

THE WIRELESS PAPER WITH THE LARGEST CIRCULATION

# Popular Wireless

Every Thursday  
PRICE  
3d.

No. 311. Vol. XIII.

INCORPORATING "WIRELESS"

May 19th, 1928.

## THE "ALL-PURPOSE" THREE



### *Special Features*

Getting "Down Under"  
Your  
Alternative Programme  
Safeguarding The L.T.  
Tracking L.F. Troubles  
The New 2LO?  
Broadcasting Power  
Grid Bias Without Batteries

Build the "All-Purpose" Three,  
fully described in this issue.  
Our cover shows the front and  
back of this excellent "all-  
wave" set.

# A WONDERFUL NEW VALVE

*With the Mullard P.M. Filament..*



**Mullard always leads !**  
 The new Mullard P.M.4D has no equivalent . . . it is the ideal valve for perfect detection and transformer coupling.

**Low impedance.  
 Large amplification.**

Consuming only 0.1 amp. at 4 volts and possessing all the advantages of the wonderful Mullard P.M. Filament. The valve for every four-volt valve user. Obtainable from all radio dealers.

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- Fil. Amps. .... 0.1
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- \*Mut. Conduct.  
 2.1 mA/volt.
- \*At Anode Volts 100, Grid  
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Please send me at once full detailed description of your new Trickle Charger.

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# SEVEN COUNTRIES ON THE DIAL



# COSSOR

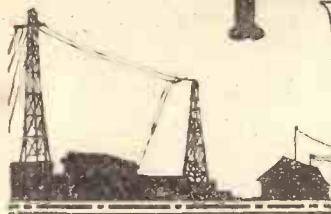
put them there

Seven Countries on the dial of the famous Cossor "Melody Maker"! Cossor Valves put them there. Get the pick of the programmes, use Cossor Valves, they improve any receiver. Use them in yours.

**Cossor Valves improve any Set**



# Popular Wireless



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## RADIO NOTES AND NEWS.

New B.B.C. Station—Viva Italia!—Are You Clubable?—Crystals Again—Advice to Winston—A Pat for 5SW—Muddling Kids' Minds.

### Omission Rectified.

**S**ORRY, gentlemen! I forgot all about it, and hasten to get it in before Spring is drowned in Summer. How does it go? Let me see, now. Oh, yes, I remember! Now is the time to spring-clean your set. Dig up the earth-plate, mark "O.K.," and re-bury. Grease aerial with walrus fat. If it is of stranded wire, undo strands and re-strand. Set all condensers to twelve noon and check by Greenwich; any found slow should be sent to the grinder's for soling and heeling. Wipe all electrons with red flannel. Tap valves with hammer for flaws.

### The Cabby Outdone.

**T**HAT duty performed—and you all expect it—let me proceed to the business of the day. Are any readers old enough to recollect the vogue of that novel, "The Mystery of a Hansom Cab"? Not many, I hope. Well, that cab has its nose put out of joint by the notorious motor-car which snootled to Lincoln's Inn Fields and was saucy enough to receive a programme from 3 L O (Melbourne) on a six-valve supersonic, with an aerial of about eight feet of copper wire fixed on top of its roof. The Australian Press Association and Mr. C. C. Allen, operator, are to be congratulated on this stunt.

### New B.B.C. Stations.

**T**HE erection of the first of the new high-power, twin-wave-length stations of the B.B.C. "regional" scheme having been sanctioned by the Post Office, it is to be expected that the work will be put in hand with the least possible delay, though I presume that a full year must elapse before programmes begin. The new station is to be just north of London, Potter's Bar way, I understand. But what will it transmit? That is the point! By the way, do you remember what happened at Potter's Bar during the war? That Zepp! The "oldest inhabitant" will die of excitement if something happens every decade.

### The Scientific Parson.

**I** READ in a Birmingham paper that the Vicar of Horninglow, Burton, has installed a radio set in his church, and, with the permission of the Bishop of Lichfield, has successfully carried out a divine service by means of radio broadcast. The slacker! I really do not mean that epithet unkindly, but having only last night completed my umpteenth perusal of Boswell's "Life of Johnson," a native of Lichfield, I felt bound to express in Georgian (V) what Dr. Johnson would have said in the language of his own time.

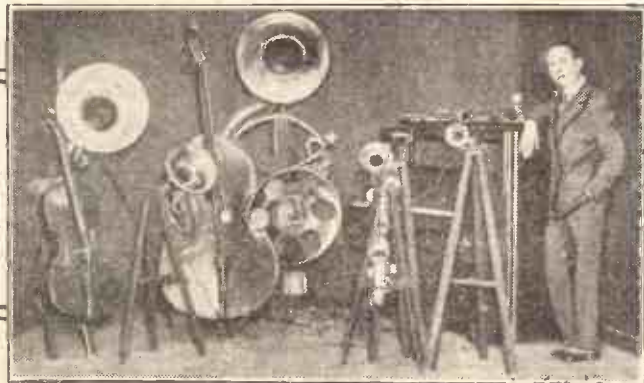
### Viva Italia!

