers in the resistance-capacity coupled type.

## How the Unit is Made.

The unit described in this article has been designed to occupy approximately the same space in a receiver as that taken by the usual transformer-coupled arrangement, and can be considered as the amplifier end of any receiver. For this reason, readers should find it very simple, if they so desire, to remove the present L.F. portion of their receivers, fit the unit shown, and make all necessary modifications without disturbing the panel lay-out or the H.F. and detector portions of the sets.

An examination of the photographs will show that no part of the amplifier is carried on the panel, and that the existing terminal strip, valve holders, and baseboard can be used.



This unit will fit into many existing sets without change of panels.

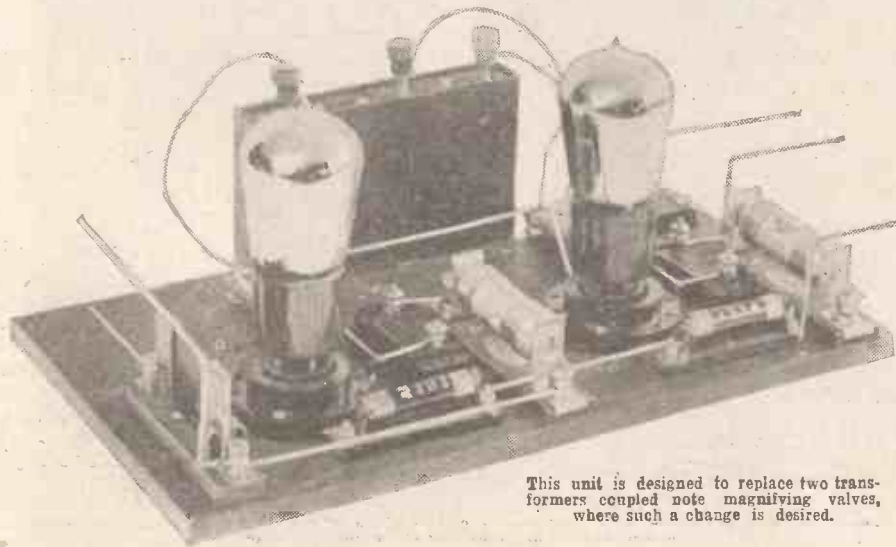
If you examine the theoretical diagram of Fig. 1 you will see that it depicts the conventional transformer-coupled arrangements. In Fig 2 I have drawn the equivalent resistance-capacity coupling method so that you may see the exact difference between the two. In the transformer method the plate current in the valve, being modulated by the incoming signals, passes through the primary of a transformer and induces into the secondary windings similar variations, but with a "stepping-up" effect, giving higher voltage variations than would otherwise be possible. This is, of course, an advantage. The variations of potential so set up between grid and filament similarly modulate the plate current of the next valve, and we repeat the process through the second transformer.

## The Resistance Arrangement.

Now compare this with the resistance amplifier. The current from the H.T. battery, on its way to the plate of the detector valve, passes through a high resistance, usually of the order of 100,000 ohms. Ohm's law tells us that for a given current to flow through a given resistance a certain voltage is required. If the resistance remains the same and the current varies, obviously the voltage required to force the current through the resistance is altered. As variations of current are set up in the valve by the action of the grid, corresponding variations of voltage occur across the terminals of the high resistance.

You will notice that one end (the plate end) of the resistance is connected through a fixed condenser to the grid of the next valve. The other end of the resistance is connected to the H.T. battery and, through this, to the filament. If you consider for a moment, you will realise that, to all intents and purposes, one side of the resistance can be considered as connected to the grid of the next valve and the

(Continued on next page)



This unit is designed to replace two transformers coupled note magnifying valves, where such a change is desired.



## A RESISTANCE AMPLIFIER.

(Continued from previous page.)

other to the filament. In this way any variations of voltage across the ends of this resistance are applied to the next grid. Thus our signals are passed from one stage to the next, just as we were able to pass them through the transformers.

The object of the fixed condenser between one end of the resistance and the subsequent grid is to prevent the positive H.T. voltage reaching the grid of this valve and spoiling its action. The value of this condenser, being fairly large, allows the passage through it of the varying audio-frequency voltages, but effectively stops any direct current flow. In this way we keep our H.T. D.C. voltage away from the grid.

### Constructional Details.

Unless we were to provide some means, the charges on the grid of the valve following the resistance would have no opportunity

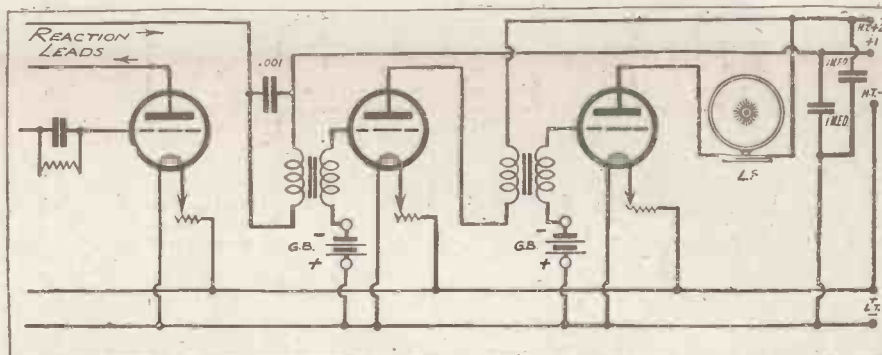


Fig. 1. A conventional transformer coupled arrangement. Compare this with the diagram below.

with a resistance, grid leak, and coupling condenser built into one.

Two high-grade fixed condensers of a value .015 mfd. Do not use the Mansbridge type here. Mica-insulated condensers only should be used. Those shown in the set are Dubilier, but there are many other good makes that can be substituted.

Two baseboard mounting grid leak holders. The Dubilier Dumetohm is shown. If you care, you can, of course, make your

One fixed condenser, .001 mfd. Any good make will do.

Two fixed resistors, suitable for valves to be used. I have used Amperites in the unit being described. If you already have filament resistances of the variable type, there is no reason why these should not be used; or, if both valves are of the same type, they can be run from the same filament resistance.

Two suitable valve sockets of the anti-vibration type of any of the well-known makes, such as Benjamin, Burndept, Etherplus, Lotus, etc., etc.

Suitable grid bias battery.

Three plugs for same.

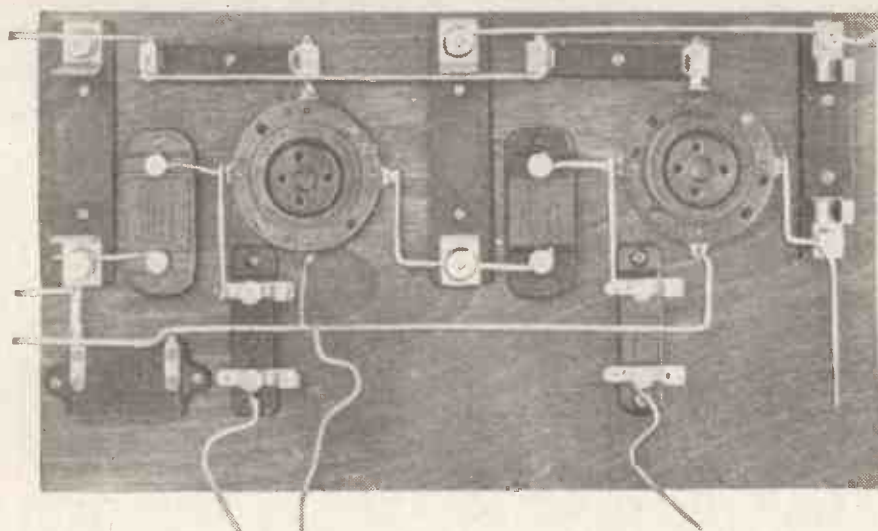
Base for clip-in condenser.

Clip-in condenser to suit your particular loud speaker. A value of .001 or .002 mfd. suits many instruments, while some loud speakers work best of all without any shunting condenser. The McMichael base and clip-in condensers are suitable here.

I suggest that you follow the lay-out of parts shown, as this makes the wiring particularly simple. It may be, however, that the space in your cabinet is not quite suitable for this arrangement, and in such circumstances you may have to modify the lay-out slightly. If you can, adhere to the arrangement shown, as, even in a low-frequency amplifier, short wiring is a distinct advantage, and helps to avoid undesirable low-frequency effects which often give rise to distortion, even in a resistance amplifier.

On examining the wiring diagram of the unit, you will find a fixed condenser connected between one input terminal and the low-tension negative. This is to provide the necessary by-pass for high-

(Continued on next page.)



A plan view of the resistance amplifier unit.

of leaking away. We therefore connect a grid leak between the grid and the filament, introducing in this path a grid bias battery to keep the grid sufficiently negative to yield good results.

An excellent article explaining grid bias has very recently appeared in POPULAR WIRELESS, so that it will not be necessary to give any further explanation on this point here.

You will now see that to substitute a resistance-capacity coupling for transformer coupling we must provide, in place of each transformer, a high resistance, a coupling condenser and a leak. Fortunately for us, these are not expensive, and the cost of building a resistance amplifier using the very best components is no higher than that of building a transformer amplifier. To build the unit described, we need:

Two anode resistances (wire-wound type). Those shown in the set are Varley. Excellent wire-wound resistances are also made by Mullard and Dubilier, while the Radio Communication Co. supply complete units

own clips quite inexpensively from small pieces of sheet brass and odd scraps of ebonite.

Two grid leaks,  $\frac{1}{4}$  or  $\frac{1}{2}$  megohm each.

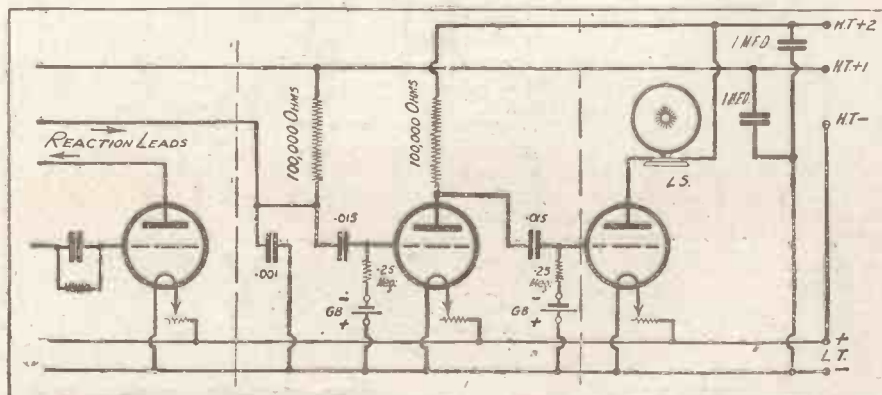


Fig. 2. A resistance amplifier unit. Note that the portions to the left and right of the dotted lines are the same as in the transformer coupled arrangement above.

## A RESISTANCE AMPLIFIER.

(Continued from previous page.)

frequency currents in the detector circuit, such as you obtain when using reaction amplification. If, as is probably the case, you have already used such a condenser across the primary of your first low-frequency transformer, this condenser will take its place; and, indeed, you can use the same condenser re-wired in this position.

I prefer the connection between the plate of the detector valve and negative low tension to the position across the resistance alone, for reasons explained in the first number of "The Radio Constructor" (on the "Correspondence" page).

### Valves.

The choice of valves for a resistance amplifier is a very important matter, for the ordinary types of valves, which give good results with transformers, are not the best for resistance amplifiers. To get the best results, you need what are called "high impedance valves." Practically all valve makers now make special valves designed for resistance amplification. These are obtainable in two, four, and six volt types, so that if you are accustomed to using, say, two-volt valves, you can obtain suitable resistance-coupling valves to go with this filament voltage.

The first special valves for resistance capacity coupling were of the six volt type,

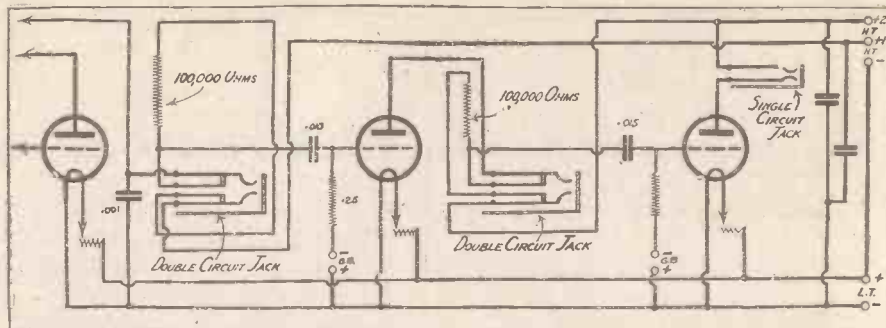


Fig. 3.—If jack switching is desired in a resistance amplifier, it can be effected as shown above.

known in one make as the D.E.5B., in another as the D.F.A.4, and another as the C.T.25B. As these were the first they are probably some of the best known, but as suitable valves have now been made

### The Last Valve.

It is important to point out that the last valve, having no resistance in its plate circuit, does not require to be of the special type, and, indeed, is preferably not of that type. For the last valve, then, use the same type of valve as you have previously used in the last stage of your transformer amplifier.

This will save buying one special valve. While the ordinary valves can be used in a resistance amplifier, the amplification so obtained will be far less than is possible with the proper type. Resistance capacity types of valves are, therefore, needed for the detector (which you will see has a resistance in its plate circuit) and the first low-frequency stage.

How you connect up your high-tension leads will depend on your present arrangement. If you have been using a rather

(Continued on next page.)

### THIS SET IN A NUTSHELL.

Circuit: Resistance unit to replace present two-valve transformer-coupled amplifier.

Purpose: To obtain pure reproduction when present arrangement is unsatisfactory.

Cost of replacement parts (excluding valves): Approximately 25s.

by most makers in the four and two-volt varieties, we are not, as has occasionally been suggested, limited to six-volt valves.

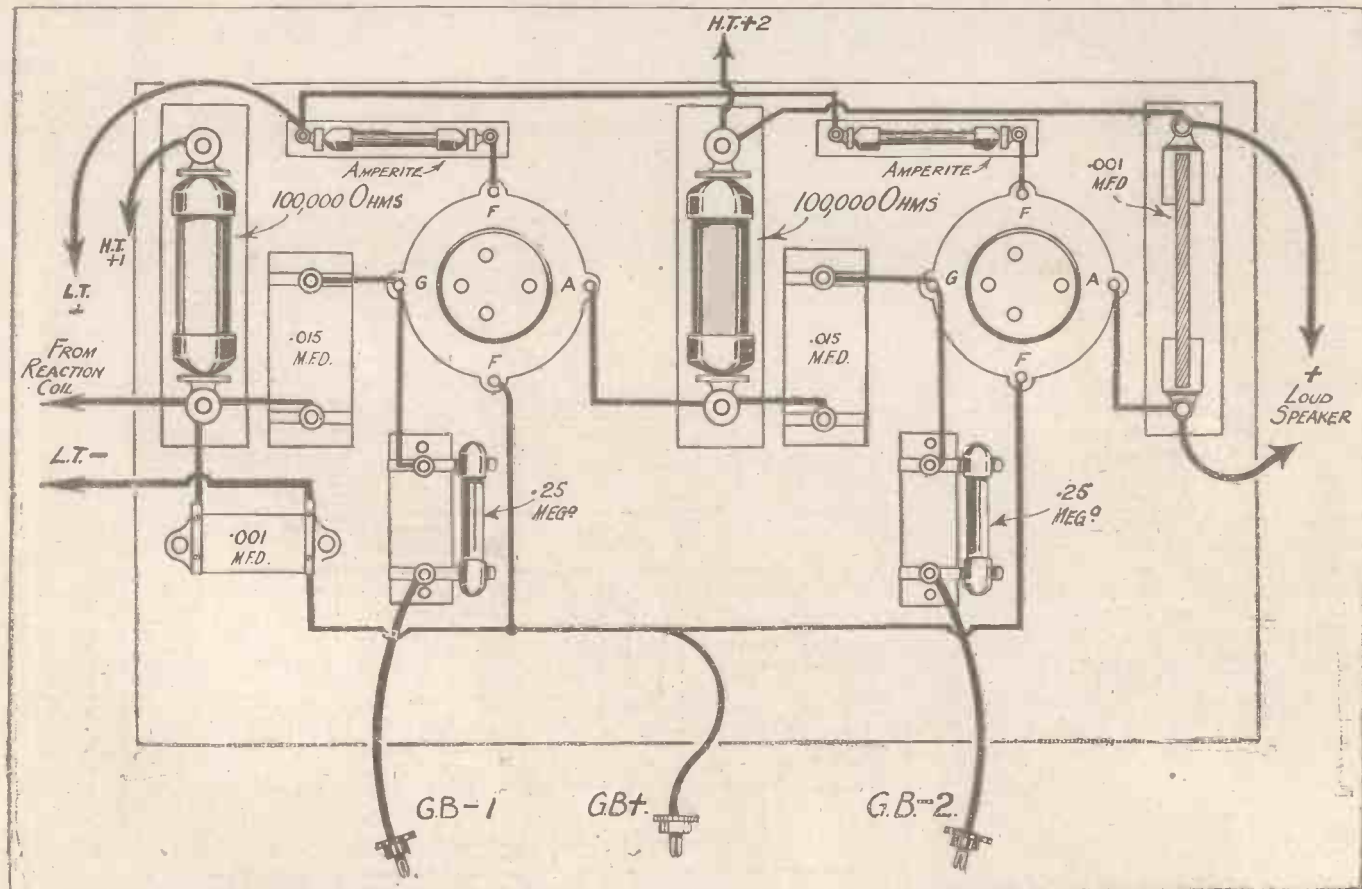


Fig. 4—This diagram shows both the wiring and the connections to the other parts of the apparatus. Mansbridge condensers should be shunted across the H.T. terminals, if not already fitted.



# FACTS ABOUT L.T. ELIMINATORS.

By P. W. H.

The Editor deals with points raised by correspondents who are building Battery Eliminators for Home use.

A CORRESPONDENT wants to know why, if we can get our high-tension supply from the mains, we are not provided by the manufacturers with low-tension eliminators, for surely, he says, supplying the filament current is a far simpler problem.

I wish it were so, for, although the accumulator manufacturers are now giving us excellent products and the valve manufacturers on their part are doing their utmost to reduce the current demands, many people find the use of accumulators highly inconvenient owing to their distance from a suitable charging station.

It must not be forgotten that accumulators need recharging even when no current has been taken from them, as they gradually

but has superimposed on it a ripple which can give a very irritating hum. It is necessary to smooth this out before it is used for wireless purposes. However, there are means

## MODERNISING THE "FOUR-VALVE FAMILY" RECEIVER.

SEE NEXT  
WEEK'S ISSUE OF  
"THE RADIO CONSTRUCTOR"

of running filaments in series and using an arrangement quite different from the ordinary smoothing unit as used for high-tension battery elimination, so as to give currents

of a small order, such as are taken by the .06 ampere type of valve, but there are a large number of practical difficulties in the way.

So far as direct current is concerned, even assuming that the supply was perfectly smooth and free from ripple, the many disturbances caused by switching lights on and off, starting and stopping lifts, trams, trains and all kinds of devices, set up many surges which inevitably find their way into the wireless set as noises. Filtering a small current of a few milliamps, such as is required to operate the high-tension side of the set, is a relatively simple matter, but to handle currents comparable with those generally used for filament lighting is not yet really practical.

You will see that if there are difficulties in relation to the so-called direct current, they are greatly magnified in regard to alternating current. The rectification of a current of, say, quarter of an ampere is quite beyond the capabilities of the ordinary small rectifying valves. These are generally designed for a maximum output of about a quarter of this figure.

In America, where the standard voltage of 110 and a standard frequency of 60 makes the design of battery eliminators a much simpler matter, the best solution that has been found is the use of a very small accumulator with what is known as a "trickle-charger," so that when one leaves the set it goes on charging automatically until the next time it is needed.

## A RESISTANCE AMPLIFIER.

(Continued from previous page.)

low voltage on your detector, remember that it must be increased by at least 50 per cent when using a resistance amplifier, as there is a considerable voltage drop in these resistances. You will generally find it convenient to connect the last two positive H.T. leads together, as this will automatically give a higher voltage on the last valve (which has no resistance in its circuit).

The last valve has to handle a much greater amplitude of signal than

the previous valve, and the higher voltage is thus desirable to avoid distortion. Usually a 120-volt battery gives adequate results with a resistance amplifier, although if very loud signals are received (this is somewhat different from very loud signals being required) you may find it advisable to use 150 volts. Normally, however, the additional cost of a further 30 volts for high tension would not be justified by results.

### Grid Bias.

The last valve will require considerably more grid bias than the other. Generally, with a 120-volt battery, about  $1\frac{1}{2}$  or 3 volts grid bias is adequate for the first low-frequency valve, as you will see on examining the leaflet supplied with the valve by the maker. For the last stage you will probably require six or eight volts, using the average small power valve.

If jack switching is used, the connections for plugging in

various stages can be as shown in Fig. 3.