**O**SRAM'S tell me that last month some sixty Italian students visited their works, where they studied lamp and valve manufacture under the tutelage of the genial Mr. C. Wilson, the director of the works, and feasted and drank toasts to the Kings of England and Italy, not forgetting Benito Mussolini. After nice speeches by Mr. Wilson and Professor Vignola, the representative of the Ministry of Education in Rome, the affair wound up with "God Save the King" and the "Anthem of Fascism," plus cheers for all concerned. (I have a photograph of the party. No such pretty girls visit "P.W.")

### Are You Clubable?

**I**F you are, and reside within reasonable distance of Kentish Town, please note that the Kentish Town Men's Evening Institute, Carlton Road L.C.C. School, N.W.5, runs a radio club by the name of the "Kentish Town and District Radio Society." Meetings every Friday, 8-10 p.m., with lectures, demonstrations galore, also workshops and all necessary tools for set and cabinet construction. A bob per term of three months, with an expert attendance. Hon. Sec., Mr. J. Batchelor. Look in, there's good fellows!  
 (Continued on next page.)

## MAKING MUSIC WITH A MAN-LESS ORCHESTRA.



Something quite new in radio reproduction is the phantom orchestra shown above. Each instrument has a unit attached to it, which responds only to the same instrument in the orchestra that is broadcasting the programme. To the left the inventor is shown adjusting his apparatus.



## NOTES AND NEWS.

(Continued from previous page.)

## National Physical Laboratory.

POSSIBLY not all our readers are fully aware of what the N.P.L. is, and the significance and value of its reports and certificates. Therefore, as quite a lot of radio gear of all kinds is tested there, a few lines on the subject may be of interest. The N.P.L. was founded in 1901 as a public institution for standardising and verifying scientific instruments, testing materials and the determination of physical constants.

## Impartial Observers.

THE Chairman of its General Board and Executive Committee is the President of the Royal Society. Its Director is Sir Joseph Petavel, D.Sc., F.R.S. Every member of the establishment is a trained scientist and a specialist. If you want a thermometer calibrated, an oil tested, a substance analysed, or a fuel valued, the N.P.L. will give you a coldly scientific, impartial answer, and it does not care a bean whether any firm's products get a good or bad report. In a word, if you want physical truth, told without bias or emotion, the N.P.L. has it in stock.

## Crystals Again.

THIS title holds no ray of hope for that stalwart band of Knights of the Cats'-whisker, which, according to reliable witnesses, still roams the ether, though it may perhaps give them a pleasurable thrill. I hear from America that the crystal is creeping into multi-valve sets again, generally with about three stages of H.F. at the front-door and as many stages of L.F. behind. Quite an embarrassing situation for a modest young Galena! Rather like the little boy who practises the fiddle next-door being shoved into the Queen's Hall orchestra! However, I am afraid that the new trend demonstrates more the necessity of valve amplification than of crystal detection—that is, on balance.

## Advice to Winston.

TALKING of fees, and paying money away in general, suggests to my mind the idea of a tax on "improving" talks and Chamber Music pieces. If such a tax were imposed, what an improvement in programmes would be effected! I have been trying hard lately to stand back, as it were, and consider the B.B.C. programmes as the N.P.L. might—coldly. My conclusion is that when they are good they are very, very good, and when they are bad they are (?). But for 10s. per annum, plus the upkeep of a set, there is only one thing can beat 'em for value, and that is "P.W." for 3d. per week, because, what with blue prints and so forth, etc.—

## Swiss "Blind Spot."

NEXT month (D.V., P.T.O., E. and O.E.) I shall hie me to a certain village in the Swiss Alps, known only to the elect poverty-struck, in my annual attempt to increase the circumference—by dint of food, peace and pure laziness—to a figure (in inches) not common to obscure journalists. My peculiar excite-

ment in this adventure is to observe the degree to which radio has penetrated that Arcadian height (6,000 ft.). In 1925, when I last went there, it showed but one aerial, badly-designed; I was assured that the set would not work and that the guests of the hotel preferred the gramophone.

## The Cenotaph.

AS the decision of the Home Office to permit the broadcasting of the November ceremony at the Cenotaph seems to have been received with general approbation, I will willingly rejoice with the majority and hope that the service will ease many hearts. Personally, I have always felt that the remembrance of and tribute to our immortal British patriots are matters for a man's inner self. But we are not all of one pattern or piety. Yes, on the whole, I think the decision praiseworthy.

## Wake up, England!

MR. W. DUBILIER, who has returned to New York after a stay in Europe, gives his opinion that Germany has made greater progress in broadcasting

during the past year than any other country. That may be so; a country with a lot of leeway to make up naturally has more scope for improvement than others in which the art developed earlier. But Mr. Dubilier says that our programmes are not on a par with those of Germany and America. Perhaps we don't want them to be. Our critic judges them from the American standpoint—which is not ours.

## A Pat for 5 S W.

THIS is the right moment to refer to a letter received from a Nairobi reader, who swears by 5 S W; he gets that station and 2 X A D with unfailing regularity and with quality excelling any other short-wave station, on a three-valve Reinartz. He says that 5 S W is his "pet station." This ought to encourage the B.B.C. to peg away at 5 S W till their ideal of "service" is attained. Personally, I think they might lower their ideal, in the interests of humanity.

## Muddling Kids' Minds.

IT is with no surprise but considerable ire that I gather from the latest B.B.C. pamphlet on broadcasts to schools that listeners' money is still being used for augmenting the time that our youngsters are allowed to enjoy free from pertinent, useful lessons. What with flower painting, art pot decorating, history without dates, chemistry without formulac, and Latin with the wrong pronunciation, I despair of having an educated daughter till she is twenty. And now this radio diversion "Good and Bad Buildings"; "On Reading Poetry Aloud"; "What is a Weed?"; "Civics."