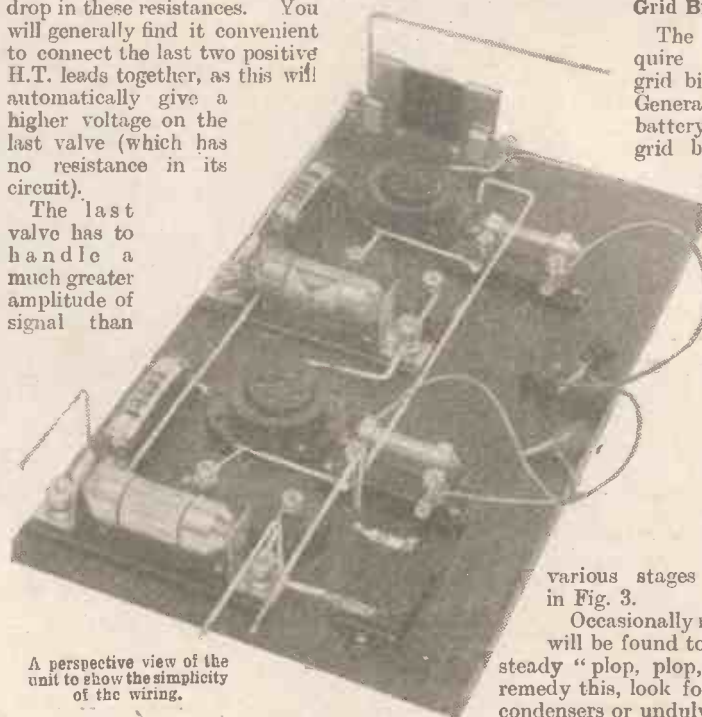
Occasionally resistance amplifiers will be found to howl, or to give a steady "plop, plop, plop," sound. To remedy this, look for faulty grid-leaks, condensers or unduly lengthy wiring.



How it feels when you don't charge your own accumulator.

lose their charge when standing idle. Indeed, accumulator manufacturers tell me that a regular charge and discharge of our accumulator is much better for its health than keeping it fully charged without use.

The so-called "direct current" supply to so many houses is not perfectly continuous,



A perspective view of the unit to show the simplicity of the wiring.

# "MEET the METER"



THE wireless hobby becomes much more interesting when we can ferret out facts for ourselves, and have not to take the "other man's word" in matters scientific. In this article I want to introduce to you a few great friends of mine, in the hope that they may prove as useful to you as they have to me. Mr. Experimenter: allow me to introduce to you the Meters! In particular this strapping daughter of the family, Milly. Milly and I have known one another for years and have made many interesting voyages of discovery together.

Then there is Micro. Micro-ammeter is a quite expensive sort of person, with a

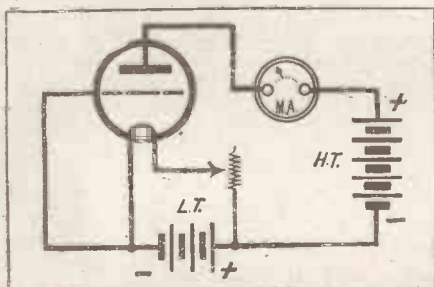


Fig. 1. Measuring plate current with a milliammeter.

vision far more acute than that of his sister Milly; and here we have Galvano. Galvanometer is a rather flippant member of the family, and usually considers he has done a good day's work if he gives a kick when he sees anything interesting.

A good, solid, reliable and very useful member of the family is Volt-meter. In my laboratory he has several servants, and I will tell you something about them and of their limitations a little later.

Seriously, I should like every reader of the "Radio Constructor" to realise how very useful one or two meters can be. Like all scientific instruments, the prices vary according to the capabilities of the particular specimens, and the high grade meters may prove very expensive indeed. However, those which are most useful are not by any means the most costly and even if we purchase only one—the milliammeter—it will provide us with an immense amount of useful information.

## The Milliammeter.

A milliamper, as you know, is one thousandth part of an ampere, and any meter which will show us accurately the amount

## The Why and Wherefore of Wireless Measurements.

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

of current flowing in the plate circuit of the valve will afford a great deal of help. A milliammeter of quite good quality can be obtained from such firms as the Economic Electric Co., Ltd., Fitzroy Square; Electradix Radio of Upper Thames Street, Ward & Goldstone, Ltd., of Pendleton, Manchester (to mention but three), for about thirty shillings, and may be chosen to give a maximum reading of not more than fifteen milliamperes.

If a scale of about this size is used, it is possible to take quite small readings without confusion. Better still, one can obtain a multi-range instrument with plugs or switches so that the variety of ranges can be obtained, but, naturally, such instruments are more expensive.

I could write several articles on the use of the milliammeter alone, but here are a few examples of its practical value. Take, first of all, the case of a valve which does not seem "up to scratch." The valve lights, but somehow or other signals seem weaker than usual or perhaps badly distorted. Such effects may be due to several causes, such as a faulty grid bias battery, H.T. battery running down, L.T. failing, transformer faults, and so.

But it may also be due to the valve having lost some of its emission power. Without a milliammeter it is very difficult to find out whether this is the case, but with the instrument it is but the work of a few moments to make a test.

If you look at Fig. 1 you will see a simple diagram of a valve, an accumulator, a filament resistance, milliammeter, and an H.T.

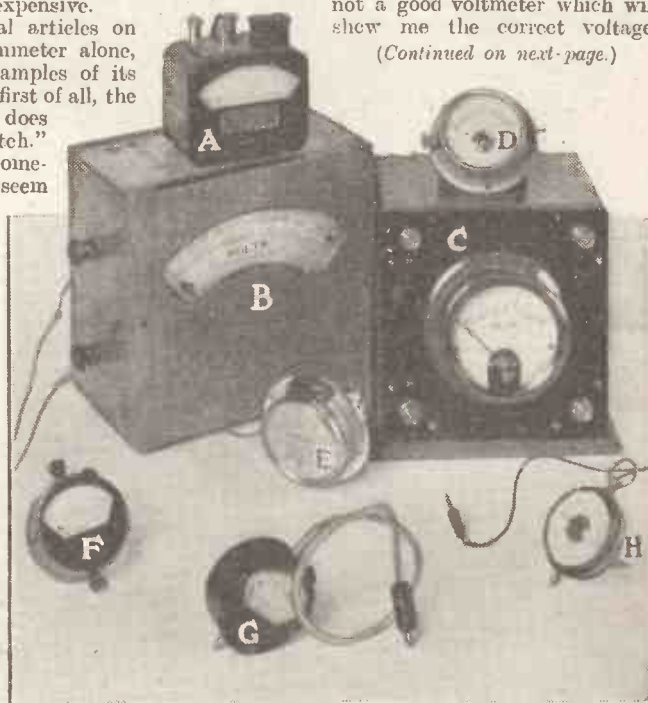
battery. It shows you the way to connect up a valve if you want to see if its emission has fallen off considerably. You can quickly rig up on a board a filament resistance, valve socket and flexible leads for the batteries, and for this test you should join the grid connection to the negative filament, keeping the filament resistance in the positive lead.

## Testing Valves.

When the batteries are connected up, a current will flow through the valve and, passing through the milliammeter, will give a reading. Now if you know the actual voltage of your H.T. battery, and add to it the voltage of your accumulator, you can then look on the makers' chart (which usually gives a curve) and see what the emission should be given at "zero grid volts." If the figure given on your milliammeter differs substantially from this something is wrong.

Perhaps you will say: I have not a good voltmeter which will show me the correct voltage.

(Continued on next page.)



Some of the meters in my laboratory. A.—A "Universal" meter, measuring milliamperes, amperes and volts. B.—A high resistance voltmeter for measuring H.T. voltages. C.—An A.C. voltmeter. D.—A D.C. ammeter (low reading). E.—Hot wire ammeter for transmission experiments. F, G, and H. Portable voltmeters and milliammeters.



## "MEET THE METER."

(Continued from previous page.)

This is not a matter of very great importance for a rough test on your set will have told you whether the H.T. battery is in fair condition and, in any case, if the valve is giving an emission reasonably near the figure it is supposed to give, there will not be much wrong with your signals.

If, as is frequently the case, you have another valve of the same type which you know to be working satisfactorily, you can see whether the reading with the satisfactory valve is the same as that for the

in the plate circuit of the particular valve will thus keep its needle steady. Now let us imagine that our grid bias has been incorrectly set to, say, two volts.

### Why the Needle Flicks,

A grid swing of three volts will therefore carry us over on to the positive side, and directly the grid becomes positive, grid current flows and a three-volt swing on either side of the working point will make the rise and fall of the current unequal. The effect will be that so long as a three-volt swing is being maintained the average plate current will be different from its normal value. Thus, every time the grid becomes positive the needle of the milliammeter will flick.

You will now see why some experimenters use a milliammeter as a check on distortion.

There are many other uses for a milliammeter, to which space does not permit reference here. For the experimenter the milliammeter is by far the most useful of all the meters, and if he is beginning to do serious work it will soon prove indispensable.

The voltmeter is also very valuable, but, unless of the correct kind, it can be very misleading. All the cheap voltmeters have a low resistance, and when connected across a battery, take a considerable current.

For example, the current taken by the cheap watch-case type of voltmeter, while not sufficient to upset the reading of an L.T. accumulator, is far too low for use in H.T. battery testing.

An H.T. battery which will show, say, 60 volts with a current of three or four milliamps. may show only half that figure when giving the large current required by a cheap voltmeter. For H.T. battery testing you should always specify a high resistance voltmeter.

Many experimenters have wondered why they cannot get a correct or even any reading with their voltmeter testing the actual voltage applied to the plate of a valve in a resistance-coupled amplifier. The reason is not immediately obvious. Let us imagine we are using a 120-volt battery and a 100,000 ohm resistance in series with it. We know there is a considerable drop of voltage in this resistance, and at the first glance we might think that connecting the voltmeter between the plate and filament would give us the voltage applied to the valve.

A few moments consideration will show us why this is not the case. For simplicity, let us consider the plate to filament resistance of the valve as 100,000—the same as that of the anode resistance. As the voltage of the battery is absorbed across the two resistances in series, half the voltage will be dropped across the anode resistance, and half across the valve. Thus, roughly speaking, 120 volts applied to the set will give 60 volts across the valve.

Now let us apply our voltmeter. We will assume it is a good voltmeter, having a resistance of, say, 10,000. This will now be in series with the anode resistance, and in parallel with the valve resistance. Again, to simplify matters, we will ignore the slight reduction of the resistance due to the paralleling of the 100,000 ohms with the valve. We will consider we have now 100,000 ohms in series with 10,000 ohms.

As the whole voltage will be dropped across the 110,000 ohms, ten-elevenths of the voltage drop will be in the resistance, and only one-eleventh across the voltmeter. The voltage across the voltmeter terminals will thus be roughly eleven, which has no relation to the voltage across the valve when the voltmeter is disconnected.

In an early issue we will consider some more facts and problems relating to meters.

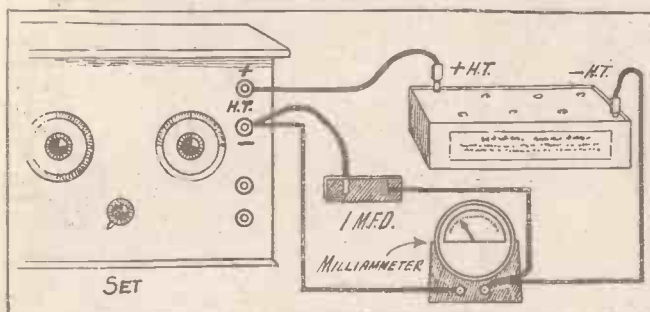


Fig. 2. Another useful method of using a milliammeter.

one about which you have doubts. This, then, removes the necessity of knowing the exact voltage of the H.T. battery.

A second very useful way of utilising a milliammeter is to place it in series with the negative H.T. lead from your battery to your set, taking the precaution of shunting the milliammeter with a one mfd. Mansbridge condenser (otherwise the inductive effect of the windings may upset the functioning of the receiver). Do this first of all when you know your set to be working well and note the figure given.

### Checking your Set.

If at any time your set should seem to be working badly, reinsert the milliammeter as shown and see if the reading is normal. Quite likely you will find that the reading has dropped several milliamperes, which may indicate that one or more valves have lost their emission. Remember that any alteration of grid bias will alter the milliammeter reading and if your grid-bias battery has failed you, you may get an indication in this way.

Many experimenters use the milliammeter as a check to see whether their audio-frequency valves are distorting. When correct grid bias has been applied to a valve the voltage swing, set up by the signals, will all be within the negative side of the curve, provided the valve is not overloaded. As a practical example, let us imagine that we are using 120 volts on the plate of a power valve of a type which requires for this plate voltage four and a half volts grid-bias. With such a grid-bias voltage, a "grid swing" of, say, 3 volts on either side of the working point will still keep the grid negative.

If the curve is approximately straight, the rise and fall of current on each side of the working point will be equal, and the average current through the valve will be maintained constant. A milliammeter



For those who wish to charge their H.T. accumulators at home, there are several commercial forms of charges, two of which are shown above.



## MY LETTER BAG



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

I HAVE recently received a number of enquiries on matters relating to apparatus and "eliminators" for running sets from the mains, particularly from readers who are ardent readers of American advertising and wireless literature. Here is a typical letter:

"Dear Sir,—I am rather puzzled at the results I am obtaining with my high-tension battery eliminator which, I must say at once, gives generally satisfactory results. Previously to purchasing this eliminator, I was using dry batteries with tapings at about 50 and at 120 volts for the low-frequency stages. On connecting up my set to the eliminator I adjusted the plugs as recommended by the makers and was soon obtaining splendid results without any trace of hum from the A.C. mains.

### Voltmeter Readings.

"I am, however, very puzzled with the readings of my voltmeter. Although signals are coming through excellently it gives a reading far below what must really be the high-tension voltage I am getting. Again, I understand that one of the greatest advantages of the battery eliminator is that it cannot 'run down' as do high-tension batteries or accumulators.

"Can you account for the fact that the other evening after I had put some new valves in the set I had to increase the voltage on the tapings very considerably before I could get the same signal strength? This is just what I had to do with my high-tension batteries owing to their steady loss of voltage."

My correspondent has asked two questions seemingly on different aspects of the subject, but which are really related to the same point. It is not generally realised that the actual voltage given by these high-tension battery eliminators is largely dependent upon the load taken from them. By this I mean that if you are getting, say, 100 volts from your eliminator when your set is taking, say, 8 milliamps, the increase of load to, say, 16 milliamps (by the use of other valves, or a change in grid bias) will bring the applied voltage down. How much the voltage drop will be depends upon the make of eliminator and its general excellence. In some the

voltage drop may be so considerable as to make it necessary to reset your tapings to entirely different values.

This is not due to the set "running down," but simply, as stated, to the fact that the voltage is closely related to the load on the eliminator. Presumably the new valves which my correspondent used took

### NEXT WEEK:

## "The Stationmaster."

A Five-Valve Set for  
Frame Aerial Reception  
and Modernising the  
"Four-Valve Family."

considerably more plate current than the older type. If he restores the old valves he will find the voltage on the new tapings will go right up. Usually, however, the battery eliminators have plenty of margin to allow for changes of this kind, although

with some of the power valves when one is anxious to get the highest possible voltage, the maximum may not be quite as high as one desires.

The point relating to the voltmeter is very interesting. Here again it is not generally appreciated that most voltmeters require an appreciable current to operate them. For example, I have a good (and expensive) voltmeter which I use for testing high-tension batteries. On a 72-volt battery it takes seven milliamps, which, incidentally, is rather a useful figure because it shows me the practical working voltage of the battery under a reasonable load.

### Doubling the Load.

Now, if I place this voltmeter across the tapings of an H.T. battery eliminator, which is already delivering seven milliamps to a set, the current required by the voltmeter added to that consumed by the set, makes in all fourteen milliamps or exactly double the normal load. This will make a very important variation of voltage. While the voltmeter thus reads accurately the voltage given by that particular battery eliminator with a load of fourteen milliamps, its reading bears little relation to the voltage given by the same eliminator at seven milliamps.

Of course, it is possible to measure the voltage with suitable instruments, but these are not generally available to the average experimenter.

Speaking of battery eliminators reminds that it cannot be too strongly impressed upon all listeners that great care must be taken in using them. Let us assume you are using dry batteries giving 120 volts, and for these you substitute a battery eliminator giving the same voltage.

The shock you can obtain from the H.T. eliminator may be far greater than that from the dry battery, although the voltage is the same. For this reason be careful when altering the various tapings.

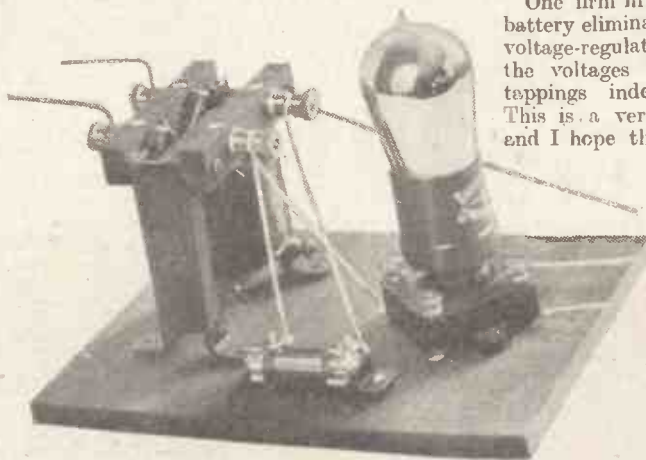
### Tapping Troubles.

Here again we come against the difficulty of load varying voltage. If you have tapings for, say, 40 volts for the detector, 60 volts for the high frequency, and 150 for the low frequency, remember that removing the plug from any one tapping will appreciably decrease the load on the eliminator and automatically increase the voltage on the others, possibly upsetting your reaction arrangements.

One firm in America is marketing a battery eliminator which has a special voltage-regulating valve to maintain the voltages applied to the various tapings independently of the load. This is a very valuable improvement and I hope that, before very long, it will be introduced into all the battery eliminators.

### A Useful Pictorial Hint.

If your amplifier howls, try connecting a  $\frac{1}{2}$  megohm grid across the IS and OS terminals as shown. This will probably stop the howl and improve the quality of the reception from both your local and distant stations.



Showing the  $\frac{1}{2}$  megohm grid across the L.F. transformer.



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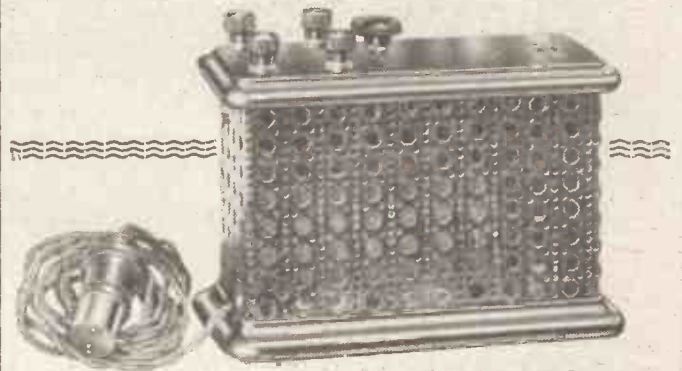
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# SULPHURIC BLEMISHES IN ACCUMULATORS

TOO little attention is given by the majority of users of wireless sets to the various *chemical* aspects of their recreative hobby. They may be well advanced in respect to the knowledge gained in an electrical, magnetic and etheric direction, but they neglect to learn, or practise, much about the changes which are liable to occur through the mutual operations of the acids and metals which necessarily form part of their equipment. Yet considerable loss of or, in minor cases, interference with current is thereby involved, with consequent and corresponding detriment.

## The Power of Sulphuric Acid.

Most readers will, I daresay, be aware that their accumulators are charged with sulphuric acid, which is known also as white vitriol, and oleum or oil of vitriol. Now this

## A MICROSCOPIC INVESTIGATION.

By JAMES SCOTT, M.S.C.I.,  
M.A.C.S., and M.E.H.A.

commences, and lasts for a very long time—unless the amount of solid substance is very trivial—continuing to consume, eat, or dissolve the metal until it entirely vanishes—that is to say, it vanishes as far as discernment by vision is concerned, although really it is still present in another condition, without form as such.

Simultaneously with these changes the evolution of a distinct colour becomes evident, this being quite different from that of the metal which has, in conjunction with the sulphuric acid, given origin to it.

The colour is dispersed throughout the acid, and differs according to the kind of metal which has been thus treated. In the case of copper it is *blue*; in that of zinc it is *white*; in iron *green*; in some other metals equally distinctive and clear.

Bear in mind that theoretically the metal, whatever element it may be, can be recovered *as metal*, in exactly the same nature and amount as it was before it was dissolved, provided that it is subjected to suitable treatment.

## Corroded Terminals.

If the acid solution is boiled so as to expel all the water, or as much of it as is possible, there should finally remain behind a *coloured metallic salt*, representing the combination of sulphuric acid and metal. By serving this salt in the same manner as an ore is dealt with metal may be smelted out from the compound and used as required.

On the present occasion I have in view the formation of the "*sugary*"—it has *nothing whatever to do with sugar, however*—crust which is frequently noticed upon the upper portions of accumulators, and so on. It is bluish in colour, unless the latter has been further modified by the presence and action, or incorporation, of a newly produced salt of one or other of the adjacent metals, such as iron or steel, when the colour may have a greenish tinge.

But I must confine my remarks to the contemplation of copper and sulphuric acid, when the salt yielded by their interactions is blue. The familiar "*bluestone*," so widely used in horticultural insecticide sprays, etc., is a compound, or salt, of copper and sulphuric acid, purposely prepared from those two items.

Copper sulphate (or sulphate of copper) is the true chemical name.

If you have an accumulator with brass or bronze fittings these will often be found surrounded by scraps, nodules, or flakes of this substance. They can be scratched or pulled away by the merest touch, and are due to the action of the sulphuric acid on the metal, especially the bared end, or terminal, of the connecting wire, which is, of course, generally copper.

## Copper Sulphate Magnified.

Brass is an alloy or mixture, of the two metals copper and zinc, and the acid dissolves the copper into "*bluestone*," and the zinc into zinc sulphate, a white salt, the presence of which lightens the blueness of



Greatly magnified bluish crust formed on accumulator terminals.

acid, like all others, possesses the very active property of readily and easily dissolving most kinds of metal. It is true that there are specialised productions which are guaranteed to resist such corrosive tendencies, and they undoubtedly do so to a certain extent.

But since these metals are, in a way, unique, and are only used in circumstances where sulphuric acid is manufactured or stored, their consideration must be ruled out from our present consideration of the subject. Our subject is a very important one, more so than might be thought by the reader unless he is conversant with the science of chemistry.

If you will pour some warm dilute sulphuric acid into a glass or earthenware jar, or any other suitable receptacle, you will find that upon dropping a piece of any ordinary metal therein action almost immediately



The same crust spread out in a drop of water.

the copper sulphate, which otherwise would be, if pure, a deep rich blue.

Bronze is a compound of copper and tin. There are, however, several varieties of bronze, named according to the ingredients which are incorporated with the alloy, and thereby confer definite, oft-times striking appearances and attributes upon it. For instance, aluminium-bronze—this is the fictitious aluminium *gold*—contains, besides the necessary copper and tin, a small proportion of aluminium, which is responsible for its beautiful brilliance. The acid forms aluminium sulphate with it.

Phosphor-bronze carries a little phosphorus in it, in addition to the other two elements named. Hence it will yield, if acted on by sulphuric acid, quite a different salt. It is too technical a matter, however, to go deeper into on the present occasion, as the presence of traces of phosphorus

(Continued on next page.)



## SULPHURIC BLEMISHES IN ACCUMULATORS.

(Continued from previous page.)

acid would have to be taken into consideration, and it is really not incumbent on me to do so.

I will now deal with the microscopic structure of this salt, copper sulphate, round the screw heads, etc., of an accumulator. When this remarkable apparatus is charged it is almost impossible to prevent some of the sulphuric acid from attacking the metals in the vicinity. Thus it gives a crusty



After a few hours' soaking, and then evaporation, crystals typical of their metal bases begin to form.

residue of copper sulphate from the copper, brass, or bronze with which it comes into direct contact.

Upon properly magnifying a scrap of this bluish, or greenish-blue, substance, in its wholly undisturbed position and condition, we find that it appears as shown in Fig. 1. It is then seen to be a mere small heap of granules, among which are embedded some minute, highly glistening crystals of various shapes, which the chemist can, if he wishes to do so, thoroughly analyse.

### Interesting Changes.

Next detach a small piece of the grit from the accumulator and lay it on a glass slide—i.e. a strip of thin glass a few inches long and about an inch wide. When this is run beneath the microscope, after a drop or two of water has been placed upon it to separate its particles, it is disclosed as a layer of crystals and specks, of the character depicted in Fig. 2. These resemble tiny gems and sparkle prettily as the light is caused to play upon them at different angles.

They signify a mixture of objects, consisting of copper sulphate, zinc sulphate, tin sulphate, and so on, and within a few hours, if enough water is present for the purpose, they completely dissolve and give a solution of the mixed salts just named. Upon prolonged exposure to the air they are replaced by formless filigree, left by evaporation of the water.

During the first few hours after being watered the irregular granules are merely surrounded by fluid medium, because certain of the components are deliquescent—that is to say, speaking in a technical sense, they not only retain but absorb from the air available moisture.

But as time proceeds changes develop in the respective constitutions of the particles, and they become devoid of all apparent solution, and stand up dry but crude, as delineated in Fig. 3. If they are warmed the final result is the production of shapeless ridges wherein these objects are fused together.

### Preventing Deterioration.

Note the comparatively long, needle-like crystals. They are known as raphides, and are typical of sulphatic combinations; or in other words, compounds of sulphuric acid with a metal, or other solid material.

The points that I have so minutely demonstrated have a very practical significance. One will commonly find in houses and shops where such should not exist faulty and dirty, or worn, accumulators. The metallic lids, coverings and fittings are spotted or disfigured by the presence of bluish, greenish, brownish and dusty wafers, specks, pimples, or other products of reactions resulting from the sulphuric acid and accompanying metals. *There need not be any such rubbish if only people would take*

*the trouble to learn about these things; and surely, in this age of wonderful experiment and practice, it should not be argued as an excuse for neglect that the owners did not know of such possibilities.*

### Maintenance Hints.

One cannot altogether avoid the appearance of some sort of signs of wear and tear, so to speak, but ordinary wear, traceable to straightforward performances, is very much different from those faults to which I am referring, since they are evidently based on necessary chemical action. We cannot expect *anything* that we handle to last for ever.

That is no reason, however, why users should hasten the decomposition of their respective sets. And it is so easy to hinder the rapid onset of these injurious traits—just keep all excess, spilt sulphuric acid from continuous intimacy with the parts hitherto mentioned. Wipe it off after recharging, or when an accumulator has been moved. Keep the metals clean and bright. In this case ignorance is *not* bliss—but means loss of current and of money!

## CONCERNING TERMINALS.

By J. F. C.

A TERMINAL which ultimately comes loose in a neatly laid out and arranged radio panel is an article the wayward propensities of which would indeed sorely try the proverbial patience and self-restraint of a Job.

Yet, indeed, this sort of thing does happen, even in some of the best constructed sets.

The first cause of a terminal coming loose may be seen in the habit some amateurs have of drilling the hole in the panel much larger in diameter than the shaft of the terminal which has to fit through it. Such terminals are merely secured by the frictional pressure of the washers and nuts below the terminal. Consider what happens in such cases. The ebonite in contact with the washer or securing nut of the terminal is subjected to a considerable degree of compression. When the panel is new, the ebonite is soft and elastic, and its elasticity enables it to bear against the compression of the terminal securing nut. After a time, however, the ebonite loses a good deal of its elasticity, especially if it be poor quality ebonite. Consequently it ceases to bear against the compression of the nut, and thus the terminal comes loose.

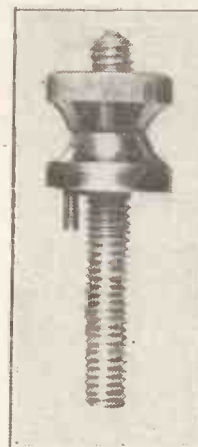
### Some Remedies.

The remedy, of course, is to drill the holes in the panel of such a size that the terminal only just passes through them. Always use a washer under the securing nut. This gives a greater area in which the pressure of the nut may be distributed.

Another cause of loose terminals is to be looked for in the undue heating of the terminal shaft during the soldering operation. Beginners in radio construction often experience a difficulty in making soldered connections to terminals, and it takes them some considerable time to effect a good joint. During this time, of course, the terminal shaft naturally becomes very hot. The heat

softens the ebonite, and thus the hole in the panel becomes enlarged. The remedy is obvious. The soldering of any connection to a terminal should be done as rapidly as possible in order to prevent these unwanted effects of too greatly prolonged heating.

Apart from making the hole in the panel only sufficiently wide to just take the terminal shaft, another good method of ensuring



[A terminal with a side prong.]

that panel terminals will not come loose is to tap the ebonite with a thread of the same gauge as the terminal thread, and then to screw the terminal home. This makes an extremely effective and permanently secure terminal mounting, but the method is rather difficult for the beginner, and its use calls for the employment of special taps.

The easiest way of permanently securing terminals to the panel is to employ only terminals which are provided with side prongs, as indicated in the illustration. Such terminals are, unfortunately, not always readily obtainable, but they can generally be procured from firms specialising in the sale of W.D. disposal apparatus.

In using these side prong terminals the main hole in the panel is drilled with just sufficient clearance to take the terminal shaft neatly. A very small hole is drilled about an eighth of an inch at the side of the main hole. This accommodates the side prong.





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These strange words were broadcast into space the other week when Mars came within the chatting distance of 42 million miles. The chat, however, was all on our side, and several theories exist as to why our advances met with no response. One enthusiast writes:

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*Illustrated above is our artist's idea of Mars and the Martians. Others, doubtless, have different conceptions. But however much at variance opinions on this point may be, no two opinions exist as far as Ormond Condensers are concerned. In this all are unanimous in acclaiming Ormond as consistently the best.*

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on the market of the same power.

When completed our sets have a workmanlike appearance and will reflect the greatest credit on the constructor. The veriest amateur can build a receiver which will compare favourably with the product of the expert.

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## RETRANSMISSION OF BRITISH BROADCASTING IN GERMANY AND SCANDINAVIA. FROM A FOREIGN CORRESPONDENT.

**R**ELAYING of foreign broadcasting is now a regular part of the weekly programmes of the German and Scandinavian main stations, and these retransmissions are indeed very popular among the listeners. The foreign stations which are most frequently relayed are Daventry, Königswusterhausen, Radio-Paris and Hilversum, but it is beyond doubt that Daventry gives the best results of them all. When the reception of any of the other stations fails, Daventry is always certain to come in at good strength.

Of course, the reception is best in the winter-time, but even in the summer months it may be wonderfully clear and, as far as Daventry is concerned, "fading" is not very much experienced in the northern part of Europe. Also several of the other B.B.C. stations have been relayed, for instance, Bournemouth, Aberdeen, Glasgow and Newcastle, whereas London is very difficult to pick up.

### A Popular Station.

In Germany the retransmissions are most often carried out by the Königswusterhausen station. Last winter Daventry was often relayed by Königswusterhausen three or four times a week from 12 to 1 o'clock at night (German time). Königswusterhausen—the German 5 XX—is transmitting with a power of 10 to 12 kw., thus having a very large crystal range, and as the retransmissions, furthermore, usually are relayed by land-line to several of the other German stations—i.e. Berlin, Cassel and Elberfeld, thousands of German listeners have enjoyed the B.B.C. programmes during the past winter season.

Königswusterhausen is a very popular station in Northern Europe, and its transmissions may be heard very well on one-valve sets in Denmark and in the south of Sweden. For many of these listeners using one-valve sets it is difficult to pick up Daventry direct, and it has therefore been of great interest to them to hear the B.B.C. programmes via Königswusterhausen.

### A Weekly Feature.

In Denmark the retransmissions are broadcasted by the Copenhagen station and also relayed to the other Danish stations. The foreign broadcasting is picked up by a receiving station ("Amager Radio") situated on a small island called Amager, a few miles south of Copenhagen. British broadcasting has always been very popular with Danish listeners. It is only quite recently that the first Danish relay stations were taken into use;—about one year ago there were only broadcasting stations in Copenhagen, and it therefore stands to reason that a large percentage of Danish listeners had to be valve set owners. Fifty per cent. of all Danish listeners are still using valve sets, and are thus also able to tune in direct to the foreign stations; as the British stations are heard

better than any of the other foreign broadcasting stations, thousands of Danish amateurs are, of course, listening in direct to the British programmes. However, as relay stations have now been taken into use the number of crystal listeners is rapidly increasing, and the weekly retransmissions of the Daventry programmes



A Danish relay post for picking up and re-broadcasting programmes from the British stations.

are very much appreciated by these listeners.

During the recent general strike the ordinary Copenhagen programmes were, on several evenings, broken off and the official strike bulletins which were broadcasted from Daventry were picked up and re-

broadcasted to the Danish listeners. The Danish nation, being so closely connected with Great Britain in commercial matters, was, of course, very much interested in the development of the situation.

### A Double Relay.

The Kungsbacka Station, near Gothenburg, is the Swedish "Keston." It is a very powerful station, which is also used for the direct wireless communication between Sweden and U.S.A. Last winter Kungsbacka relayed Daventry once a week, and these retransmissions are known all over Scandinavia, and are generally recognised as being some of the best of this sort. Heard on a crystal set these relays of the Daventry programmes are often almost as good and clear as the transmissions of the local station.

### TELL YOUR FRIENDS ABOUT

"The Radio Constructor,"

"P.W.'s" Weekly Supplement.

Swedish listeners have even heard American broadcasting via one of the British stations. The Swedish "Keston" was on a certain evening re-broadcasting the Newcastle transmissions, and as the Newcastle station on that evening also retransmitted K D K A, Pittsburg, U.S.A., it was made possible for thousands of Swedish amateurs to hear American broadcasting, which it, so far, has proved impossible to relay direct to the Scandinavian listeners.

The reason why the retransmission of British broadcasting is so popular in these countries is, no doubt, also due to the fact that English is understood better than any other foreign language, and is taught in most schools. The B.B.C. programmes are published in full in many of the daily newspapers, and several of the leading British wireless periodicals may be obtained at many book-stalls in the larger towns.



Part of the Swedish Keston—at Kungsbacka—where British broadcasting is picked up and relayed to the Swedish stations.

## WHY A FAMOUS SINGER LIKES BRITISH BROADCASTING.

By "ARIEL."

THERE are some people who sit beside the fire for hours reading novels. I, too, can sit for hours at my fire-side, but I know of no more agreeable companion than my wireless set."

Madame Maria Olczewska, the famous singer, told me this when I saw her a few minutes after her great ovation at the Royal Albert Hall, on the occasion of the First National Concert organised by the British Broadcasting Company.

There was never a voice more suited to broadcasting than the one we heard that evening, but it is a pity that the items chosen were rather of a sombre nature. One can imagine Madame Olczewska in lighter and better vehicles for such a fine voice. Notwithstanding the somewhat doubtful songs and the great drawback of the German language (for those who understand German are in the minority), she scored a great personal triumph both with her seen as well as her unseen audience.

Madame Maria Olczewska is a radio enthusiast. I had not spoken to her for one minute before I discovered the fact. Not only has she a beautiful set in her home abroad, but she also takes a deep interest in the scientific possibilities of wireless.

Madame Olczewska and I spoke in French, as she is not a fluent linguist when it comes to the British language.

"Broadcasting in England seems to be run on a much smoother line than is the case on the Continent," she said. "In my opinion, and I am one of many who think the same, broadcasting programmes at the London station are far superior to those relayed by any of the Continental or even American stations.

"Is England Really Musical?"

"I think that the items are chosen with more care, and there seems to be something to satisfy every taste. This is not the case in other parts of Europe, and I am often bored by what I hear through a loud speaker."

Madame Olczewska went on to say that the success of a broadcasting programme relied mainly on its originality.

"The London station seems to be able to furnish its programmes with this most necessary evil. The little revues and im-

promptu shows I like very much, and what I have heard or know of them have afforded me great pleasure and infinite amusement.

"But just now, of course, the great thing is to be able to answer that most important question, 'Is England really musical?' and as you, too, ask me that question I can reply to you without a moment's hesitation, 'Yes.'"

"I Love Jazz."

"Of course," went on Madame Olczewska, "what is wrong about good music in England is that there is not enough of it done. It has remained to the B.B.C. to show how popular good music can become; and



A "one-knob", four-valve set, complete with loud speaker, which can also be used as a table lamp.

I really believe that the B.B.C. National Concerts will prove a very effective weapon in driving the fact home."

"Many great musicians in England today believe that the B.B.C. is missing great opportunities. Their criticism is that the kind of music that is broadcast is not good enough," I told Madame Olczewska.

"I am one of those who realise how very difficult it must be to compose a really perfect radio programme," she replied. "When it comes to including good music in these programmes it is more difficult than ever, as in this particular case, more so than in any other, there is no limit to the variety of taste.

"Personally, I love some kinds of Chamber music that my best friends could not listen to at any price. I love jazz. Sir Hamilton Harty, to whose accompaniment I have just sung, hates the very word.

"I like any kind of music, and I think

that any kind of music should be broadcast. Certainly as much as possible only the best should be given, and I think that the first National Concert has shown that the tendency is definitely in that direction."

Madame Maria Olczewska told me, furthermore, that she did not think that serious music should be taken purely as an entertainment rendering all listeners speechless with delight, but rather in the form of an education.

"Good music is one of the finest forms of education in existence to-day. It is better than all the medicine in the world. I will even go farther and say that syncopated music, in other and simpler words, jazz, is one of the finest means of relaxation after stressful periods of fatigue and brain work.

"I may be a little biased," she said, with a smile, "for I love dancing. After my singing, I love my dancing more than anything else. That is why I cannot suppose for one second that the broadcasting of dance music is overdone.

"Jazz is an incentive to dancing; beautiful symphony: an invitation to dream. Why, therefore, if one wants to dance, why shouldn't one prefer syncopation to symphony at certain times of the day.

"Certainly there are times when all kinds of music seems out of place. It must be terribly annoying to get jazz when one's mood asks for symphony, that is why I should like to see the scheme of alternate—or is it alternative?—programmes come into being. Then at leisure one could get just what one happened to be wanting at that moment, *n'est ce pas, monsieur?*"

"Your Talks Annoy Me."

I asked Madame Maria Olczewska if she had any criticism against broadcasting.

"Yes," she said to me most emphatically, "your talks annoy me tremendously. I cannot understand them. Why are they not broadcast in any of the languages I understand. And some of your jokes. I cannot see the point. *C'est vraiment très ennuyant!*"

"But there is one thing I would like to say in conclusion. I wish to say how impressed I have been by the marvellous way my singing has been received both in the Albert Hall and over the wireless. I have received nothing but congratulations. I confess that before the concert I was a trifle frightened, and I feel so happy that my vast English audience has been so good to me.

"Will you tell them through POPULAR WIRELESS that I send them my sincere thanks for the kind letters they have sent me, and that whenever I have another invitation to broadcast I shall always do my very best to fulfil it."

And Madame Olczewska, with her charming smile, said *au revoir!*

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A Special Eight-page Supplement

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Edited by  
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Appears in "P.W."

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**T**HERE can be no doubt that Bowyer-Lowe Components are the most successful for their particular purpose. No "stunts" are tolerated, the essential requirements **ONLY** are considered, and then carried out in the simplest manner consistent with adequate mechanical strength. The numerous letters of congratulations we receive from both experts and amateurs are ample proof that Bowyer-Lowe Components achieve the objects of their individual design—high efficiency and faultless performance.

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# IT'S THE CURVE THAT COUNTS!

By JOHN SCOTT-TAGGART, F. Inst. P., A.M.I.E.E.

**F**AR too little attention is given these days to the characteristic curves of valves, although no one can question the fact that all the operating merits or faults of a valve show up in its characteristic curves. The size, shape, etc., of the electrodes of a valve all contribute to the curves, so does the emission from the filament. There is, in fact, no essential feature which does not affect the mutual conductance, the impedance, or amplification factor of a valve. The experienced experimenter can learn all he wants to know from the curves and that is why I am publishing this week the curves of the S.T. valves which disclose their great superiority over ordinary valves. The curves given are of the static variety to enable readers to make comparisons with other makes. The valves have, however, been designed on the basis of *Dynamic* curves, which represent operating conditions, i.e. with an impedance in the anode

circuit. This impedance is, in actual practice, a transformer, loud speaker, or other apparatus, and causes the anode voltage to vary during reception, while in the case of static curves the anode voltage is maintained fixed at, say, 80 or 100 volts.

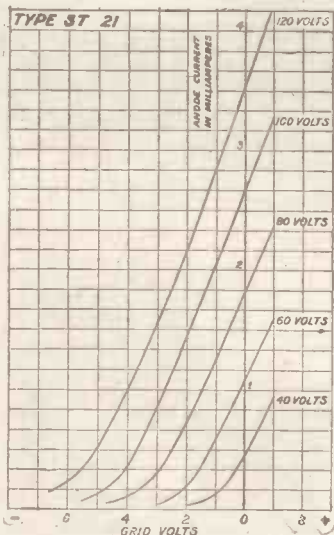
The excellent operation of S.T. valves is borne out in practice, and, in fact, every valve is tested not only electrically, but on actual broadcasting. It was, however, essential to ensure that these good results would be maintained. For this reason, the filament is made of thorodium, which operates at an extremely low temperature. The vacuum is also vital and the Barguet process of exhaustion ensures the highest vacuum known to science.

To return to the curves, you will no doubt wish to keep them for reference. Meanwhile, they will convey to you far more regarding the merits of the valve than pages of claims.

S.T. LIMITED, 2, MELBOURNE PLACE,  
ALDWYCH, LONDON, W.C.2

(Next to Australia House.)

## VALVES FOR 2 VOLT BATTERIES.

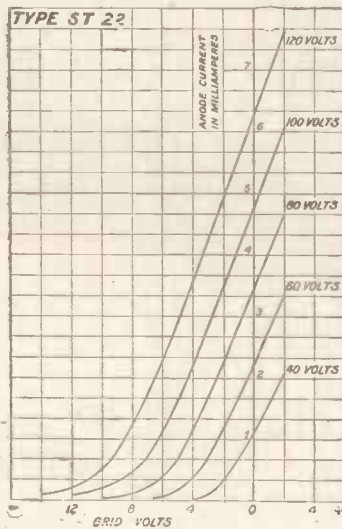


**S.T. 21  
H.F.**

Filament 1.8 volts.  
" 0.1 amp.  
Anode 40-120 volts.  
Impedance 26,000 ohms.  
Amplification 16.