## Pure Bunkum.

IN support of that I will quote from a B.B.C. announcement about its unwarranted intrusion into the sphere of trained teachers. "Psychologists have repeatedly stressed the importance of myth in the development of the child mind." Maybe! But perhaps psychologists do not realise that the children of non-psychologists will have to wring a living out of a cold, hard, business world in which competition is becoming keener every year and which does not give a tinker's cuss for myths, psychology, poetry or "civics." The average employer wants accuracy and commercially useful skill or knowledge.

## Important Announcement.

THE B.B.C. states that Prof. G. Wallas will be unable to give the course of six talks on "Social Direction," and that instead, Prof. Laski will talk on "Social Purpose." Hip, hip, hurrah! boys. Gather round!

## British Radio Trade.

AT the Liège International Exhibition held some weeks back an English manufacturer won the first of the only two medals awarded for valves; two English manufacturers got gold medals for loud speakers and "pick-ups," while another received the Grand Prix for a portable; a very fair bag, to say nothing of various gold and silver medals for components. Then, trade returns for February show that our radio exports (£132,474) were higher than in any other month. There's life in the old lion yet!

ARIEL.

## SHORT WAVES.

## THIS WEEK'S CYNICISM.

Some people are so cautious that they smother themselves with eucalyptus if a wireless announcer sneezes.—  
"Daily Mirror."

Radio Expert: Perhaps the three greatest sources of interference are X-ray machines, circuit-breakers and electric railroads.

The Other Fellow: By the way, you haven't met my wife, have you?

The burning question of the radio trade is "How to sell radio receivers in the hot weather."

Perhaps the best way would be to give an ice-chest away with each one.

## ALSO A STATIC ELIMINATOR.

Recently an ad. appeared in the local paper as follows: "Send us one dollar and we will tell you how to reduce your radio upkeep one hundred per cent."

Having dutifully forwarded our dollar, we received the following: "Don't use your set!"—  
"Radio News."

A wireless telephone station is being erected in Angora. Travellers will be able to recognise this station immediately by the pink eyes on the aerial guy ropes.

"How did you get rid of that wireless instalment collector so soon?"

"Oh, I just started up the loud speaker."—  
"Everybody's Weekly."

Small Boy (watching spider): "Look, dad, a spider putting up his aerial!"

Hints on how to get some new stations.  
Put the loud speaker on the bed—and get Davenport. Try the sideboard—and get China.

When the person who looks after the radio On his vacation has gone,  
And just when you want to hear something You find something is wrong.

You open the cabinet and look inside;  
Bewildered, you turn every knob in sight;  
And, after playing around awhile,  
You find the thing won't even light.

You rush to the 'phone and call a service man  
And tell him your tale of woe.  
That the thing won't work  
And you just can't make it go.

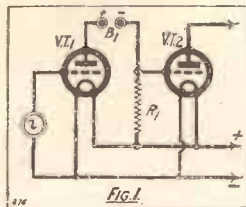
And then while you're waiting for him to call  
You glance around and find—  
Someone has pulled the plug out of the wall.  
Ain't that the dumbest feeling!  
"Radio Digest."



**M**ESSRS. LOFTIN & WHITE, whose names have recently come to the fore in connection with the so-called Loftin-White Circuit, have now described a detecting and amplifying system for modulated carrier currents which has practically negligible frequency characteristics and negligible electrical and sound feed-back properties.

The simplest arrangement of the system is shown in Fig. 1 where the effect of the battery  $B_1$  upon the grid of the valve  $VT_2$  is controlled by the impedance of the plate-filament path of the valve  $VT_1$ , the voltage of the battery being about 4 volts. The potential which can develop across the resistance  $R_1$  varies between zero and about 10 volts, depending upon the potential of the grid of  $VT_1$ . It should be noted that there is practically no coupling between the input and output circuits of each valve.

The valve  $VT_1$  operates at a high plate-filament impedance value, with the result that the space current is very small—of the order of 10 to 15 micro-amps. In these circumstances, mechanical movements of the electrodes of the valve have no appreciable effect upon the strength of the current, which is



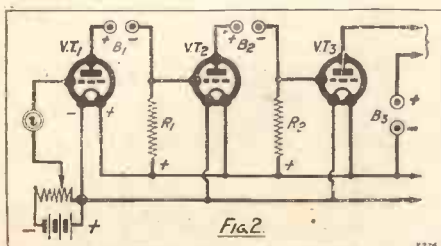
the reason microphonic effects and acoustical feed-back effects are negligible.

**An "Auto-Compensator."**

The circuit shown in Fig. 2 is the same as that in Fig. 1, but with the addition of a power valve  $VT_3$ . The battery  $B_2$  gives the required grid voltage for the normal operation of the power valve, plus about 50 per cent, and it will also be noted that a variable bias is obtainable on the grid of the first valve.

This system can be used as a combined rectifier and amplifier.