An excellent valve for H.F. amplification and resistance capacity coupling. It is also to be recommended as a detector valve.

Price 14/-

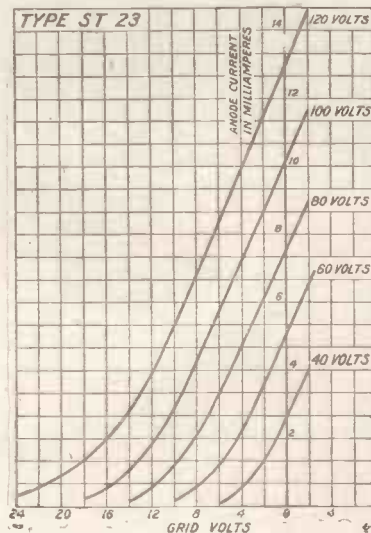


**S.T. 22  
L.F.**

Filament 1.8 volts.  
" 0.1 amp.  
Anode 40-120 volts.  
Impedance 16,000 ohms.  
Amplification 10.

This valve is for the first stage of a low frequency amplifier and will give undistorted reproduction. It may also be used for H.F. amplification, especially in neutrodyne circuits, and for detection.

Price 14/-



**S.T. 23  
POWER**

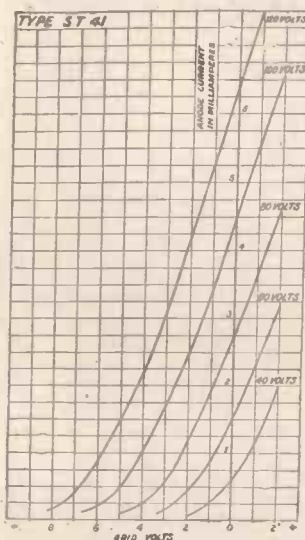
Filament 1.8 volts.  
" 0.15 amp.  
Anode 80-120 volts.  
Impedance 6,000 ohms.  
Amplification 6.

A magnificent 2-volt power valve giving superb reproduction when used as the last valve of a set, when a loud speaker is employed. Note its low impedance and the high amplification factor for such a valve.

Price 18/6



## VALVES FOR 4 VOLT BATTERIES.

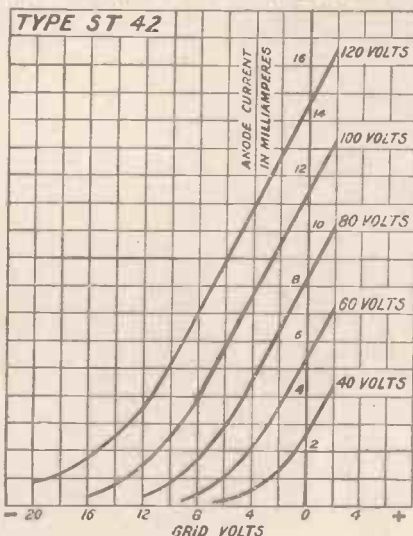


### S.T. 41 H.F.

Filament 3.7 volts.  
" 0.1 amp.  
Anode 40-120 volts.  
Impedance 16,000 ohms.  
Amplification 13.

This is an efficient H.F. valve, more particularly designed for neutrodyne circuits. It brings in the distant stations with ease. This valve may be used as the first L.F. and as the detector valve. It is the valve for resistance capacity coupling.

Price 14/-

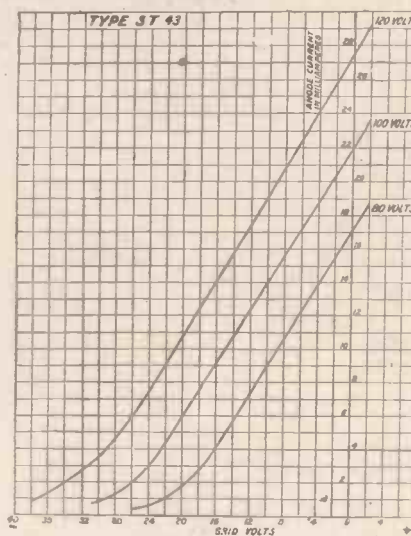


### S.T. 42 POWER

Filament 3.8 volts.  
" 0.1 amp.  
Anode 40-120 volts.  
Impedance 6,000 ohms.  
Amplification 6.

An excellent power amplifier recommended for first and also the second stage of L.F. although the S.T. 43 is the ideal loud speaker valve in the 4-volt class.

Price 18/6



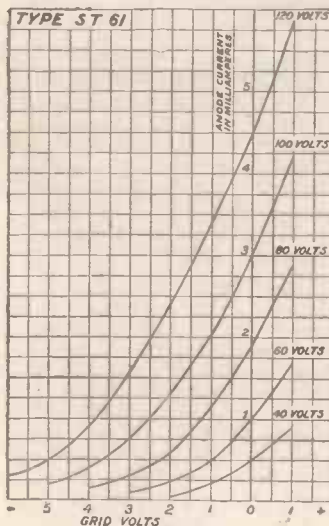
### S.T. 43 Super Power

Filament 3.8 volts.  
" 0.25 amp.  
Anode 120 volts.  
Impedance 4,000 ohms.  
Amplification 3.33.

This valve is the only standard 4-volt valve in the super-power class, hitherto confined to 6-volt valves. It is "the valve with the golden voice" and is capable of great volume and exceptional purity of tone.

Price 22/6

## VALVES FOR 6 VOLT BATTERIES.

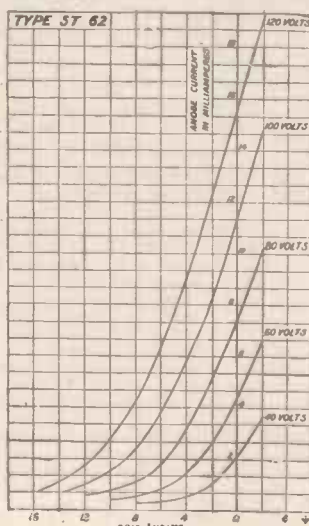


### S.T. 61 H.F.

Filament 5.6 volts.  
" 0.1 amp.  
Anode 50-120 volts.  
Impedance 20,000 ohms.  
Amplification 20.

This efficient H.F. valve is particularly to be recommended for all neutrodyne types of circuit, while it may also be used for resistance-capacity coupling. It makes an excellent detector.

Price 18/6

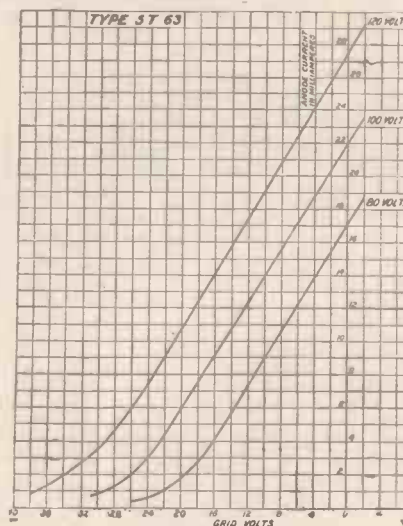


### S.T. 62 POWER

Filament 5.6 volts.  
" 0.1 amp.  
Anode 80-120 volts.  
Impedance 6,000 ohms.  
Amplification 8.3.

This power valve is the best of its class and makes a good 1st and 2nd L.F. valve. It is intended especially as a good all-round power valve.

Price 18/6



### S.T. 63 Super Power

Filament 5.6 volts.  
" 0.25 amp.  
Anode 120 volts.  
Impedance 4,000 ohms.  
Amplification 3.33.

This is "the valve with the golden voice." It is an entirely new class of valve, having very long, dead-straight, dynamic curve, giving exquisitely pure loud speaker reproduction.

Price 22/6

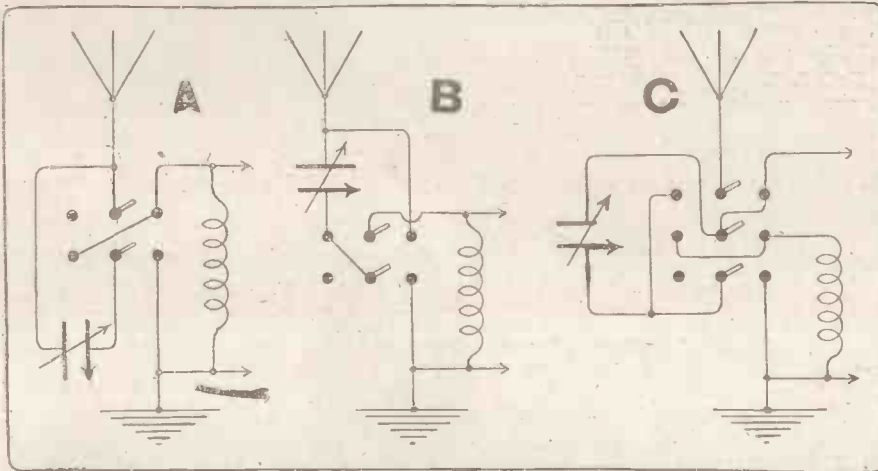
# AN INTERESTING COMPARISON.

By O. J. RANKIN.

**H**AND-CAPACITY effects are most pronounced when the moving vanes of a tuning condenser are connected to that part of a circuit where the presence of the operator's hand has an unbalancing effect upon the tuning. It should be remembered that the moving vanes are connected to the spindle, which, of course, carries the manipulating knob; and that every time the knob is adjusted, one's hand

of course, not possible to connect the moving vanes to earth, but it is possible to connect the fixed plates to grid (assuming a direct coupled circuit) and this should always be done. But with many series-parallel switching devices even this becomes impossible, as will be seen from the examples given at A and B in Fig. 1.

Here we have the two most common series-parallel arrangements; in each in-



is thus placed in close proximity to the spindle, or otherwise moving vanes. For this reason they should always be connected to the "earthed end" of a circuit. In other words, the fixed vanes should be connected to the "aerial" or "grid end" of a circuit, not only in the case of direct or inductively coupled aerial circuits, but also in tuned anode and H.F. transformer couplings, the anode of the valve being considered as the "grid end" in the latter examples.

## A Three-Pole Switch Method.

This rule applies in all cases where the condenser is connected in parallel; in the case of a series aerial tuning condenser it is,

stance a D.P.D.T. switch is employed, the condenser being in parallel at the right-hand setting, and in series at the left-hand setting. The moving plates of the condenser are indicated by the heavy arrow-head, as in further examples.

It will be seen that when the condenser is in parallel with the coil the fixed vanes go to grid, as they should do, but in the series position the moving vanes go to grid. One obvious method of overcoming this difficulty is to use triple-pole two-way switch in the manner shown at C; here the fixed vanes go to grid at either position. But such a device is complicated and expensive, and when we consider the merits of the simple and inexpensive three-terminal method of

series-parallel switching, one cannot help wondering why elaborate switching devices are allowed to flourish in aerial circuits.

## The Three-Terminal System.

Diagram D, Fig. 2, shows the correct method of wiring up the terminals, condenser, and coil. It will be seen that the moving vanes of the condenser are connected to the centre terminal, which is usually marked "A2-Series." The top terminal, which is connected to the fixed vanes, is marked "A1-Parallel." The lower terminal is the common earth terminal, this being provided with a length of flex long enough to reach the centre terminal. This and the aerial lead-in are fitted with spade terminals. The condenser is in parallel when connections are made as indicated at E, and in series as at F.

It should be noted that the fixed vanes go to grid at either position; thus one obtains the same effect given by the arrangement at D, Fig. 2. But on account of the complex nature of the latter one loses a good deal of efficiency at the cost of a little convenience, whereas with the three-terminal system it is possible to obtain the highest possible degree of efficiency, and I have never yet heard anyone complain of the inconvenience of hooking up terminals.

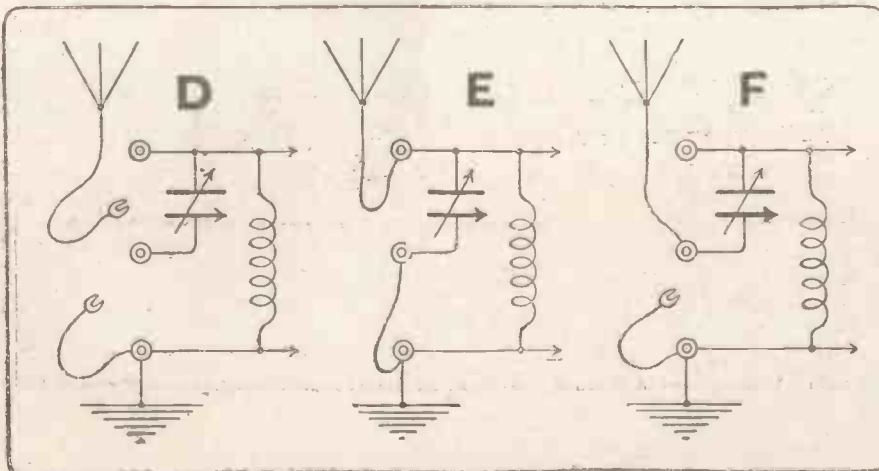
By the way, I believe the present popularity of this ideal arrangement is due to the efforts of the "P.W." technical staff; it is invariably included in their circuit diagrams, and maybe that is one reason why they "get away" with so many successful hook-ups.

## WHAT TO DO WITH AN INEFFICIENT TRANSFORMER.

**I**F one possesses two L.F. transformers, one of them a first-class instrument with a primary winding of high inductance and a moderately low ratio (not more than 4 : 1), and the other a 5 : 1 component with comparatively little wire in the windings, the difference in the results when tested under similar conditions may be so marked that there will be a temptation to throw the cheap transformer into the dustbin forthwith.

But even if the results with the cheap transformer are relatively very bad, it is probably not altogether worthless. Much depends on the type of valve used immediately before a transformer of this kind. If only one stage of L.F. amplification is being used and if the detector valve is of the H.F. type, it will be found that the results from the cheap transformer will be very much improved by substituting a small power valve in the detector position. If two L.F. stages are employed, the cheap transformer will probably be better in the second stage than in the first, provided both the L.F. valves are power valves. The first L.F. stage may contain the better transformer, or a resistance or a choke.

If only one transformer coupled stage is desired, the cheap transformer may often be used successfully as a choke, either for L.F. amplification, or in a shunt circuit across the loud speaker terminals. When the transformer is used as a choke, the windings may be connected in series, O.P. being joined to I.S., or the secondary winding only may be used.

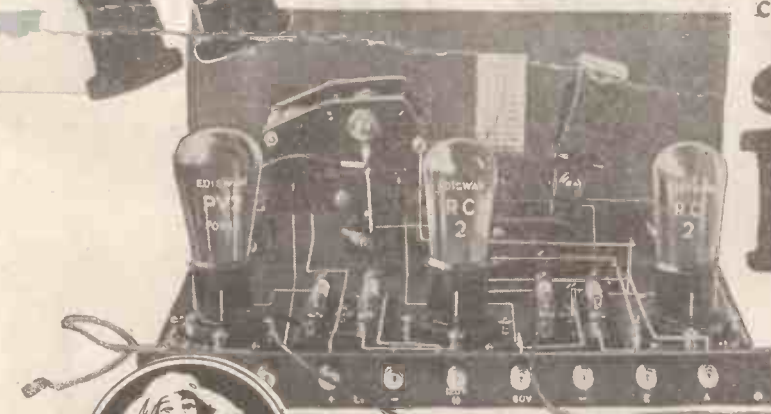




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3-valve resistance  
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## The R.C. Threesome— A wonderful 3 valve set you can build yourself in three hours for £3.0.0. or less

Again, Ediswan leads!—this time with resistance-coupling amplification.

Beautiful, mellow, natural reproduction with an abundance of volume has been made possible by the employment of two New Ediswan Valves—R.C. 2 and P.V. 2—in the new quarter-watt POINT ONE ECONOMY Range.

For the betterment of wireless reproduction, with economy, Ediswan offers FREE, the new R.C. THREESOME Book of simple-to-follow instructions, with a full size blue-print of the wiring diagram. A theoretical diagram is included for experienced experimenters.

If you can use a screwdriver you can make this set in one evening—it's so simple. The necessary components are inexpensive—in fact, the set can be made for £3, or less.

Reception is truly remarkable. Both local and high-power stations come through at full volume—tone is pure and rich without a trace of the throatiness so evident in transformer-coupled sets.

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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.

#### EUREKA LOW-LOSS H.F. TRANSFORMER.

SOME long time ago we gave it as our opinion in these pages that insufficient attention was paid to the design of H.F. transformers. These were for years treated more as L.F. than as H.F. components. Both windings were generally wound cotton-reef style in a tight little bunch in a groove turned in solid dielectric. Moreover, most of the wire used was of an extremely fine nature. In these circumstances it is to be wondered at that many amateurs asked the question "Is H.F. amplification worth while?"

We recalled these facts to mind when we received a Eureka low-loss H.F. transformer for test—as good a specimen of modern practice as we have seen. Being critical, we cavil at the use of the words low loss, holding the opinion that all radio components should, as a matter of course, be "low loss" these enlightened

days, more especially H.F. components. However, as there are probably still a number of very "high loss" H.F. transformers still flooding forth from the factories of unconscientious exploiters of radio, there is no doubt that the Eureka people must put those two words in as a measure of self-protection.

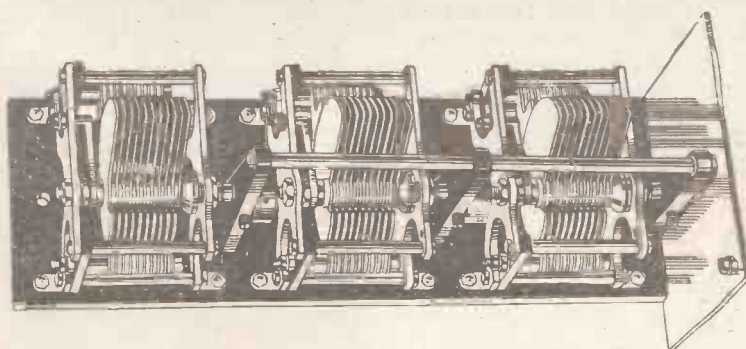
The Eureka low loss H.F. transformer is by no means cheap; with a standard valve holder base it costs 15s., and 17s. 6d. with a special wide spaced base. But the component really is beautifully made and its design as "modern" as could be. It is wound with a healthy gauge of silk-covered wire, and the windings are carried on high-class ebonite formers of the true "skeletonised" order. Replacing an old-fashioned H.F. transformer for one of these modern Eureka's, the difference can be noted at once. Tuning is much sharper, and the increase of sensitivity obtaining is most

noticeable. This realisation of what is almost an ideal in a key H.F. component will make the DX "fan" really happy, even if it is rather expensive. Five models covering ranges of 150—300 and 2,400—3,500 metres are available.

#### R.I. H.F. CHOKE.

As was stated in one of our recent articles, one of the chief requirements of an efficient H.F. choke is that it shall have a very, very low self-capacity. The self-capacity of the new R.I. H.F. choke—a sample of which was recently to hand—is so low that for practical purposes it is quite negligible. The former upon which the wire is wound is less a former than a mere collection of light, but strong, little girders. The wire is wound in eight small bunches, each bunch being widely separated from the others. A reduction of turns (and this means to some extent a reduction of losses) has been obtained by employing a rather larger diameter than usual—nearly two inches. But the component is not unwieldy and is less than 3 in. high. It is designed for base-board mounting. Very wisely, we think, Messrs. R.I. have given it a transparent casing so that all its "innards" are in plain view and ready for the critical inspection of the modern amateur. We have already used this R.I. H.F. choke in one or two important experimental receivers, and in each case it gave perfectly satisfactory results. We can describe it as a "safe" component—i.e. designed to choke H.F. currents it can be incorporated in a hook-up without fear that it will fail to do its duty under the most adverse of conditions.

(Continued on page 708.)



CONSTRUCTORS are giving this handsome new model a most enthusiastic welcome because of (1) Its absolute freedom from whip. (2) Independent adjustment of each Condenser by novel means, completely eliminating hand capacity.

Send for particulars of the CYLDON WAVEMETER—it identifies unknown stations, and makes searching and testing out simplicity itself.



OTHER attractive features are:—Each Condenser electrically separated; anti-capacity plate supplied; operation of all three condensers as "silky" as if only one was used; whole instrument perfectly rigid; supplied ready for immediate fitting; construction and finish are well up to the fine CYLDON standard.

#### "Cyldon" TEMPRYTES

The best means of valve control. British made and delivered from stock immediately. Can be supplied in correct resistance for any Valve. State resistance (ohms) required when buying, or be sure to give name of Valve and voltage of Accumulator supplying current to the Valve.

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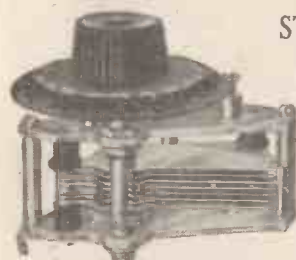
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Made of best quality enamel coated ebonite, these insulators take advantage of the excellent insulating properties of glass, and at the same time avoid losses by keeping the lead-in well away from walls. Rubber rings form a watertight joint against the pane. The cone keeps a portion of the insulator dry in wet weather.



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A special drill, with instructions for making hole in glass, supplied with each insulator.



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A precision instrument, the design of which ensures perfect mechanical construction with high electrical efficiency. The rotor plates are earthed, eliminating hand capacity effects. It is also completely silent when adjustments are being made.

Perfect electrical contact is obtained by means of a flexible phosphor bronze pigtail connection.

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(Patent 253,612.)

A most ingenious device for applying slow motion to variable Condensers, coil holders variometers, etc., consisting of an ebonite dial and knob (0-180°) fitted with worm-wheel bracket and worm-spindle, micrometer barrel and pointer, complete with fixing screws. Gear ratio 240-1. Fitted with instantaneous release. Backlash entirely eliminated. Hand capacity reduced to a minimum. Suitable for the following makes of condensers: Silvertown, Burn-dept, Igranic, Polar, Sterling, Ormond, Jackson, Devicon, Utility, Ashdown, Lamplugh, Ediswan, Edison-Bell, Bow-yer-Lowe, Atlas, W. and M., A.J.S., etc. Price 6/- each.



### AN AID TO ENTHUSIASTS.

We have prepared a logging chart for recording wavelengths, condenser settings, etc., of those stations which require careful calibration to tune in. A copy of this chart, printed on stiff card, with hanger, can be obtained free of charge at any of our Branches or from any high-class dealer.

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TALK No. 3

Testing a H.T. Dry Battery

Considerable misapprehension appears to exist regarding the correct method of testing a H.T. dry battery. To be of any value such a test should only be made with a high resistance moving coil volt-meter having a resistance of at least 100 ohms per volt scale. The internal resistance of the battery increases with use and age, but its internal resistance is relatively not of much importance in view of the high internal resistance of a thermionic valve, i.e. from about 8,000 to 30,000 ohms. A battery having a high internal resistance may still be capable of supplying the maximum current required to operate the receiving apparatus, providing its overall voltage is sufficiently high. Even a high-grade moving coil volt-meter having a resistance of 100 ohms per volt of scale will take a current of 10 milli-amperes at its full scale reading, and it can be assumed, therefore, that if a battery shows a good voltage on such an instrument it will give at least the same voltage when delivering current to the receiving apparatus.

Testing sections of a H.T. battery by means of a flashlight bulb is not recommended. It will certainly indicate the ability or otherwise of a battery to light such a lamp, but is an extremely unreliable method of determining whether the battery is still capable of being used for H.T. purposes. The usual flash-light bulb takes a current of from 200 to 300 milli-amperes, and although a battery which has seen considerable service may not be able to give this discharge it may still be perfectly capable of supplying the very much smaller current required for H.T. purposes. Incidentally, the practice of connecting a wire across an apparently "dead" section is usually a certain method of damaging the entire battery and is strongly deprecated.

The above is an extract from our new Catalogue No. 650, "Siemens Radio Batteries," which will assist you in the selection of the correct size of battery to be used for any radio purposes. It also contains a large amount of practical information on the CARE and MAINTENANCE of radio Batteries.

A copy will be sent post free on application to

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## APPARATUS TESTED.

(Continued from page 706.)

### RIPAULT'S LATERAL ACTION CONDENSER.

A very novel movement is incorporated in this component, a sample of which was recently sent in for test by Messrs. Ripaults, Ltd., King's Road, London, N.W.1. Two sets of plates, measuring approx.  $2\frac{1}{2}$  by  $1\frac{1}{4}$  in. are provided, one set being made to travel along two guides and intermesh neatly with the other by means of a cam device. Thus the area covered by the condenser is no greater than that of the 4-in. dial in whatever position are the moving plates. The action is as mechanically perfect as could be, and there is not the slightest "backlash" harshness or looseness or any other such fault at any point during the  $360^\circ$  revolution of the dial between maximum and minimum.

A direct and permanent connection is made through two soldered springs between the metal frame and the moving plates. One bar of ebonite is all the solid dielectric which figures in the solid construction of this Ripault product. Electrically the device is essentially a "low-loss" component and obeys a "square law" in accordance with modern practice. A low minimum is provided, and the maximum capacity is substantially as stated. One hole fixing is possible.

This variable is very well made, being strong and clean in design and nicely finished. Model S.Q.1, which is rated at 0.005 mfd., is priced at 18/6, but it is a

precision instrument and not an inartistic assembly of black composition and aluminium.

### THE CLEARTRON "N" RECEIVER.

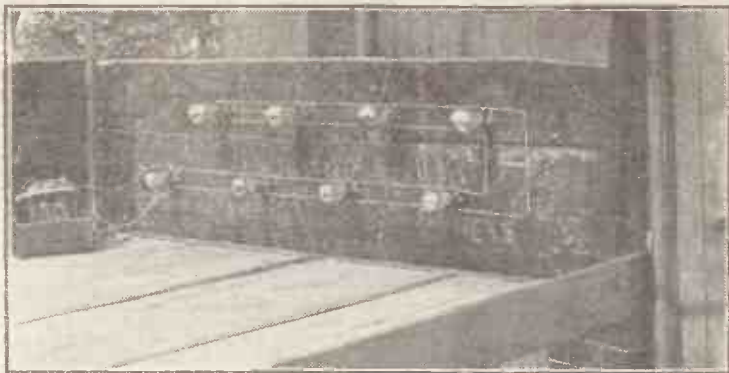
We recently received a complete "N" receiver outfit from Messrs. Cleartron Radio, Ltd. It included a two-valve Lodge "N" set, a Cleartron loud speaker, valves and batteries, and was exactly similar to those advertised at £15 15s. inclusive of all royalties. All our readers will know what an "N" two-valver is, and should not need to be told that it is a Det.-L.F. embodying a circuit due to our eminent scientific adviser. Nor should it be necessary for us to enter into details concerning the remarkable properties of this circuit, as these have been described in articles written by the inventor, Sir Oliver Lodge, F.R.S. But doubtless many readers will appreciate our unbiassed comments on the Cleartron assembly.

The receiver is contained in a handsome polished case, which is provided with an apartment for batteries. The panel is mounted at a

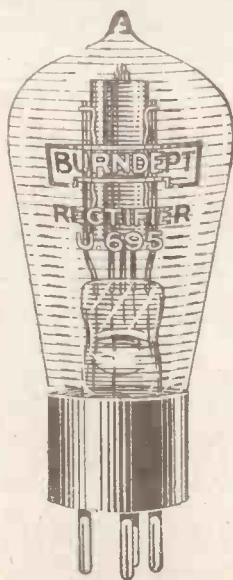
very convenient angle and allows comfortable access to the single tuning dial. First-class materials appear to have been used throughout and the lay-out and wiring closely follow the original specifications. The Cleartron dial allows the fine adjustment the set requires and the filament rheostat gives a smooth control of volume.

Quite apart from the fact that this receiver embodies a special "N" circuit we consider that it would be good value for £15 15s. with the complete set of accessories were it only a standard Det.-L.F. On test the Cleartron "N" gave excellent results well up, in our opinion, to those given by the original model upon which we have reported at length. The Cleartron loud speaker capably handles the respectable volume the "N" delivers.

### A VERY PRACTICAL TEST.



Eight "Lotus" valve holders, complete with valves, were fitted to the tailboard of a Ford lorry, which was then driven over 30 miles of rough roads. Despite this rough treatment, no damage was done.



## Here is the Rectifying Valve for your H.T. Accumulator Charger

IF you are building the H.T. Accumulator Charger described by Mr. Percy Harris in "Popular Wireless" of November 6th, you will need this Burndept Super Valve U695. It is a Dull Emitter Rectifying Valve for alternating current. The filament is designed to operate on a *maximum* of 6 volts, at which it takes nearly 1 ampere. The anode is very substantial, and is most rigidly supported. Circuit diagram, full instructions, and licence under the Patent are supplied with each Valve. **PRICE 20/-**

If you do not wish to make your own, we recommend the **BURNDEPT H.T. ACCUMULATOR CHARGER** ready for use. It will do all you desire satisfactorily in every way. You can get one from your local Burndept Dealer. **Price £6 : 17 : 6.** Ask to see one or send for full details to:

Head Offices & Factory:  
Blackheath, London, S.E.3  
Telephone: Lee Green 2100.  
Telegrams: Burnacoil, Phone,  
London.

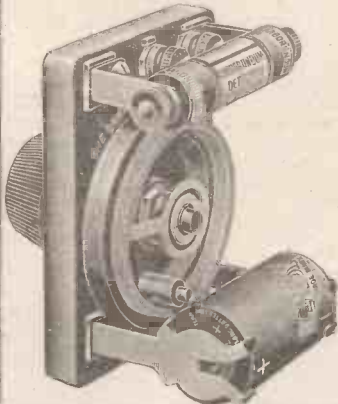
# BURNDEPT

London Offices & Show-  
rooms: 15, Bedford Street,  
Strand, W.C.2  
Telephone: Gerrard 9072.  
Telegrams: Burndept West-  
rand, London.



## WHY USE VALVE RECTIFICATION

The special feature of the CARBORUNDUM STABILISING DETECTOR UNIT is the electrical control, which enables the resistance to be varied to match the circuit impedance. The CARBORUNDUM STABILISING DETECTOR UNIT can therefore be substituted for any detector in any set with the following advantages:—  
**OSCILLATIONS OF H.F. VALVE UNDER PERFECT CONTROL. INCREASED SELECTIVITY. CRYSTAL CLEAR TONES.**



The UNIT is also of inestimable value to the two-valve set user, as it enables the detector valve to be used for H.F. amplification, thus giving increased range and volume, and sharper tuning.

### PRICES

(including postage):

No. 32, price each 12/6

Ever Ready Dry Cell U.W. 5, 5d.

No. 30 (Detector only) 5/-

Send for Descriptive Folder W3 and Hook-up Booklet to:

**The CARBORUNDUM COMPANY, LIMITED**  
Trafford Park, Manchester

## THE NEW No 7



### RECUPERATING AGENT

IN THE

## HELLESEN DRY BATTERIES

### FORESIGHT!

Five years ago the manufacturers of Helleesen Dry Batteries realised that specialisation was necessary in Wireless types if the needs of to-day were to be efficiently and economically met.

A longer life to meet the long and frequent periods of use which you demand to-day without sacrificing in the slightest the smooth uniform supply which has made Helleesen Dry Batteries known as the **BEST IN THE WORLD.**

60 volt "WIRIN" 12/6

99 volt "WIRUP" 21/-

(Postage Extra)

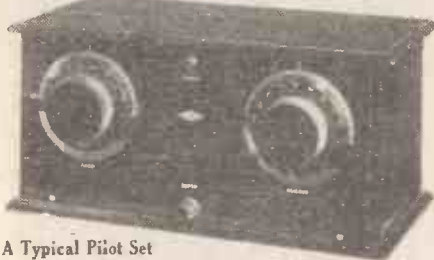
All types, voltages, etc., in Double and Treble capacities for H.T. and L.T. Supply. Ask your dealer for the type to suit your set and get the maximum service, or write us for full particulars.

Obtainable at all Radio, Electrical and General Stores, Harrods, Selfridges, etc., or direct from

**A. H. HUNT, Ltd. (Dept. 12), CROYDON, SURREY**

## ALL THE LATEST "P.W." SETS

Supplied as finished instruments or in parts for home construction



A Typical Pilot Set

If you want an efficient and handsome receiver ready built, you cannot do better than purchase one of these "Pilot" sets. They are designed by experts, made by skilled workmen, and thoroughly tested on a large number of stations at full loud-speaker strength. These sets are installed free within 50 miles of any one of our branches.

**Every finished set we sell is tested under the supervision of Capt. R. W. TINGEY, A.M.I.R.E. (Late of Radio Press Laboratories).**

Should you prefer to assemble your own set—and there is no finer hobby for the long evenings—you can do so under our famous "Pilot" Service, with every assurance that your efforts will be successful. Write for details of this service and mention the type of set you want.

**IN EITHER CASE WE GUARANTEE GOOD RESULTS!**

*There is a set to suit YOUR needs in the famous "PILOT" range.*

Let us know exactly what results you wish to obtain, and we will advise you as to the set most suitable for your requirements.

The PILOT MANUAL contains illustrated details of a number of up-to-date sets which we thoroughly recommend. Much useful information on soldering, assembling, testing, etc., is also included. Post free .. 3d.



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**PETO-SCOTT CO., LTD.**

Head Office & Works: 77, City Rd., LONDON, E.C.1

Branches: 62, High Holborn, London, W.C.1. WALTHAMSTOW—230, Wood Street. PLYMOUTH—Bank of England Place. LIVERPOOL—4, Manchester Street.

TRADE

# HUNT'S

MARK

*They Last Longer*

## EXPERTS IN RADIO

IS THIS WHAT  
YOU'RE LOOKING  
FOR?

Testing the new 2-valve receiver at our Works at Slough, on a standard P.M.G. aerial, we tuned in the two Paris stations, London, Daventry, Bournemouth, Birmingham and Newcastle on the loudspeaker. This despite bad screening set up by a large power station not more than 50 yards from the vicinity of the laboratory. We were testing on 66 volts only. You can expect even better from the 3-valve Brandeset.



## THE BRANDESET II.

The new Brandes 2-valve set features simplicity of control and ingenious compactness. Condenser dial, filament rheostat, reaction dial and "throw-over" switch for long or short wave tuning complete the panel controls. Straight line frequency condenser tuning and grid-bias is employed. The standard coil is suitable for Daventry and no "plug-in" coils need be purchased. The L.T., H.T., and grid-bias leads are plated into one cable

**£6 10**

(Exclusive of Marconi Royalty and Accessories.)



## THE BRANDESET III.

The new Brandes 3-valve receiver employs the same ingenious characteristics as the Brandeset II, except that an extra stage of Audio Frequency is employed. It has straight line frequency condenser tuning, grid-bias, and is adapted to long and short wave tuning. Both receivers give most excellent loudspeaker reproduction on a number of stations, and are specially designed for this purpose.

**£8 10**

(Exclusive of Marconi Royalty and Accessories.)

# Brandes

From any reputable Dealer.

Brandes Limited, 296 Regent Street, London, W1

ACOUSTICS SINCE 1908

## RADIOTORIAL.

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. Life, Ltd., 4, Ludgate Circus, London, E.C.4.

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

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

## TECHNICAL QUERIES.

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

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

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

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

**BLUE PRINTS.** A series of 20 Blue Prints can be obtained from the Query Dept., price 6d. per Blue Print. Only a limited number of circuits are covered in this series, and full details of the circuit arrangements available in Blue-Print form are published fortnightly in the advertisement columns of this journal.

No set in this series has more than three valves. All are of the flat-panel type.

All other back-of-panel diagrams have to be specially drawn up to suit the requirements of individual readers at the following rates: Crystal Sets, 6d.; One-Valve Sets, 6d.; One-Valve and Crystal (Reflex), 1s.; Two-Valve and Crystal (Reflex), 1s.; Two-Valve Sets, 1s.; Three-Valve Sets, 1s.; Three-Valve and Crystal (Reflex), 1s. 6d.; Four-Valve Sets, 1s. 6d.; Multi-Valve Sets (straight circuit), 1s. 6d. Except **SUPER-HETERODYNE DIAGRAMS**, all of which, irrespective of number of Valves used, are 2s. 6d. If a panel layout or list of point-to-point connections is required an additional fee of 1s. must be enclosed.

Wiring diagrams of commercial apparatus, such as sets of any particular manufacture, etc., cannot be supplied. (Such particulars can only be obtained from the makers.)

Readers may submit their own diagrams, etc., for correction or for criticism. The fee is 1s. per diagram, and these should be large, and as clear as possible.

No questions can be answered by 'phone. Remittances should be in the form of Postal Orders.



## MORSE INTERFERENCE.

H. J. W. (Whitley Bay, Northumberland).—I have a crystal set with which I get fair results (with an indoor aerial) from Newcastle B.B.C. station, distant 8 to 10 miles.

Unfortunately I am near to the Cullercoats Signal Station (about 1½ miles). When this station is working "listening-in" is impossible. I shall be glad if you could advise me what to do "to cut Cullercoats out" by recommending a selective (1) crystal set, or (2) a dull-emitter one-valve set.

If the latter I should prefer one with which distant stations, particularly London, could be obtained on the 'phones. Would either of the

(Continued on page 712.)

ELECTRADIX  
BARGAINS No. 112

**GYROSCOPES.**—Navy Torpedo in mahogany cases, beautiful workmanship, for Television experimenters. Cost £25. Price 15/-.

**POWER TRANSFORMERS.**—H.T. Step-up to 1,000—0-1,000 volts from A.C., 50/-; 220 volts to 3, 5, or 8 volts, 12/6. Double wound for Receiver H.T., from A.C. mains, for 220 volts; two-centre tap secondaries for H.T., 20 m/a and L.T., 25/- each. 50 m/a, 37/6.

**ACCUMULATOR SALE.**—Fuller "BJX24," 2 volt 24 amp, 6/-; 4 volt 24 amp, 11/-; 6 volt 24 amp, 16/-; "BJX30," 2 volt 30 amp, 6/6; 4 volt 30 amp, 12/-; 6 volt 30 amp, 17/-; Fuller—2 volt 45 amp, 10/-; 4 volt 50 amp, 20/-; 2 volt 60 amp, 13/-; G. Exide—6 volt 8 amp, 6/8; H.D., 2 volt 40 amp, 7/-; H.D., 4 volt 40 amp, 13/6.

**SWITCHES.**—Every size stocked.

**PROTRACTORS.**—Engraved Double 0-180 in leather case. Taylor Hobson. Cost £2. Our price 8/-.

**FORTEVOX CRYSTAL SETS.**—Slider Tuning Coil, neat Detector, Range 25 miles. Complete with head phones, 15/-.

**ELECTRIC BELLS, 1/6; MORSE SOUNDERS, 6/6 each. MORSE KEYS, with cover, 2/6.**

**BUZZERS.**—Highest note. For sharp tuning, 3/6 each; models, 2-. Small Power Buzzers, 4/8.

**MICA SHEETS.**—Best Ruby Mica for Condensers, .002, 2 by 2 by .002 thick, 1/- per dozen.

**PLUGS AND JACKS, 2/6 pair.**—One hole, 3/- pair; Switches—Dewar's 1-way, 1/6; 3-way, 2/6; 2-pin Lucas Plug and Sockets, 4d. pair; Panel 2-pin Base and Plug, 8d.; Electric Adapters, 5d.

**SALE CLEARANCE LOUD SPEAKERS, with cord.** We have the surplus stock of Western Electric Table Talkers, famous for Tone Purity. Sale price, 2,000 ohms, 17/8; T.M.C. Loud speakers, 2,000 ohms, 12/8; Ultra, 26/8; Magnavox for large room, 60/-; Fuller Sparta 4-guin. model, 50/-; Large Serenada, tone horn, 30/-; Texas Cone, bronze stand, 40/-.

**WAVEMETERS.**—We have a large stock of all ranges at greatly reduced prices, from Townsends at 35/- Details in catalogue.

A thousand bargains in our catalogue of 600 unique illustrations, price 4d. It will Save you Pounds.

**SLATE PANELS.**—Polished glass, ½ in. thick, 5/6 per sq. ft.; ¾ in. thick, 6/6 per sq. ft. Plain slate Bars for power rheostats, 10d. each.

**CHATTERTON'S COMPOUND, 1/- stick.**

**PANEL DASH LAMPS, 1/- each.**

**POCKET FLASH LAMPS, 9d. and 1/2.**

**POLAR SURPLUS ALL NEW.**—Precision Condensers: .003, list, 12/6. Sale, 4/8. Polar Varia H.F. Transformers 300/500, 3/8. Dubilier Anode Res., all sizes, 3/8. Holders on ebonite, 1/-; Polar Cosmos Varlometer, scale and dial, list, 21/-; Sale, 8/6.

**NEW COIL HOLDERS.**—Polar Panel 2-way Vernier, 4/-.

**HIGH TENSION ACCUMULATORS.**—H.D. Co., 80 volt 1 amp, with taps, ebonite case and lid, glass cells, new. Reduced to 40/-.

**D.C. GENERATORS.**—Shunt wound for charging 6/9 volts 8 amperes, ball-bearing, enclosed, 50/-, cost £10. Auto fitted cut-in-out, £3. 50/100 volts, 5 amperes, ditto, £4. 50/70 volts, 10 amperes, £9. 50/70 volt, 25 amperes, £11. 80/100 volts, 30 amperes, £12. 220 volts, 12 amperes, £12. 12 volts, 20 amperes, Mackie, £4.

**A.C. to D.C.**—220 v., 50 cycles. M.G. to 30 v. 15 amp, £16.

**APCO 220 v. A.C. to 6 v. 4 a. D.C., 70/-.**

**DIXON ULTRA ONE-METER.** The 58 range Radio Star. Instrument, 50/-; Multipliers, 6/6.

Descriptive Booklet, showing how to make all Radio Tests, 1d. stamp.

**PRECISION INSTRUMENTS.** Finest stock in London. Mov. Coils to 500 m/a, etc., 20/-; 3-range Milliammeters, 37/6; 2-range Voltmeters, 6/120, 11/8; 0-30 volts, 10/-; 120 volts, 20/-; 600 volts, 55/-; 0-1,000 volts, £3; 1,500 volts, £4 10s.; 2,500 volts, £6; 5g Mov. Coil Siemens Cell Testers, 15/-; 250 m/a or 500 m/a Thermo Meters, 15/-.