A modulated carrier current impressed upon the input of the first valve lessens its plate-filament impedance, thus allowing  $B_1$  to act more strongly on the grid of  $VT_2$  as a negative bias to increase the plate-filament impedance of that valve, and causing  $B_2$



to be less effective on the grid of  $VT_3$ , all of which, in turn, causes the space current of  $VT_3$  to rise in value. The current flow between  $VT_1$  and  $VT_2$  is mainly H.F., somewhat rectified, and this H.F. component persists even to the plate circuit of  $VT_3$ .

# GRID BIAS WITHOUT BATTERIES

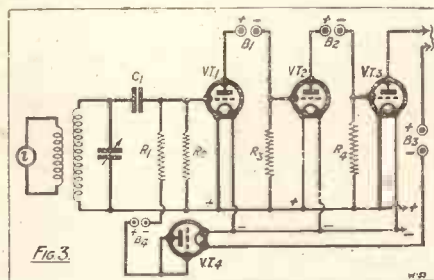


\*-----\*  
 An interesting description of an automatic volume control recently originated by Messrs. Loftin and White, the American inventors.  
 By  
**Dr. J. H. T. ROBERTS, F.Inst.P.**  
 \*-----\*

(this being proved by the fact that tuned traps placed between any two valves are quite effective in diminishing signal strength). In the same way any capacity to earth of the batteries lessens the sensitivity, owing to the by-passing of this persisting H.F. component.

The system just described is principally of laboratory interest only, without some form of automatic control for the bias of  $VT_1$ .

In a form of auto-compensator for the effect (on the plate current of the last valve) of carrier currents of varying strengths, it



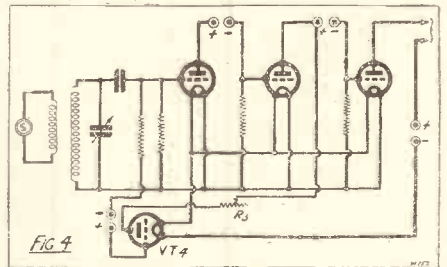
is possible to employ a rise of plate current above the normal to influence the grid bias of the first valve. The correction, however, must apply only to the steady or direct-current component of the plate current (as affected by variations in valve impedances, carrier-wave strengths, and so on), and not for plate-current changes at an audio-frequency rate representing desired signal tones, as this would introduce audio-frequency feed-back whether positive or negative.

**Another Arrangement.**

One method which suggests itself is to take the voltage drop across a resistance in the plate circuit of the last valve and impress this drop on the grid circuit of the first valve. A more satisfactory arrangement; however, is that shown in Fig. 3. The valve  $VT_1$  is arranged so that its

filament current is the total anode current of the H.F. and power valves of the receiver, and may be 30 to 35 milliamps. Anything which tends to make the anode current of the last valve rise in value will increase the emission from the filament of  $VT_1$  and tend to impress the potential of  $B_2$  upon the grid of  $VT_1$ . The filament-anode resistance of  $VT_1$  is variable from an infinite value to a comparatively small value with a change in the filament current of only a few milliamperes, and consequently will place just enough negative bias on the grid of  $VT_1$  to compensate for the strong carrier currents that may be encountered in receiving nearby or local stations.

Fig. 5 shows a means for overcoming differences between current furnished by the high voltage plate supply and the current required to operate the filament of the valve used in the position  $VT_3$ . The current in the filament of this valve, for correct operation, must have a rather

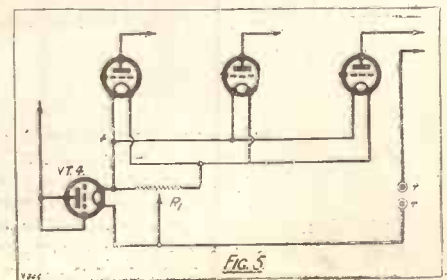


critical value, which, of course, depends upon the type of valve used. The resistance  $R_1$  is a potentiometer of a value of 1,000 to 2,000 ohms. When adjusted towards the negative side, a local circuit is formed which furnishes any additional steady heating current required to compensate for too little current from the plate supply. When adjusted towards the positive side, its resistance is so low that its shunting action predominates and we obtain compensation for too high a plate circuit.

**A Sensitive System.**

The valve  $VT_4$  may also be used to prevent signal intensity from exceeding a pre-determined limit in the way shown in circuit in Fig. 4, where the grid of  $VT_4$  is used for the correction of carrier current effect and the anode is used to introduce a comparatively low resistance in parallel with the anode circuit of  $VT_2$ .

The sensitivity of the system is equivalent to the usual detector and two stages of transformer-coupled L.F.



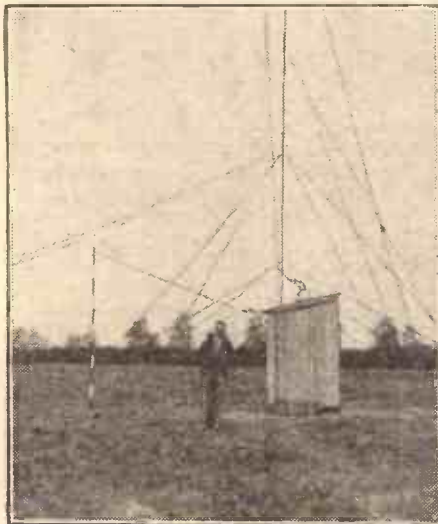
# The NEW 2LO?



The search for a convenient site for the first of the regional stations is nearing completion, and exhaustive tests are being carried out.

From A SPECIAL CORRESPONDENT.

SOME few miles north of London, to the right of the Great North Road, lies an unimportant-looking field. It is a large field, situated on the summit of a slight hill, and is certainly one of the highest points round about; but, apart from the fact that it is open and high up, there is nothing much about the field to attract one's attention.



The down-lead from the "T" aerial is taken to a large insulator and thence by twin wires to the transmitter some fifty yards away.

But a transformation is down on Fate's list of future events, and, if things go as they appear to be going, that field will remain a mere field for very little longer. Instead, it will become the site of the latest thing in broadcasting stations, the first of the twin stations of the Regional Scheme—the new 2LO.

That is, if all goes well.

At present the field is occupied by a couple of 100-120-ft. masts supporting a single aerial with cage down-lead, by a twin wire T aerial, and by a Daimler van containing a 2 kw. transmitter and a crystal receiver.

### Successful Site.

The power from the transmitter is led through an insulator in the back of the van

via two parallel feed wires to another insulator some 50 yards away, where it is directly under the aerial. Thence the lead is taken up to the centre of the aerial.

Several aerials have been tried and the most thorough tests have been carried out during the few weeks that the "station" has been in operation.

Tests on the strength of Daventry and 2LO have been made, and the field strength of the 2 kw. mobile station situated on the new site has been checked by travelling receiving outfits in all directions and at varying distances from the transmitter.

According to the engineers, everything has gone splendidly, and the site is fairly successful. In other words, the position for the new London Station may have been found.

### "Still in the Air?"

But now comes the chief snag for, up to the time of writing, no final arrangements with the Post Office authorities have been made, so that the much-talked-of Regional Scheme is still "in the air" instead of being "on the air." But, as soon as the P.O. says the word "go," I understand that work on the new station will begin, and the very latest thing in broadcasters will raise its masts above the countryside.

But at the present we must expect some delay and, meanwhile, further tests are being carried out.

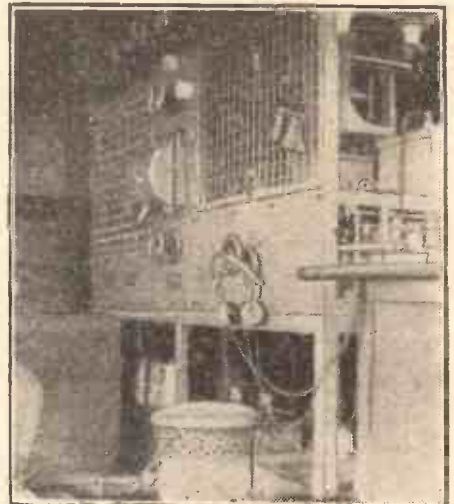
The interior of the van used as the temporary testing station is very compactly laid out, the transmitter being in sections—as the photograph shows. Power is obtained from the engine of the car and tests are being made at various times on 340-370 metres, the strength in London being very much greater than that of 5GB.

Unlike the Daventry Station, I under-

stand that the new 2LO—when it does arrive—will not take its power from any electric mains, but will make its own at a specially-built generating station. This appears to be essential as, I believe, the district at present under consideration is without electric-light supply of any convenient kind. However, as the new station could hardly be ready within a year from now, even if construction commenced at once, all sorts of modifications may take place and so these details must needs be rather scanty.

### Further Delay Possible.

In fact, it is not certain, although the site appears technically to be satisfactory, that the new station will be built in the position now occupied by the van, for rumours are current that yet another move is contemplated to a pitch nearer the Metropolis for reasons which are not yet allowed to be



A section of the transmitter. The control panel is placed at one end of the van and the "bottles" and tuning circuits at the other end.

expressed in public. But as to the veracity of this rumour—we must wait and see.

Anyhow it is comforting to know that a move has been made, and we may hope that the final arrangements may not long be delayed and that travellers on the Great North Road will soon see the towering masts of the new 2LO.



The Daimler van housing the 2 kw. transmitter used by the B.B.C. in the "regional" tests in the North of London. Note the huge insulator and the twin wires leading to the separate insulator beneath the aerial itself.



# The "ALL-PURPOSE" THREE



If a set is to be really of the "all-purpose" description, by which I mean it is to be suitable for the reception of short waves, broadcast, and long-wave stations, it *must* be a short-wave set to start with. By this rather cryptic sentence I wish to emphasise the point that almost any short-waver will work efficiently on the broadcast wave-lengths, but it is not every broadcast set, by any means, which will receive the shorter waves.

### COMPONENTS REQUIRED.

- 1 Panel, 14 in. x 7 in. (Any good branded material).
- 1 Baseboard for same, 12 in. deep.
- 2 .0005 variable condensers, with slow-motion dials (Bowyer-Lowe. Any good make).
- 3 Non-microphonic valve holders (Benjamin, Bowyer-Lowe, Burndept, Burne-Jones, Igranic, Lotus, Marconiphone, Pye, W.B., etc.).
- 1 L.F. transformer (Ferranti. Any good make).
- 1 H.F. choke (Lissen). (Any good make. Bowyer-Lowe, Climax, Igranic, Ormond, R.I.-Varley, etc.).
- 1 Rheostat (Any standard make).
- 1 Single-circuit filament-jack (Bowyer-Lowe, Igranic, Lotus, etc.).
- 1 .0002 and one .015 condenser, one 4-megohm leak with clips, and one 1-megohm leak with base (Dubilier). (Clarke, Igranic, Lissen, Mullard, T.C.C., etc.).
- 1 250,000-ohm wire-wound resistance (R.I.-Varley in set. Any good make. Dubilier, Igranic, Mullard, etc.).
- 1 "Adjustable-fixed" condenser, .0001-.0015 (C.A.V.).
- 1 Baseboard-mounting neutralising condenser (Igranic. Any standard make).
- 1 On-off switch (Igranic). (Benjamin, Lissen, Lotus, etc.).
- 1 7-terminal strip and one 2-terminal strip.
- Material for short-wave coil mount, screws, bolts, wire, etc.