1,000 "Bargain" Catalogue, 600 Illus., 4d.

**ELECTRADIX RADIOS,**  
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# C.A.V.

**IMPROVED  
1927 MODEL  
H.T.  
ACCUMULATOR  
60 VOLTS  
60%**

SUPPLIED FULLY CHARGED



*100  
Guineas  
for a  
Name!*

HAVE  
**YOU**  
ENTERED

WRITE FOR FULL PARTICULARS

**Competition open to Users of this Accumulator.**  
 Owing to the various special features of our H.T. Accumulator we desire to give it a distinctive name, and invite suggestions. Prizes will be awarded as follows—

**CAVandervell & Co. Ltd.**  
ACTON, LONDON, W.3

**FIRST PRIZE - - - 75 GUINEAS**  
to the entrant of name adjudged the best.

**SECOND PRIZE - - - 25 GUINEAS**  
to the trader from whom the First Prize winner  
— purchased his Accumulator.

**THE  
SPECIAL WINDINGS  
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## *Watmel*

AUTO-CHOKE

are done by expensive and absolutely up-to-date machines which lay the wire exactly parallel and interweave cotton strands between each layer. Cotton acts as binder and ensures perfect insulation. Get to know the other reasons for the fine amplification and natural-toned reproduction, possible only with the **WATMEL AUTO-CHOKE**. Write for N.P.L. Curve 103/1, and Booklet describing Auto-Choque.

Price **18/6**. From your dealer or direct from  
**THE WATMEL WIRELESS CO. LTD.,**  
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Lancs, Yorks, and Cheshire Representative  
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Registered Trade Mark.



**Makers of the  
original world-famous  
BECOL LOW LOSS FORMER**

As used in sets that took the first four prizes at the 1926 "Manchester Evening Chronicle" Wireless Exhibition and the set that won the Gold Medal at the 1926 Amsterdam Exhibition.

Size: 3 inches diameter to outside of wings. Prices:  
 6 inch lengths 3/- (Postage 9d.)  
 4 inch lengths 2/- (Postage 6d.)  
 3 inch lengths 1 6 (Postage 6d.)

Write for List "C."

Ebonite Rods, Tubes and Sheets. Panels guaranteed free from surface leakage.

THE BRITISH EBONITE Co., Ltd., Hanwell, London, W.7.



SAFETY SWITCH

Comprising: Switch, Lightning Arrestor, Lead-in Tube and Weatherproof Cover.

The Eelex safety switch, the latest development in Safety First devices, enables the operator to earth the aerial outside the house. By pushing the knob the set is at once connected to the aerial. A pull instantly disconnects the set from the aerial system, automatically earthing the aerial. The spark gap provides ample means of by-passing any electrical discharge which may occur, while the set is in operation.



6" Tube  
PRICE  
**5/6**

12" tube, 6/6. 18" tube, 7/6.



EELEX  
MULTIPLE  
CONNECTOR

Part of the Eelex System of Standardised Plugs and Sockets, is non-reversible. All parts detachable and adaptable for other purposes.

Price Complete 5/6

Other Eelex Parts  
Standardised System.

WRITE for NEW LIST P.W.3, Now Published.



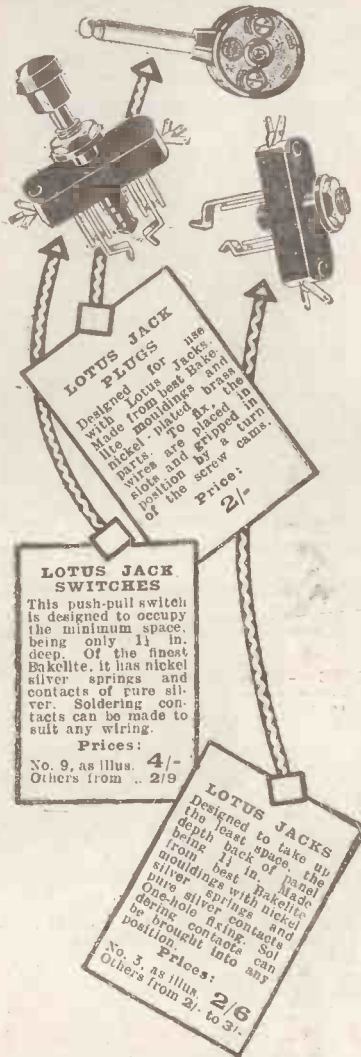
J. J. EASTICK & SONS

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118, Bunhill Row, E.C.

Phone: Clerkenwell 9282.



## THE NEW LOTUS JACKS & PLUGS



The name 'LOTUS' is your guarantee of sound results and solid satisfaction.

From all Radio Dealers.

# LOTUS

## JACKS-SWITCHES-PLUGS

Made by the makers of the famed 'LOTUS' Vernier Coil Holders and 'LOTUS' Buoyancy Valve Holders.

Garnett, Whiteley & Co., Ltd.

Lotus Works,  
Broadgreen Road, Liverpool.

## RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from page 710.)

one-valve sets described in the "P.W." "Constructors' Guide" in "P.W." for week ending October 23rd be suitable? If not, perhaps you could refer me to a design in one of your back numbers.

A powerful land-station working Morse constitutes one of the most difficult forms of interference that has to be contended with. Apart from specially designed circuits made experimentally on the spot, the most effective form of wave-trap or selector is one that can be used for loose-coupling, "series-drain," or other trap circuits, the various methods being tried on the spot until the best one for that particular locality is found.

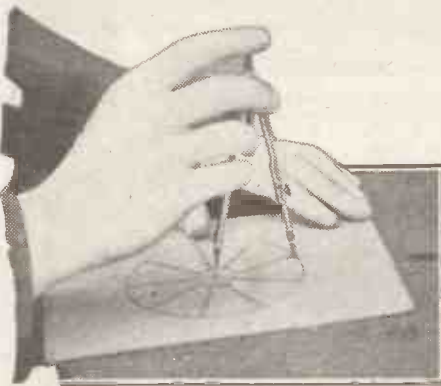
Such a wave-trap is the "Complete Eliminator," that was described in "P.W." No. 193 (Feb. 6th issue). It is suitable for use with any ordinary valve or crystal set, though the latter type is generally not suitable for reception in an area where interference is very bad.

The "Complete Eliminator" would, however, be quite suitable for use with the straight 1-valve set described in "P.W." No. 220 (Oct. 23rd issue).

### SPIDER WEB COILS.

"COUNTRYMAN" (Perthshire).—What is the best method of marking out spider-web coil formers for making flat tuning coils?

A compass or dividers may be used as shown in the accompanying photograph. Alternatively the segments may be marked out from a template,



Marking the slots for a Spider-Web Coil-Former.

showing the respective angles. A template of this kind, with all necessary details for 9 or for 11 slots, was given in the "Radiatorial" columns of "P.W." No. 228 (October 16th issue).

### ECONOMICAL 2-VALVE CRYSTAL SET.

S. B. J. (Gloucester).—I have the following parts on hand, and should like to build them into a good long-distance set: One 2-coil holder, two valve holders, one L.F. transformer, one crystal detector, one '0005 variable condenser, coils, 'phones, rheostats, etc. What would be a good circuit to employ, using two valves and a crystal? (I should prefer a straight circuit to a reflex.) The set will generally be required to work three pairs of 'phones at good strength, but sometimes for reaching out for foreign stations on one pair of 'phones only.

You should get good results from a straight H.F. crystal, and L.F. circuit, for which you have on hand most of the essential parts.

We recommend you to include a switch so that when trying for long distance only the H.F. valve and crystal can be used, the last valve being switched into circuit only when necessary.

Such a circuit appears in the "P.W." Blue Print series (No. 16). It can be obtained from the Query Department for 6d. If a stamped, addressed envelope is enclosed. (See announcements under the heading "Radiatorial.")

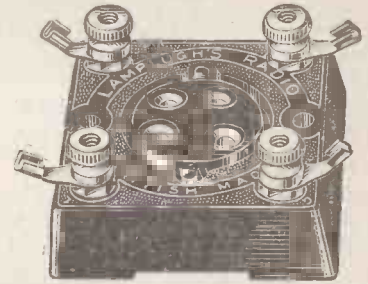
### H.T. UNIT FOR A.C. MAINS.

"NEW READER" (Islington, London, N.19).—I wish to make an H.T. unit to do away with H.T. batteries for my set, which is a 3-valver. Where can details of a suitable unit (for A.C. Mains) be obtained?

(Continued on next page.)

Britain's Best **ADIC** in Radio.

## LAMPLUGH PRODUCTS



## SILENT VALVE HOLDER

Anti-microphonic

Fitted with Heavy Terminals & Grip Tags, PRICE 2/6

Obtainable from all leading Wireless Dealers.

SEND FOR LISTS.

## S. A. LAMPLUGH LTD.

King's Road, Tyseley,  
BIRMINGHAM.

Sole Distributors for London and Southern Counties:  
The Empire Electric Co., 303, Euston Road,  
London, N.W.

Scottish Depot: 38, Montrose Street, Glasgow.

## 'PHONE REPAIR SERVICE

Headphones Re-wound or Re-magnetised, 4/6. Loud Speaker Re-wound, 4/6. Transformers Re-wound, 5/-, Re-magnetising only 2/-. All work guaranteed. Postage extra. Write for trade terms. H. R. P. Co., 1, Cottrill Rd., Spurstowe Terr., Hackney, E.8.

RADIO		PANELS	
Inches		Inches	
7 x 5 1/2		6 x 6 1/2	
7 x 6 1/3		8 x 5 1/2	
8 x 6 1/4		9 x 6 1/7	
10 x 8 2/1		11 x 8 2/3	
10 x 9 2/4		12 x 8 2/6	
12 x 10 3/8		12 x 9 2/10	
11 x 12 4/8		14 x 10 3/5	
		14 in. thick.	
		Post Free.	

Money back guarantee that each and all Panels are free from surface leakage. Megger test infallible. Callers cut any size. Quotations by post, or 'phone Clerkenwell 7853. Samples and prices post free to the Trade.

CROXSONIA CO., 10, South St., MOORGATE, E.C.2.

## BALL BEARING, STRAIGHT LINE FREQUENCY

'0005 VARIABLE CONDENSERS.

7/6 Nickel Plated, Ebonite End Plates. Complete Post free. With Knob and Dial. Superior instruments. ISONS RADIO STORES, 47, ORFORD RD., E.17.

## EASY PAYMENTS

Finest 2-valve amplifier set, including loud speaker, 120 H.T., D.E. valves, £7 10s.; or 18/9 down and 11 instalments of 15/-.

### CASH BARGAINS.

Amplifiers, 17/6 and 21/-; 'Phones, Telefunken type, 7/9; Fr. T. Houston, 11/-; Good H.T., 60v., 8/9; or 41v. (laboratory test), 3/9 doz. Accumulators, with 12 months' guarantee, 2v. 40 Ignition, 8/3; 4v. 40, 15/-; 6v. 60, 29/-; Valve Radio Micro '06, 5/6; 2v., 25, 5/6; Power 4v., 8/9 or 11/9; Wonderful Metal Valves, 2v., 2, 5/-; 2v., '06, 6/9; 2v., 5, Power, 8/6; Transformers: Croix, 3/5; Habana, 3/6; Radiolys, 3/9; Fr. T. Houston, 8/3; Brunet, 7/9. Also Ferranti, Eureka, Formo, etc. Everything in wireless reliable and cheap. Satisfaction or cash refunded.

### MUSIC ROLL EXCHANGE.

29, High Street, Clapham, London, S.W. 4

## ACCUMULATORS ON EASY PAYMENTS

High-Tension Accumulators built up from 20-volt sections (15/- each). Example: 60-Volt H.T. 45/- CASH or 12/6 DOWN and 6 monthly payments of 6/- Carriage Paid. Satisfaction or money back. Write for Lists to DEPT. 11, COVENTRY DIRECT SUPPLIES LTD., 23, Warwick Row, COVENTRY. Any Wireless Goods supplied on easy payments.



## RADIOTORIAL QUESTIONS AND ANSWERS.

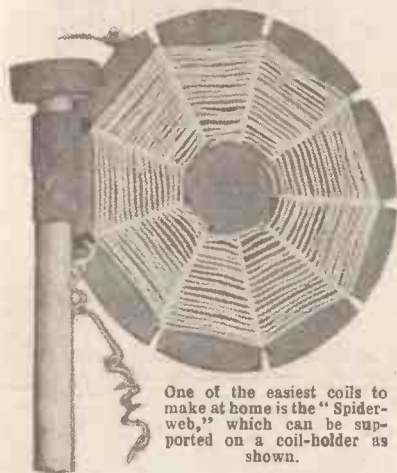
(Continued from previous page.)

An H.T. unit for A.C. mains was fully described in "P.W." No. 227 (Oct. 9th issue). Back numbers of "P.W." can be obtained direct from: The Back Number Dept., Amalgamated Press (1922), Ltd., Bear Alley, Farringdon Street, E.C.4. Price 4d. each, post free.

### HOME-MADE COILS.

"COIL-MAKER" (Bury St. Edmunds).—Are cheap coils made at home really efficient? If so, which is the least expensive kind to make to tune a one-valve set?

It is possible to make extremely efficient coils at home, and some of the types which are easy to make.

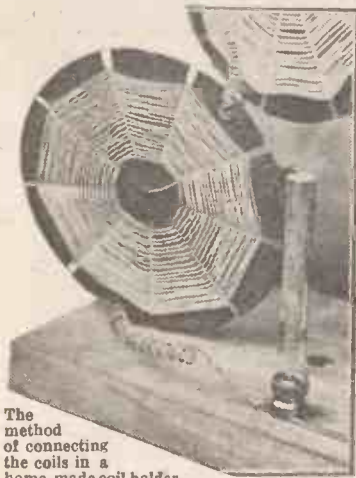


One of the easiest coils to make at home is the "Spider-web," which can be supported on a coil-holder as shown.

e.g., basket-coils, spider-web coils, have a very high efficiency when properly constructed.

One of the simplest forms of tuning coil is the "spider-web," shown in the accompanying photograph. It is wound in and out of slots upon a cardboard former, the "number of turns" being the number of times the wire passes round the former. No. 22, 24, or 26 D.C.C. wire is suitable.

A simple, but not very efficient, method of mounting the formers in a home-made coil-holder is shown in the lower photograph (2). The cardboard formers are fastened to wooden pillars which are mounted side by side in holes drilled for the purpose. Connections are made by the flexible ends. For simple tuning a variometer effect is obtainable by joining one coil to the next, and then "swinging" one of the coils to vary the coupling. Such a "tuner" has a limited



The method of connecting the coils in a home-made coil holder.

wave-length range, but it covers this fairly well. Many foreign stations have been picked up on the set from which the photographs shown here were taken.

### STRAIGHT THREE-VALVE SET.

"STRAIGHT 3-VALVER" (Warrington).—Where can I obtain details for building a straight 3-valve set, (H.F., Detector, and L.F.)? I should like to use the "Tuned" (Continued on next page.)

## EXPERTS IN RADIO ACOUSTICS SINCE 1908

### TWO NEW CONE SPEAKERS

THE Ellipticon has been described as "the best loudspeaker on the market" by one who is fully qualified to judge, and who has no personal interest in our success. And we honestly consider that it is one of the best instruments we have ever turned out. The Tablecone, too, can really be said to be superior to similarly priced Cones.



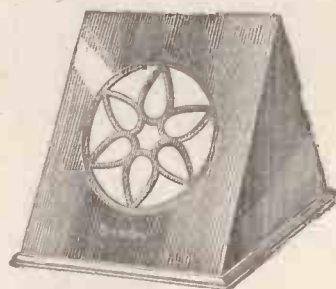
### THE ELLIPTICON

(Registered Trade Mark)

The new Brandes Cone. Undoubtedly the best loudspeaker produced, it brings tone of great depth and sweetness. The cone has a large vibrating area and a driving unit of special design. The magnets in the unit are unusually large. There is no diaphragm but a small arma-

ture which, actuated on the "push-pull" principle, reacts to the faintest impulse. The specially designed cabinet "reflects" the sound in rich and mellowed tones.

Height ..	13½ ins.	£5 10
Depth ..	7½ ins.	
Width ..	10½ ins.	



### THE TABLECONE

Attractive cabinet of unique design, finished in dark walnut. The cone unit is fitted with a large magnet and the circular diaphragm has an extremely sensitive driving unit which provides plenty of volume with unblemished tone.

Supplied complete with cord connection. It has a genuine claim to be superior to any similarly priced cone speaker.

Height ..	10 ins.	£2 15
Depth (at base) ..	11½ ins.	
Breadth ..	9½ ins.	

# Brandes

From any reputable Dealer.

BRANDES LIMITED • 296 REGENT ST. • W.1

**KAY RAY**  
S.L.F. CONDENSERS  
LATEST MODEL  
NOW READY.  
**6/11**

'0003 or '0005 ... **6/11**  
With 4" dial ... **7/11**  
Low-loss or Ebonite Ends.  
Post 6d. Set.

**LOW LOSS SQUARE LAW**  
This variable Condenser is simply marvellous value. It cannot be equalled in price or quality.  
'0005 or '0003 **4/11**  
By Post 5/11  
VERNIER 1/- each extra.

**EVERYTHING in Demand**  
Stocked for Wireless.

**Grand Value in NON-MICRO-PHONIC VALVE HOLDERS.**  
Board Mounting 1/5

**AMERICAN Type Oak Cabinets**  
with baseboard, take 12 x 8 ebonite, 10/6; 12 x 9, 11/9; 10 x 8, 16/11, 18/11.

**RADIO MICRO VALVES.**  
'06, 3v. 6/11; 2v. 6/11; 6/11; Power - 3, 8/6; Power - 1, 9/11. (Power 3-4 volts.) Post 6d. each.

**ACCUMULATORS.**  
2v. 40, 7/11; 2v. 60, 9/6; 2v. 80, 12/6; 2v. 100, 14/6; 4v. 40, 13/11; 4v. 60, 17/11; 4v. 80, 26/6; 6v. 35/6.  
ALSO another good make, 1/6 extra on each of above. Post 1/-.

**BURNE-JONES**  
(Magnum) Screened Coils, West-End Depot.

**AMPLION Large stocks of LOUD SPEAKERS.**  
28/-, 48/-, 58/-  
**ALL MODELS STOCKED.**

**VALVES.** — Cosmos S.P.18, Red or Green, 14/-; New Blue Spot, 14/-; All Mullard, Ediswan, Osram, Marconi, Gossor, Bright, D.E. and Power, 8/-, 14/-, 18/6; 22/6, 24/6, 30/-, 42/-; Mullard P.M. 1, 2, 3, 4, 5, 6 stocked.

**CHOICES.** — Cosmos H.F. 6/6; Lissen H.F. or L.F. 10/- each. Success L.F. or P.F., 10/- each. A.J.S. 15/-, with unit 20/-

**Ormond Products.**  
**SQUA-E L.A. Low Loss.**  
'0005, 9/6; '0003, 8/6  
1/6 each less to vendors.  
Friction Gears '0005, 15/-; '0003, 14/6; '00025, 13/6. Straight Line Frequency Friction Gears, 20/-, 2005. S.L.F. '00035, 19/6. S.L.F. '0005, 12/-; '00025, 11/-.  
**SQ. LAW LOW-LOSS DUAL.** '0005, for Klartre Six, 15/11 each. Ormond Friction Dial, 10/6.  
**Filament Rheostats.** Dual, 2/6; 6 ohms or 30 ohms, 2/-; Potentiometer, 300 ohms, 2/6.  
**L.F. Shrouded.** Inter model, 15/-.

**SCREENED COILS.** H.B.C. 250/550

**ALL MAKE - 5XX**  
1500/2000

**VOLTRON VALVES (British)**  
Smash High Prices!  
2v. 2 - 5/6 4v. 06 6/6  
2v. Power 7/11 4v. 06 5/11  
1v. P. Power 8/6 Post 6d. each

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**K. RAYMOND**  
27 & 28a, Lisle St., Leicester Sq., W.C.2  
Hours: 9.15 to 7.45 Back of Daly's Theatre  
Saturday: 9 to 8.45 Nearest Tube, Leicester Square  
Sunday: 11 to 1 'Phone: Gerrard 4637

## RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

Anode" type of H.F. coupling, the set to be built on a flat panel so as to reduce cost as far as possible.

Details of a set of this type are given on the "P.W." Blue Print, No. 19.

### GRID LEAK SUPPORTS.

F. L. (Northampton).—I am making an L.F. amplifier and wish to support the grid leaks by the wiring, as there is hardly room for clips. Is there likely to be a loss of efficiency if this is done?

Provided that good springy wire is used, and the contacts between the leak and wires are of large surface area, there should be no loss of efficiency. A



good plan is to use square section wire (as shown in the accompanying photograph). The area in contact with the leak is then much larger than when rounded edges are used to support the leak.

### VALVE POSITIONS.

S. T. G. (Redlands, Bristol).—I have an H.F. and Det. receiver, using D.E. 3 valves. I am going to add a 2-valve amplifying unit to this, using one transformer and one resistance-capacity coupled stage. What valves should I use to go with the D.E.3's on hand.

The ideal arrangement for such a set using the D.E.3 type valves, is as follows: H.F., D.E.3 B; Det., D.E.3; 1st L.F., D.E.3 B; 2nd L.F. (Power valve, D.E.4).

As you already have two D.E.3's on hand, we should try the following combination: H.F., D.E.3; Det., D.E.3; 1st L.F., D.E.3 B; 2nd L.F. (Power valve) D.E.4.

As the makers recommend the D.E.3 B for the first and the third positions, we should try the effect of changing over the first and third valves, to see in which position best results are obtainable with the valves you have on hand.

### "P.W." COIL TABLES.

#### No. 3.—BASKET OR SPIDER-WEB COILS.

##### (A) AERIAL COILS WITH SERIES TUNING CONDENSER.

No. of Turns.	Gauge of Wire S.W.G.	Wavelength, in Metres.		Suitable No. of turns in reaction coil.
		Capacity of the Series Condenser. = '0003	Capacity of the Series Condenser. = '0005	
20	24	Max. 150	Min. 95	20-40
30	24	200	130	20-40
40	24	260	170	20-40
50	26	325	210	25-50
60	26	390	255	30-60
70	26	465	305	40-80
80	23	535	350	40-80
90	28	610	395	40-80
100	28	690	450	40-80
125	30	875	570	40-80
150	30	1100	710	40-80

### A SIMPLE TWO-VALVE SET.

"DET. & L.F." (Maidenhead, Berks).—I built the "P.W." Blueprint No. 11 (Det. and L.F.), and having obtained excellent results with this, I wish to make up a similar set, with several alterations to suit rather different conditions:

The new set will be used constantly as a two valver, so no switching is required. Also,

(Continued on page 716.)

## Simple Soldering at Last!

Soldering is now something that every novice can do, for "Flusolda" has come to the aid of expert and novice alike. With a tin of "Flusolda" at your side, a perfect clean joint becomes merely a matter of applying a clean fluid and heating it.

Put on a little—**FLUSOLDA**—and Heat it—That's All

(Patent Applied For.)

(Regd.)

No flux or tinning required.

One of the outstanding successes of the Manchester Wireless Exhibition, where large sales were made.

In tins at 1/3 from Wireless Dealers and Ironmongers.

Trade enquiries to the Sole Manufacturers—THE TRANSPORT SUPPLY CO., LTD., WARRINGTON.

London Office—

82, VICTORIA ST., WESTMINSTER, SW.1.

Telephone: Victoria 7834.

### A.C. MAINS TRANSFORMERS.

As specified for Radio Constructor H.T. Battery Charger Unit, in "P.W." issue, Nov. 6, 200/250 volts. A.C. current, 50 cycles, 1 amp. Satisfaction guaranteed, 9/6 each, post free.

STOREY BROS. & CO., Radio Engineers, 24, Regent Street, RUNCORN.

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OR STRIPS, ETC., DESCRIBED IN THIS ISSUE (OR ANY OTHER) CAN BE OBTAINED IMMEDIATELY THROUGH ANY TRADER FROM—

TRELLEBORGS EBONITE WORKS, LTD., AUDREY HOUSE, ELY PLACE, LONDON, E.C.1.

**WIRELESS.**—Capable, trustworthy men with spare time who wish to substantially increase income required where we are not fully represented. Applicants must have practical knowledge of installation of Set and Aerial, be a householder or live with parents, and be able to give references; state age and experience. Address: Dept. 32, General Radio Company, Limited, Radio House, Regent Street, London, W.1.

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**HALF PRICE** (Except Weco, S.P.'s, and low capacity types). Minimum D.F. Current 0.15 amps when repaired. **ALL BRIGHT & DULL EMITTERS** Listed at less than 10/-.  
Minimum charge - 5/-  
**VALCO LTD., Dept. P.W. Tabor**  
Grove, Wimbledon, S.W.

## SAVE YOUR VALVES

PRICE complete 2/-



New Bulbs 6d. each

**HUNTS**

**"SAVE IT"**

SAFETY FUSE COSTS PENCE A. H. HUNT, LTD.,

WANDER PLUG SAVES POUNDS (Dept. 12), Croydon, Surrey



# The Master Non-Vibratory Valve Holder

ANTI-  
-MICROPHONIC  
-VIBRATION  
-SHOCK  
-CAPACITY

WORLD



SPRUNG-YET  
THERE ARE NO  
SPRINGS OR  
RUBBER  
SUSPENSION  
PATENTS.

The Artic Valve Holder represents a real step forward in valve-holder design at a small extra cost, a De Luxe Holder giving results obtainable in no other type.

Used in De Luxe 2 and Spider 3, and recommended by "Popular Wireless" to all its readers.

The Artic suspension is used by the Admiralty and all large Industrial Concerns for preventing the destruction of metallic filaments through vibration and shock. What better recommendation can be had than that of experts who have tested all devices?

ORDER NOW—DON'T DELAY!

THE ULTRA  
SENSITIVE  
VALVE  
HOLDER



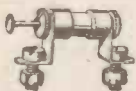
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OR DIRECT

3/9  
EACH

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READ WHAT USERS SAY ABOUT THESE WONDERFUL DETECTORS

THE LITTLE GIANT



Takes a minimum panel space but gives maximum results. A really wonderful Permanent Detector supplied complete with Screws, Nuts, and Template. Each Complete 2/-

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Silver Plated converts your Catwhisker into a Loud, Lasting Vibration Proof Detector in two seconds. Many testimonials from delighted users. Each 2/6

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PERMANENT  
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3/6 each  
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Screws.

Mr. Hicks, City Arcades, writes:—"The 'B.P.' is a marvellous Rectifier. After trying several other makes, including some at nearly double the price, I have no hesitation in saying that yours is 100% better than the best of them."

The "B.P." (Best Possible) is different from other Detectors—That's Why! Fits clips on existing sets. From Wireless Dealers or post free from PARTRIDGES Ltd., 140, Northwood St., Birmingham

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CLEAN, ECONOMICAL, SIMPLE  
AND EFFICIENT.

Simply plug-in to any Convenient Lampholder. Supplied complete with Adaptor, Flexible Cords and full instructions.

The "ALTERNO" (As illustrated).  
Alternating Current.

Charges the High Tension Accumulator at negligible cost. Price 21/-

The "INDISPENSO" Direct Current.

Charges the High Tension Accumulator at no extra cost when light is in use. Price 6/-

GOLTON "PENDLETON." (Patent App.)  
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Charges the Low Tension 2, 4 or 6 volt Accumulator economically and effectively. No Valves or renewals. Charging Rate Price £2:12:6 approx. 2 Amps.

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Please state voltage and frequency of Lighting Mains when ordering.



Large fully illustrated Radio Catalogue, No. R.116, on request. Dealers should enclose Business Card for Trade Terms. "Goltone" Products are stocked by the Leading Stores. Refuse substitutes.



"PENDLETON"  
CHARGER with  
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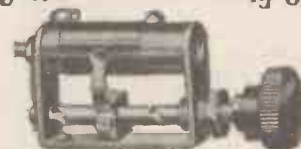
J. W. D. Ormskirk Rd., Aintree, writes: "I bought an 'Alterno' and was surprised at the results. I think it the most wonderful and simple arrangement I ever saw for so little money."

**Ward & Goldstone**  
PENDLETON. MANCHESTER

## THE FINEST VALVE CONTROL

Can be assured by using only the

Resistance 6, 13 or  
30 ohms 2s. 6d.



Potentiometer  
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## NEW T.C.B. GUARANTEED RESISTANCE

Smooth and dead silent in operation; positive stops for "Off" and "Full On" positions; a travel from "Off" to "On" in two turns of the knob; easy to fit; occupies minimum panel space.

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If ordering direct, state  
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Don't forget to use  
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BRITISH MADE REGD.

COLOURED CONNECTING WIRE

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Makers of Electric Wire for over 40 years

'Money saved is Money earned—  
So when your 'VALVES' get old or burned  
Send them to us—and we, to you,  
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Restored to function  
with original charac-  
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EFFICIENCY MAINTAINED!  
RESULTS GUARANTEED.

on application.  
B.E. 4/-; D.E. 2v. '3  
7/6; D.E. '06 8/-.

Price List for Power Valves  
We return the actual Valve you  
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THE NORTH LONDON VALVE CO., LTD.,

22, Cazenove Road

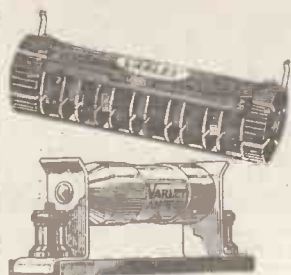
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Out of the enormous number of Varley Bi-Duplex Wire-Wound Anode Resistances sold, only one has been returned as faulty.

Their remarkable reliability is the result of the famous Varley Bi-Duplex winding, developed by specialists after years of intensive research. This unique construction, where every turn of bare wire is separated by pure silk ensures a constancy of perfect reception, and a purity of tone which excites admiration.

Varley Bi-Duplex Anode Resistances are made in a complete range of sizes up to 250,000 ohms.

The VARLEY MULTI-CELLULAR High Frequency Choke, wire-wound on the same famous Bi-Duplex System, is so remarkably efficient that it opens up new fields for Radio Development.

Price complete 9/6.

Varley products are stocked by all the best Dealers. We can supply on receipt of order, so if you have any difficulty send us the name of your dealer (we will refund postage), and your letter will have our immediate attention.

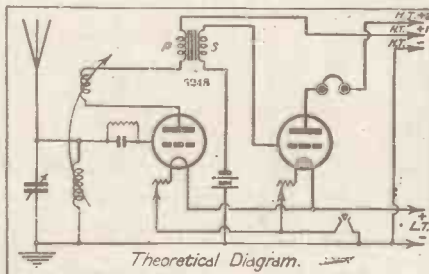


THE VARLEY MAGNET CO.  
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## RADIOTORIAL QUESTIONS & ANSWERS.

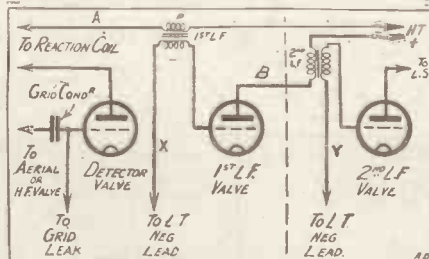
(Continued from page 714.)

as it is for an elderly gentleman to operate, I do not want series and parallel tuning, but parallel only. I should like an "on-off" switch for the filaments, and also provision for grid bias, if this is recommended. Please give a diagram (theoretical) of this arrangement.



The diagram (reproduced herewith) shows the required arrangement. Grid bias and extra H.T. for the last valve have been incorporated. Although 'phones are shown in the plate circuit of the second valve, a loud speaker can be used here when the incoming signal is fairly strong. No 'phone or loud speaker condenser is shown, but of course this can be used if required.

## For the Constructor



No. 9.—GRID BIAS.

Grid Bias is essential for the second L.F. amplifying valve, and often improves results if applied to the first L.F.

For L.F. transformer-coupled valves it is inserted at the points X and Y, shown above. The lead is broken here, and that end which is now joined to L.T. is connected to a red wander plug, which is plugged into the + socket of a tapped grid bias battery.

The other wire (which is connected to grid via Secondary) should have a black wander plug, and is then plugged in the G.B. battery, at the tapping which gives best results.

(NOTE.—Many receivers have switches at the points A or B, but this does not affect the principle.)

## EBONITE.

J. B. C. (Chelmsford).—What is ebonite made of, and is there much difference in the various grades?

Ebonite is largely composed of rubber and sulphur, which have been mixed and vulcanised at a high temperature. As there are great variations in the quality, it is advisable to buy from a reputable source.

## H.T. AND L.T. BATTERIES.

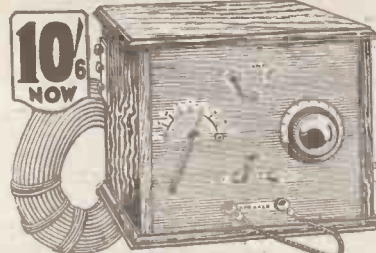
A. J. S. (Wallington).—Why are two separate batteries necessary to operate the ordinary valve?

Because two different conditions are necessary in order for the 3-electrode valve to work. In the first place, its filament must be heated in order to liberate electrons (this is done by the L.T. battery).

Secondly, this liberation has to be helped by a large difference of potential between the heated filament and the plate of the valve. This potential difference is supplied by the H.T. battery.

## GRAVES

2-VALVE LOUD SPEAKER BARGAIN.



This highly efficient 2-Valve Loud-Speaker Set is the finest wireless value ever offered.

It gives a volume and quality of tone unattained by any instrument of a similar price and is the essence of simplicity. Fitted with coils covering all the British wave-lengths, including Daventry. THE CABINET is of beautifully polished Oak, & all components are of the highest quality. Dull Emitter Valves with patent valve holders, &c.; H.T. Battery, 2-volt accumulator and complete Aerial Outfit. LOUD SPEAKER of exclusive design with unique magnetic system and improved mica diaphragm. Price £7:17:6

TERMS: Our Bargain Price is for deferred payments. Send 10/6 now, & complete purchase in 14 monthly payments of 10/6. If you wish to pay cash, 5 percent discount is allowed. Catalogue Post Free. Up-to-date Crystal & Valve sets at keenest prices.

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## REPAIRS SETS, PHONES, TRANSFORMERS.

Officially Approved by Radio Association. ALL WORK GUARANTEED LOWEST RATES 24 HOUR SERVICE. Cash on Delivery if Desired. JOHN W. MILLER, 68, FARRINGTON ST., E.C.4. 'Phone: Central 1950.

BUY DIRECT FROM THE MAKERS. Variable Condensers, Straight-line Frequency, Polished Ebonite End-plates, with Knob and Dial, .0005 mfd. each 5/6. 2-way Coil Holders, Geared Vernier, Panel Mounting, Nickel-plated, each 3/-. Back of Panel, one-hole fixing, 2-way Coil Holders, with Geared Vernier adjustment, N.P., each 4/6. 2-way Plain Coil Holders, a cheaper line, N.P., each 2/-. Single Coil Holders, Baseboard Mounting, with side Terminals, each 1/-. Valve Holders, Baseboard Mounting, N.P., each 9d. Cash with order. Please include postage. All excess refunded. Trade orders invited.—Shinn & Cresswell, Radio Manufacturers and Factors, 8, West Avenue, Walthamstow, London, E.17. 'Phone: Walthamstow 0579.

TRANSFORMERS REWOUND. Transformers, Phones, Loudspeakers, Rewound and Repaired to Maximum Efficiency. All One Price 4/- each. Don't discard if burnt out. All work guaranteed for 12 months. Write for trade terms. TRANSFORM CO., 115, LINKS RD., TOOTING, LONDON, S.W.17.

Wet H.T. Batteries (Leclanché Type). Cheapest in long run. Each cell gives 1.4 volts. Full instructions sent with each delivery. Price per dozen cells, complete, 3/9. Alternatively: Zincs 1/-; Sacs, 1/6; Jars, 1/3 per dozen. Carriage extra. Orders for £1 and over carriage paid. Trade enquiries invited.—Wet H.T. Battery Co., 23, Goldharbour Lane, Camberwell, S.E.5. 'Phone: Brixton 2539.

WIRELESS CABINETS made in all kinds of woods and designs to suit any set. Finest workmanship and lowest prices. All Cabinets sent on approval. Send for prices, etc., to H. WOOLLER & SON, Cabinet Makers, ROBERTOWN, LIVERSEDGE, YORKS.

BUILD A LOUDSPEAKER WITH OUR NEW SEAMLESS MOULDED CONE (Prov. Patent 25069/26.) and a BROWN A. or LISSENOVA. You will obtain PERFECT RESULTS. Successful Construction for a minimum outlay is assured with our Specialities. Illustrated Lists and full particulars for Stamp. GOODMAN'S, 27, FARRINGTON ST., E.C.4.



## THE RIGHT COIL HOLDER AT LAST!!!

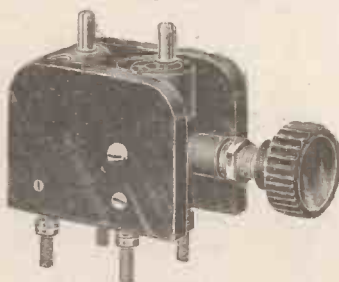
**WORM-GEARED MICROMETER COIL HOLDER**



WITH UNDER PANEL INVISIBLE CONNECTIONS

Each individually tested before leaving our works.

Vernier control is continuous throughout the whole range of action and with complete absence of backlash.



Patent Pending.

Incorporating the following and long - looked - for improvements.

1. Revolving Coil for reversing capacity coupling.
2. Anti - Backlash Spring.
3. Automatic safety stops for limiting position of coil in either direction for invisible mounting.

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LEAVING NOTHING TO BE DESIRED

OR ONE-HOLE FIXING

Made from the Highest Grade (Hand Polished) Ebonite and Nickel Plated Fittings.

WORKS AS SMOOTH AS VELVET

WITH THE HEAVIEST OF COILS.

Two-way only for outside panel mounting or One-Hole Fixing.

7/6 each.

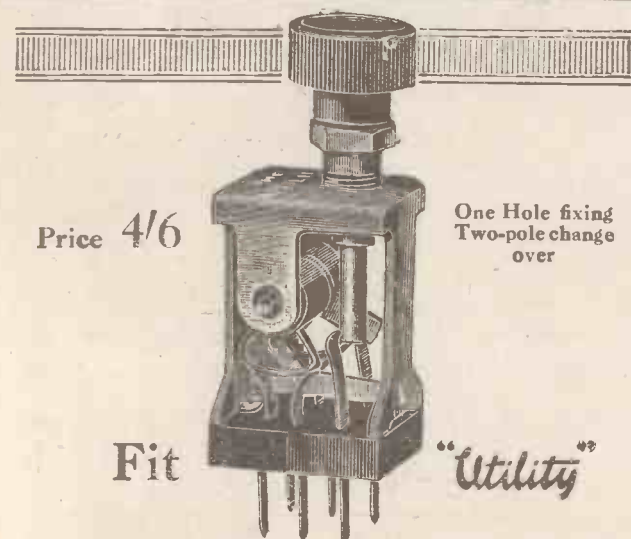
For inside baseboard mounting, with 6 in. extension handle.

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THE BEST COIL HOLDER ON THE MARKET TRY ONE AND BE CONVINCED

GET IT FROM YOUR DEALER

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**FRANKLIN & FREEMAN, LIMITED** (HOME & EXPORT)  
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Telephone: LONDON WALL, 7906.



Price 4/6

One Hole fixing  
Two-pole change over

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"Utility"

## Guaranteed Components

### The Push-Pull Switch

is designed and made with the same care and accuracy to detail that distinguishes all "Utility" Guaranteed Components. Its extremely low capacity, smooth action and perfect contact ensure best results. To secure the greatest possible efficiency use "Utility" Components—you can obtain them from your local Dealer. If he cannot supply, send for Catalogue.

Insist upon—"Utility" Push-Pull Switch; No-Capacity Change Over Switch; Micro Dial; Jack and Plug; Low Loss Condenser.

**WILKINS & WRIGHT LTD**

KENYON ST.

*Utility*  
WORKS

BIRMINGHAM

## THE GUARANTEE SLIP

which accompanies every  
**FERRANTI TRANSFORMER**

FERRANTI TRANSFORMERS, TYPES AF 3 & AF 4 are guaranteed to reach you in perfect condition.

They are also guaranteed to be within 5 per cent of the published curve.

They are further guaranteed against defects in workmanship or material for 12 months from date of dispatch.

In the unlikely event of any defect developing under proper usage the transformer should be returned, post paid, accompanied by this label with your name and address on the back.

FERRANTI LTD., HOLLINWOOD, LANCASHIRE.

Get a  
*Ferranti Transformer for your set*

## Salt and Water only

Run your set, any number of valves, low and high tension on salt and tap water. Guaranteed satisfaction. Thousands in use. Practically everlasting.

**FOR LOW TENSION.** Giant batteries per 1.5 volts, 7/6, 3 volts, 14/-, 4½ volts, £1. Suitable for any number of valves (Postage 1/-). Small 4½ volt in box complete 6/-.

**HIGH TENSION,** 1.5 units, 8d. 60 volts, complete in carrier, tapped every 3 volts, £15 6 (Postage, 1/-), for larger voltages, add 8d. per every 1½ volts. Remember you can buy 1½ volts at a time. (Salt water only.)

**DRY BATTERIES,** 60 volt, 7/-, 36 volt, 5/6, 100 volt, 12/6. Dull Emitter 1.5, 2/-, 3 volt, 4/3, 4½ volt, 6/6. Cycle Batteries, 1/6, Grid bias 9 volt tapped, 1/3, etc., etc.

### PREMIER DRY BATTERIES

17, Riches Road, Harringay, London, N.15.

Telephone: Mountview 3287.

### HIGH & LOW TENSION ACCUMULATOR HIRE SERVICE

Here's a way of improving reception, saving money, time, and trouble for all valve set users who live within 12 miles of Charing Cross. Write now for particulars of the unique service.