In the "Every-Purpose" Two, which I described in March, 1927, the change-over was made simply by substituting special short-wave coils which were mounted on the ordinary plugs and sockets. This scheme, while very convenient and simple, is not quite so efficient as it might be, and I have accordingly made up this "All-Purpose" Three on somewhat similar lines,

\* \* \* \* \*

The "Every-Purpose" Two, which was described in "P.W." a year or so ago, achieved enormous popularity owing to its abnormal efficiency on both short and ordinary wave-lengths. The "All-Purpose" is a three-valve version of this well-known, easy-to-build receiver. It is just the set you want for the loud-speaker reception of far-distant broadcasters.

By L. H. THOMAS.

\* \* \* \* \*

but with improvements and alterations, particularly as regards the coil mounting.

The set is, above all, a low-loss short-waver. It will "do its job" in this department without any demur.

What we make it do afterwards does not matter very much, and we may rest assured that if it really does work as a short-wave receiver it will do everything else that we ask of it.

Following up this reasoning, you will

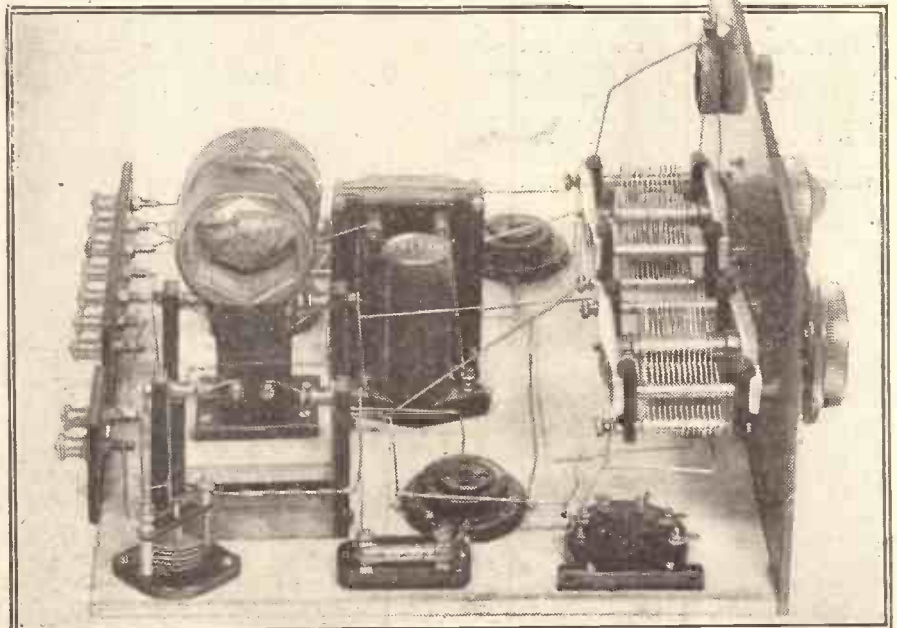
see that a short-wave coil mounting is used, and when it is desired to receive broadcast an "adaptor" for ordinary coils is brought into use. This is mentioned early because I know several people who think they are doing very well by plugging an "adaptor" for short-wave coils into an ordinary pair of plugs and sockets used for broadcast work. Thus all the losses in the broadcast coil-mount are still present in addition to the other!

### Well-tryed Circuit.

An absolutely "straight" circuit is used; this has never yet been known to fail for short-wave work, and is undoubtedly far more popular than any freak circuit yet perpetrated for short-wave work. Several features of the old "Every-Purpose" Two have been retained, but where any alterations have been made, they have all been the result of some definite experiment with a view to improvement.

Fig. 1 shows the theoretical circuit,

(Continued on next page.)



The "All-Purpose" uses ordinary components, and is essentially an amateur home-constructor's outfit. Yet it will bring in the short waves with the utmost ease and stability, and is excellent for the reception of the ordinary stations. It was subjected to exhaustive tests by the "P.W." Research Department, under the personal supervision of Mr. G. P. Kendall, B.Sc.



## THE "ALL-PURPOSE" THREE.

(Continued from previous page.)