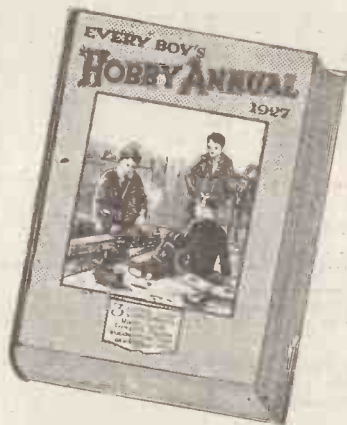
**RADIO SERVICE COMPANY,**  
105, Torrington Avenue, N.W. 5.  
Phone North 0623 (3 lines).

Our Low Tension Hire Service effects a considerable saving if you add the depreciation in value to the cost of having your own accumulator unskillfully recharged.

Rotax High Tension Accumulators greatly improve Loud Speaker reception, eliminating the annoying noises caused by partly run down dry batteries and may be hired ready for use.

Our Low Tension Hire Service effects a considerable saving if you add the depreciation in value to the cost of having your own accumulator unskillfully recharged.

# An Ideal Gift for Every Boy



This new and different "How-to-Make" book deals with **all** hobbies that appeal to every boy. There are hundreds of pictures which make everything plain—and it is absolutely up-to-date. There is also a loose leaf supplement, comprising a Radio Guide, Fretwork Design, and Woodworkers' Chart.

## EVERY BOY'S HOBBY ANNUAL

Price **6/-** net

At all Newsagents', etc.

### 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.

#### THE "SPIDER."

The Editor, POPULAR WIRELESS.  
Dear Sir,—I shall be very glad to hear of anyone in the Tonbridge or Tunbridge Wells district who has constructed or is constructing the "Spider" set described in POPULAR WIRELESS No. 228.

Yours faithfully,  
"Grasmere,"  
52, Lionel Road,  
Tonbridge.

#### FILADYNE IN AUSTRALIA.

The Editor, POPULAR WIRELESS.  
Dear Sir,—I feel it due for me to write in praise of your "Filadyne." I have followed your Filadyne articles very closely and to-day, Saturday, unearthed all my junk and made up your 1-valve Filadyne, and put it on our local station, 6 W F, 1,250 metres. To my astonishment, "Hello 6 W F," fair shouted at me as if I was deaf. My friends now are listening on a B.T.H. concert grand. "What do you know about that?" on one valve.

Considering I am 6 miles from 6 W F and practically under the nose of V I P Applecross spark station, which I can cut out completely—something that I can hardly do on my "four valver"—this is in itself another feature.

Now as to parts, 1 old-type 0005 Ormond condenser (Rolls-Ford), 3-way coil-holder, 1 old Yankee valve holder, 1 rheostat, junk, 1 Condor valve, 3-8-06, the choke coils are 200 on the plus side and 150 on the minus side, 1 4-volt accumulator, 90 volts on the H.T., wiring faithfully followed from your instructions.

I am convinced that properly wired and good parts reception will be even better (here comes a friend of mine—a dealer—to listen).

Reference to modulation it is perfect, reproduction of voice is remarkable. Can tell immediately the parson moves in the pulpit, as his voice is reflected accordingly. I am making this note especially as I've often remarked that one cannot tell from what part of the auditorium the sound comes from, back, front or side of micro.

Let me thank Mr. Dowding first for the "Filadyne," then yourself and paper for the pleasure and education it gives one who thoroughly reads it.

Yours faithfully,  
W. E. GREENFIELD.  
199, Hensman Road,  
Subiaco, Perth, Western Australia.

#### IT PAYS TO "BUY BRITISH."

The Editor, POPULAR WIRELESS.  
Dear Sir,—I have discovered that it pays to buy British components of a make with a good reputation. I bought a set of Brandes headphones about three years ago, and some weeks ago, while I was in Shetland, a winding burnt out.

I had no spare set and removed the cap from the offending earpiece and short-circuited the coil which was defective. The results with only one side of the electro-magnet were excellent, and it was difficult to distinguish the faulty 'phone.

I returned the 'phones to Brandes for repairs, and in spite of the fact that I had removed the cap and diaphragm against their printed instructions, and in spite of the fact that their guarantee had expired two years ago, they very kindly repaired my 'phones free gratis, and fitted not only a new winding, but apparently new diaphragm as well.

Such treatment is wonderful advertisement for British goods.

The set I was using in Shetland was a small one-valver, and I picked up on a poor aerial and poorer "earth" practically all B.B.C. main stations and many foreigners, German, Norwegian, French and even Spaniards coming in quite well. Newcastle was audible in bright sunlight at 4 o'clock, but Daventry was never good.

In Rothes, in Morayshire, Daventry is poor compared with London,ournemouth, Dublin or, indeed, almost any main station.

Yours faithfully,  
WM. R. CUMMING.

19, Holburn Road,  
Aberdeen.

#### CRYSTAL SETS ON LOW WAVE-LENGTHS.

The Editor, POPULAR WIRELESS.  
Dear Sir,—An expert in the trade states that he has never heard of a crystal set which could get below a 200 wave-length. Would you allow your readers to say what is the lowest they have reached and how they managed to reach it?

P. R. T.

84, Westcombe Park Road, S.E.3.

20/-  
down



## Great New Wireless Offer

Our wonderful 2-valve set with loud speaker and headphones installed free in your own home—anywhere—by our own Installation Engineers for £12 cash; or £1 down and 20/- a month for twelve months only. And we guarantee satisfaction.

There is nothing else to buy—the set is complete with all accessories.

When our Engineers have installed the set just switch on and enjoy perfect and powerful loud-speaker reception. You are also entitled to two free calls from our Engineers after the set is working.

The General Radio set is British made, unsurpassed in efficiency and purity of tone. It has no superfluous controls and is as easy to work as turning on the light.

Send a postcard to-day for free illustrated catalogue No. 3W—and full particulars of this offer.

**General Radio**

GENERAL RADIO CO. LTD.  
RADIO HOUSE  
235 Regent Street, W1



#### 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.



#### RIFANCO-PHONES & PARTS.

Cabinets for Wireless or Gramophones, Motors, Tone-arms, Soundboxes, Horns, Springs, Needles, Hinges, Knobs, Lid-stays, Handles, cheaper than anywhere else. 64 pages, 180 illustrations. Catalogue free, telling how to assemble gramophones, sent for 3d. 25 types of Motors from 9/6, carr. paid; 25 models of Gramophones from 27/6. 4,000 ohm Headphones 8/6, Accordians 8/6, Violins 18/-. Trade Discount to Regular Dealers. REGENT FITTINGS CO., "P.W.", 120, Old St., London, E.C. Est. 20 years.

#### GLASS TUBES FOR H.T. ACCUMULATORS

Standard Size No. 2, 1 1/2" x 2 1/4". 15/- in Gross quantities of 1/6 per dozen.

Carriage and packing free.

Other sizes and separate component parts supplied.

Write for Price List.

BEST ENGLISH MAKE.

Special quotation to the trade.

**I. ISAACS & CO.,**  
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106, Midland Road, N.W.1.

Phone: Museum 4209  
Telegram: Isaglasbot, Kincross,  
Established 100 years. London.





## Why you can't afford to use Barretors and Fixed Resistors.

They are incapable of adjustment and often heat your Filaments unnecessarily.

They shorten the lives of your Valves through incorrect adjustment.

They are expensive to buy and maintain, because a change of Valve necessitates a new Resistor, at an average cost of 2/6. The popular Resistor costs 1/6 for Clips and 2/6 for the Resistance Element.

### The MICROSTAT Variable Fixed Resistor

is attached to your base by two screws, the L.F. switched on, and they are adjusted with Micrometer accuracy to give the exact Filament Emission necessary.

Made and guaranteed by the Manufacturers of the world-famous "Microstat."

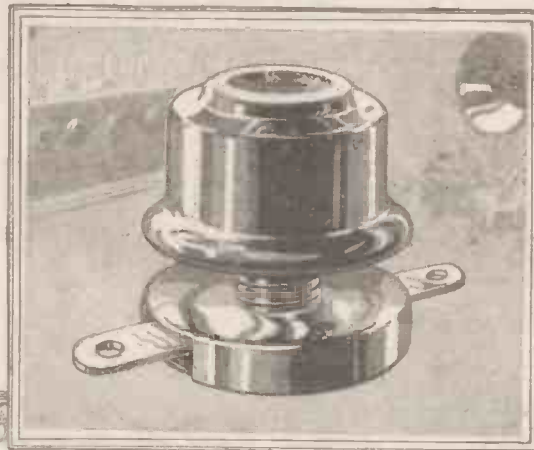
**LIFFORD ENGINEERING CO.,**  
Lifford Lane, King's Norton,  
Birmingham.

Woodwright.

After this they "stay put," and are operated by the pull-push switch like the ordinary Fixed Resistor, or by the "Microstat" Master Rheostat, which gives even wider range of control.

Should you change your Valve the individual V.F.R. concerned is again adjusted to the correct emission by a slight right or left turn. They need no renewals, one Resistor suiting any type of Valve, and their initial cost is lower. The Complete "Microstat" V.F.R. costs but 3/- and is

**Adjustable for any Valve and Lasts for Ever.**



### The Moving Block Cannot Fall

The vernier movement comprises three sets of enclosed precision machine-cut gears, and reduces the speed of the moving block by eight times.

Side plates, coil blocks, and knobs in artistic bakelite mouldings. All metal parts heavily nickel plated. Made for left as well as right hand.

## LOTUS VERNIER COIL HOLDERS

#### PRICES:

#### Two Types:

For outside panel mounting:  
Two-way .. 7/-  
Three-way .. 10/6  
For inside baseboard mounting, with 6-in. handle:  
Two-way .. 8/-  
Three-way .. 12/6

Made by the makers of the famous Lotus Buoyancy Valve Holder.

**GARNETT, WHITELEY & CO., LTD.,**  
Lotus Works, Broadgreen Rd., LIVERPOOL

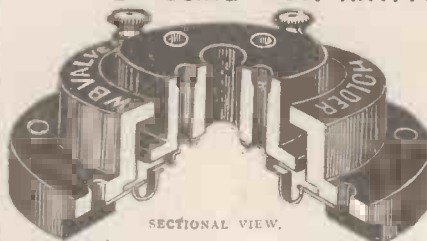
## PROTECT YOUR VALVES

BY USING W.B. ANTI-PHONIC

**LOW LOSS  
VALVE  
HOLDERS**

**PRICE  
Complete  
with Terminals**

**2/3**



If unable to obtain from your dealer write direct.  
Manufactured by **WHITELEY, BONEHAM & CO., LTD.,**  
Duke Street, MANSFIELD, NOTTS.



**A MONUMENT IN THE  
MARCH OF PROGRESS**  
The Formo Shrouded Transformer is the universal favourite.

Made in Ratios 1-1, 1-2, 1-3, 1-4 and 1-5  
**10/6** 1-3 and 1-5 for 1st and 2nd stages

Send for Catalogue and Descriptive Literature of Complete Formo Range  
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Phone: Hampstead 1787.

Manchester: Mr. J. B. Levee, 23, Hartley St., Levenshulme.  
Phone: Heaton Moor 475.

## TECHNICAL NOTES.

(Continued from page 674.)



Panel Talks: No. 4

## Why some Panels change colour

—and how you can be certain yours will not

**M**OST probably if, in the past, you have not chosen your panel wisely you have been disappointed, after a few months, to notice it has taken on a very unpleasant greenish shade. Almost as if it had gone mouldy!

For your new Receiver you will want to be sure that the colour of the panel is permanent. How can you be certain of this? Here is the answer. Cheap ebonite contains a large amount of sulphur. Sulphur, as you probably know, reacts to the action of the light. A panel, therefore, which contains sulphur, after being exposed to the light for a period, soon loses its black colour and becomes "mouldy" in appearance. How, though, can you be certain that in the Panel you buy, sulphur is entirely absent? The answer lies in the twin names, either of which is borne by every panel of the American Hard Rubber Co. [Britain] Ltd.—the names 'Radion' and 'Resiston'. Like the Hall-mark on gold, either of these names on a Wireless Panel is your safeguard. They are a veritable insurance against all panel ills. They mean that a panel bearing such a name is permanent in its colour—now and in the years to come. They mean that, in insulation, the panel is a hundred-per-cent perfect; that it is non-metallic, and its surface therefore is impervious to moisture and dirt, and lastly that 'Resiston' and 'Radion' Panels will not warp, nor will they split or break—they can be "worked" with absolute confidence.

## Send for the 'Radion Book'

It's Free!

Please send me free the 'Radion Book' giving constructional details of four unique Receivers. Thanks!

Name .....

Address .....

**RESISTON**  
PANELS

American Hard Rubber Co., Ltd., 138, Fore St., E.C.4

G.A.6381

the end of the vertically-mounted transformer and may be held down by a screw or bolt on either side.

### "N" Crystal Set.

Referring to the Lodge "N" circuit, I have a letter from a reader who states that he has used this circuit in a crystal set with the choke aerial and has obtained very good results. The circuit, he states, is a very easy one to use in this way and the signals are distinctly louder than with the ordinary tuned-aerial circuit. Readers who are devotees of the crystal and want something new to try may be interested in experimenting with the above.

### An Interesting Effect.

I wonder how many experimenters have noticed the effect which is sometimes obtained when placing the loud speaker in close proximity to the set. I am not referring here to the L.F. microphonic influence of the sound waves from the loud-speaker upon the detector valve; that, of course, is a very well known influence, which sometimes leads to annoying L.F. howling.

I am referring in this case to the inductive and capacitive influence of the loud speaker, considered merely as a large metal object. I have a set which employs two stages of H.F. amplification and one stage of L.F., the set being used with a special frame aerial enclosed within the cabinet and using a reaction system of rather a peculiar kind. With this set, the placing of the loud speaker on the top of the cabinet has quite a pronounced influence upon the volume obtainable. It is easy to see why this should be so, for the loud speaker is equivalent (it is an ordinary metal-trumpet loud speaker) to a comparatively large metal sheet placed in close proximity to the reaction coil (which latter, in the case under discussion, forms part of the frame aerial). Not only does the loud speaker cause a considerable change in the electrical capacities involved, but its influence upon the distribution of the electro-magnet fields in the region of the frame aerial must be considerable.

### Compound Rheostats.

I notice that this season quite a number of compound or multiple rheostats have made their appearance on the market. In some cases these consist of an arrangement of two resistance elements which may be used alternatively. This recalls that about two years ago the writer invented a rheostat which employed two resistance elements in a special way and another which employed three resistance elements. The number of different maximum resistances which can be obtained with three resistance elements is surprisingly large.

If I remember rightly, the number with certain values of resistance was about 17. The reader can easily work it out for himself, for if we call the resistances A, B, C, we have the following resistance values: A, B, C, A and B in parallel, A and C in parallel, B and C in parallel, A, B, C, all in parallel, A, B in parallel and the combination in series with C, B, C, in parallel and the combination in series with A, etc., etc., etc.

## EVERY LOUDSPEAKER

## DESERVES MULLARD MASTER VALVES

— Ask for —

Mullard P. M. Power Valves.

£2?

WOULD you like a Multi-Valve Receiver for 40/- down? In our Catalogue "P" are details whereby many well-known Sets are obtainable on easy terms. Accessories too! Our technical advice is yours without charge. Write to-day to:

New Times SALES CO.  
77, CITY ROAD, E.C.1

## "FROM SCHOOL TO PROFESSION" via Wireless.

No long expensive apprenticeship. Just RADIO MARITIME TRAINING—and your son will be placed in a responsible position. Within twelve months the capital invested is returned in his salary as a Wireless Operator. But it must be the TRAINING WITH THE WIRELESS SERVICE BEHIND IT. Write to Radio Maritime, Ltd., 25, Broadway Chambers, Hammersmith, W.6; or to 26-27, St. Mary Street, Cardiff.

**UNUSUAL BARGAIN.** Brand new TANGENT L.F. Transformers No. 6510. Ratio 3-1. Usual price 12/6. Our price, 7/- post free. Money refunded if dissatisfied. Partridge & Wilson, 217a, Loughborough Road, Leicester.

## H.T. WET BATTERIES— DEMON CELLS

As recommended in "Popular Wireless" August 14th

6/6 per doz. 7/6 post free.

(Each cell registers 1.25 volts.)

DEMON SACS & ZINCS

3/- per doz. 1/6 per doz.

(Carriage and packing extra.) Small DEMON SACS with Brass Caps, 1/6 per doz. Zincs for same 1/- per doz. The Sacs are specially prepared for H.T. Wet Batteries. They are not flash lamp sacs, and are solely manufactured by

**THE DEMON BATTERY CO.,**  
59, Badlis Rd., Walthamstow, E.17.  
Factory: 113, Chingford Mount Road, E.4.  
Telephone No.: Chingford 363.

Trade Enquiries Invited.



AERMONIC cost a shilling less—and they're better. Air-spaced. Anti-phonic. Beautifully sprung. High insulation. Splendid new design. So don't pay more than 1/9. List of Aermoric Specialities Free. If your dealer does not stock, apply to:

**JAMES CHRISTIE & SONS, Ltd.**  
246, West Street, SHEFFIELD.

London Agents:  
**A. F. BULGIN & Co.,**  
10, Cursitor St., London, E.C.4

## 4 - ELECTRODE VALVES

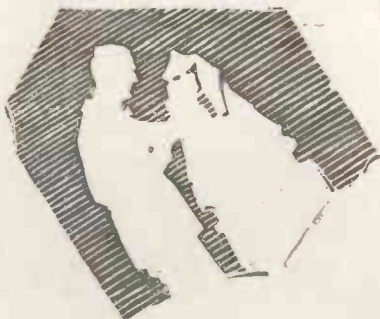


We are the suppliers of the genuine U.C. and Thorpe valves, as specially tested and recommended by the "Undyne" inventors and "Popular Wireless" U.C.5 and Thorpe K.4 (both 4-electrode 5-pin valves), each, post free.

Order direct from—  
**LUDGATE RADIO CO.,**  
56, LUDGATE HILL, LONDON, E.C.4

R/R





## PERFECTION BY ELIMINATION

Perfection is not attained by any sudden flight but by the slow process of elimination.

When you build your wireless set, you can hardly expect perfect results first time out, small adjustments and alterations will have to be made before you get reproduction that will please you.

But you can certainly cut this work down to a minimum by using the R.I. Multi-Ratio Transformer. Here you have an instrument capable of operating correctly in conjunction with any valve and in any circuit you may select. Instead of having to experiment with a number of different transformers you can apply the process of elimination to this one unit and easily find the ratio or impedance value which is absolutely suited to your requirements.

The R.I. Multi-Ratio Transformer offers certain satisfaction, for its available range of seven ratios, and three impedance values precludes any risk of failure due to unsuitable characteristics for the work in hand.

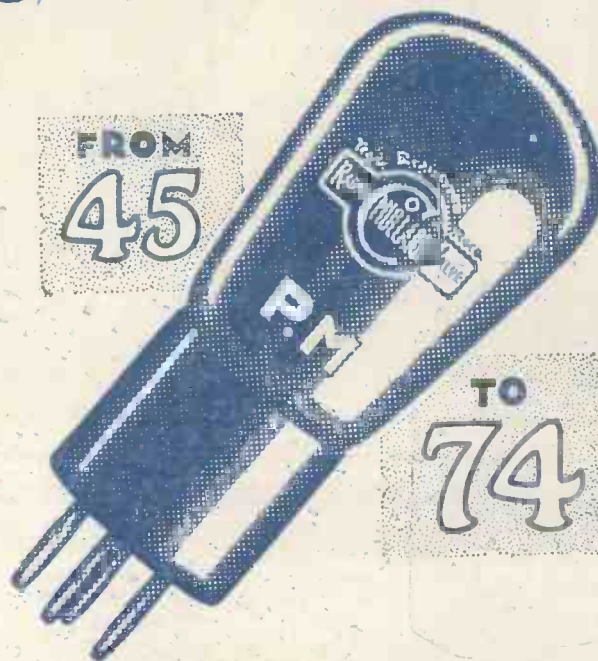
**Price 25/-**

R.I. Ltd., 12, Hyde St., New Oxford St., London, W.C.1



The mark of  
Better Radio

# THE WONDERFUL P.M. FILAMENT WITH THE HIGHEST FIGURE OF MERIT



**MULLARD  
P.M. VALVES  
GIVE YOU MOST  
VALUE FOR MONEY**

The higher the figure of merit of a filament the greater the efficiency and the more you get for your money. For the same input the wonderful P.M. Filament gives you twice the out-put of the ordinary dull filament and 20 times that of the best bright filament.

Couple this with the huge life of the P.M. Filament due to its operating temperature being as low as 180° below the pyrometer scale and you will understand why it pays to demand

**MULLARD P.M. VALVES  
WITH THE WONDERFUL  
P.M. FILAMENT.**

For 4-volt accumulator or 3 dry cells  
THE P.M.3 (General Purpose)

0'1 amp. 14/-  
THE P.M.4 (Power) 0'1 amp. 18/6

For 6-volt accumulator or 4 dry cells  
THE P.M.5 (General Purpose)

0'1 amp. 18/6  
THE P.M.6 (Power) 0'1 amp. 18/6

For 2-volt accumulator

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

*These prices do not apply  
in Irish Free State.*

## Mullard

**THE MASTER VALVE**

THE MULLARD WIRELESS SERVICE CO. LTD., MULLARD HOUSE, DENMARK STREET, W.C.2.