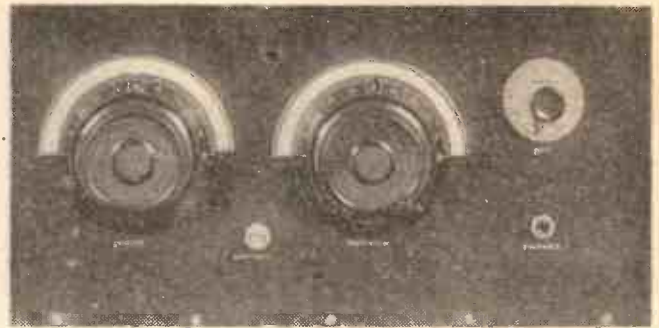
omitting, for the sake of simplicity, the filament jack. It is a straight three-valver consisting of a detector, one transformer-coupled and one resistance-coupled note-magnifier. We will first deal with the points requiring mention in connection with the detector. First, the coil is tuned by a .0005 variable condenser. This is a good size for the broadcast waves, but far too large for anything below about 100 metres.

For this reason a "variable-fixed" condenser has been placed in series with this .0005, with a switch to short it out when necessary. This condenser, which

This gives a very smooth and easy control of oscillation, and is one of the few methods which permit the earthing of the moving plates of the variable condenser. It will be seen that the variables are connected to points at earth potential, and it may be taken for granted that this is about the one efficient arrangement for a short-waver, unless one in prepared to screen the panel and other components.

As a matter of fact, the H.F. choke may not always be necessary; it is included, however, as a precau-

Both the "note-mags." are perfectly conventional; a resistance stage was



Putting in the 'phone plug automatically switches on the set, the "On-Off" control shown being for the short-wave tuning condenser.

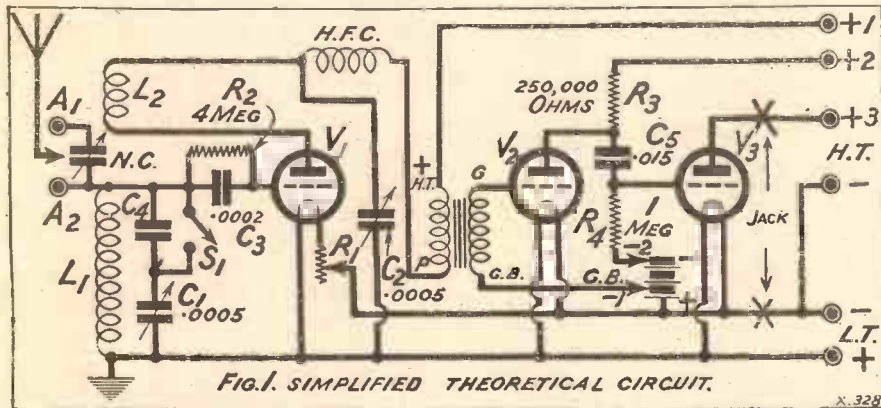
chosen to follow the transformer, since the operator will generally be wearing headphones for short-wave work and would probably find the signal strength given by two transformers rather unhealthy for the ears!

### The Coil-Mount.

The coil-mount, as will be seen, consists of a little wooden "platform" from which four ebonite strips 3 in. in height stand up. These are mounted at the corners and provided with telephone-type terminals at their tops. The photograph which shows the short-wave coils in position explains the method of support. Provided that they are wound with reasonably stiff wire, once the ends are bent out to the correct distances the coils will stand up nicely on the mount, and will not tend to develop an "anti-microphonic" wobble! They should be wound with wire not thinner than No. 18, but fuller details on this are given later.

The adaptor for the broadcast coils simply consists of another little platform

(Continued on next page.)



may be seen on the baseboard to the extreme right of the set (referring to one of the back-of-panel views), allows of any capacity between .0001 and .0015 being used.

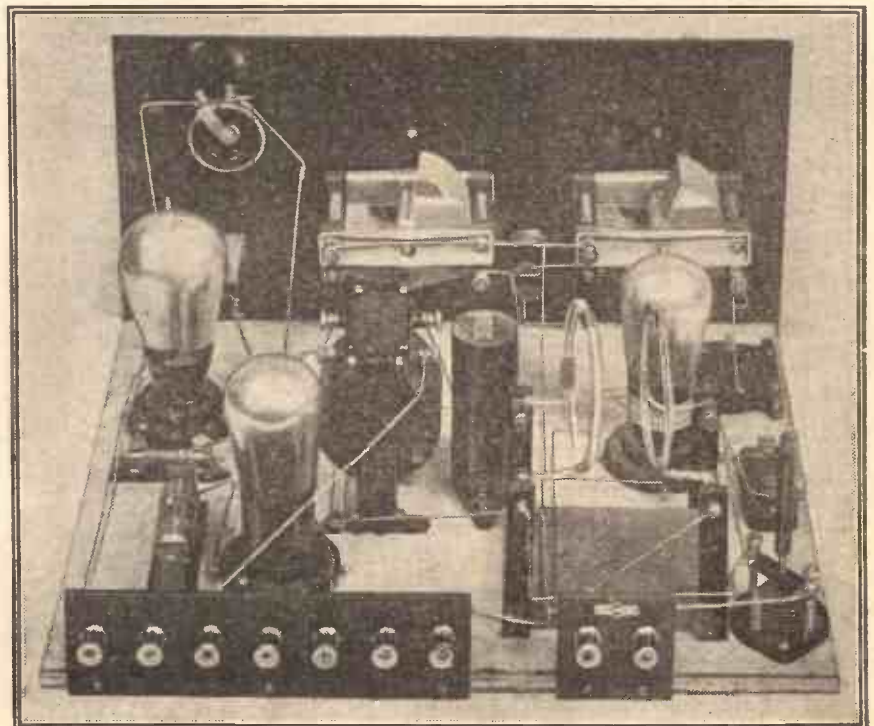
The normal value in use is .0001. Thus, with the shorting switch in the closed position, we have our .0005 condenser for broadcast reception, and when the switch is opened we have a .0005 and a .0001 in series, giving a resultant effective capacity of about .00008. Bearing in mind that the capacity of the switch is in parallel with the .0001 fixed condenser, it is probable that the effective capacity of the variable becomes about .0001, which is an excellent value in the usual way for short-wave work.

### "Throttle" Reaction.

Next, we have a baseboard-mounted neutralising condenser connected in series with the aerial; one of the aerial terminals (A<sub>1</sub>) allows us to connect the aerial directly to the grid coil for broadcast work, while A<sub>2</sub> puts the neutralising condenser in series with it, giving the capacity-coupled aerial circuit that is used with such success in many American short-wave sets, and is often used over here by amateur constructors.

There is really nothing more to say about the detector, except with regard to the reaction control. This is the standard "throttle-control" method, using series feed for the H.T. The latter is applied to the detector anode through the L.F. transformer primary, an H.F. choke, and the reaction coil. From the plate side of the H.F. choke another .0005 variable condenser is taken down to earth,

tionary measure, since some makes of L.F. transformer may by-pass a sufficient amount of H.F. energy to maintain the set in a state of oscillation even when the reaction condenser is "all out."



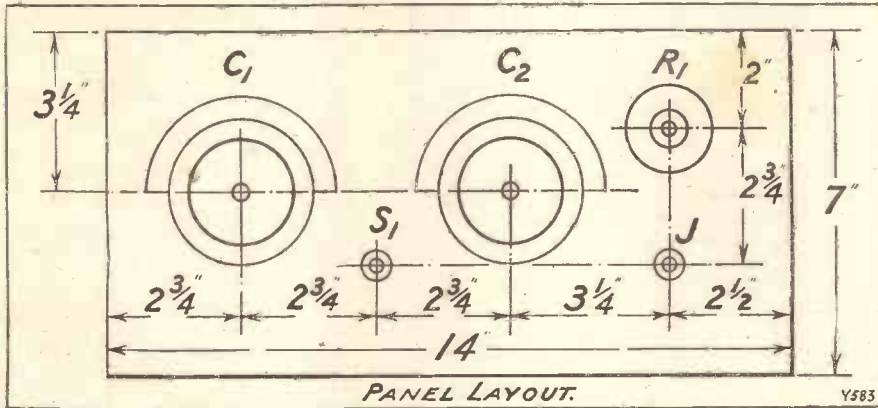
This method of mounting the coils is not only simple to arrange, but has several other advantages to recommend it.



**THE "ALL-PURPOSE" THREE.**

(Continued from previous page.)

with two standard coil sockets mounted on it about  $\frac{1}{2}$  in. apart, with four wires, also bent to the correct positions, so arranged that one simply removes the short-wave coils, slips the little platform into position, screws down the terminals



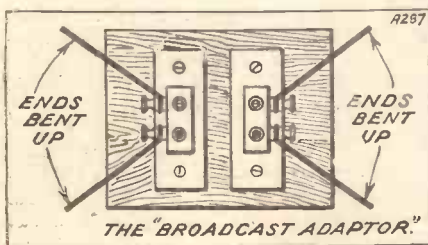
on the four wires, and inserts the necessary coils. This is seen in one photograph with two ordinary coils in position. (See also separate sketch.)

The mount has, of course, been arranged so as to give the short-wave coils a position well above the baseboard and the wiring, and to keep their field free of large metal components. It may thus be found that if one is not careful with the mounting of the "adaptor," when the broadcast coils are in position the lid of the cabinet will not close properly. Sufficiently long wires should be provided on the adaptor for it to go down quite close to the baseboard itself when it is placed in position. Note that the broadcast adaptor and all its losses are completely removed when short-wave reception is carried out.

**Well Spaced Wiring.**

The seven-terminal strip on the left of the baseboard carries the H.T. and L.T. terminals, and also the earth terminal. This is a convenient arrangement, since the earth is connected over to L.T. positive, which is the next terminal to it. The two terminals on the other strip are both aerial terminals.

The rheostat on the panel is in series with the filament of the detector. There is



no particular point in providing rheostats for the L.F. valves, but this is sometimes useful to prevent "threshold howl" although this annoying trouble has, luckily, never been present in this set at all.

When constructing the set, keep the wiring as similar as possible to that of the original, since it has been made as short as possible, bearing in mind the fact that the components are well spaced out. Most of the wiring is fairly low on the baseboard. Bare wire has been used, but there is, of course, no objection whatever to the use of "Systoflex," "Glazite," or some similar wire.

The jack on the panel is of the "single-circuit filament" type; removing the 'phone plug breaks the filament circuit.

The short-wave coils seen in the photograph were found to give results quite equal to any other type; they were simply wound with No. 18 D.C.C. wire on a 2-in. former, allowed to spring off, tied with cotton at four points, and the ends trimmed off for insertion in the 'phone terminals on the mount.

They may not seem particularly "low-loss" to those who spend hours on winding wonderful spaced-wire coils, but are probably just as efficient! It should take the average person about half-an-hour to wind a complete set of them. Be careful, of course, to see that they are all wound in the same direction. The ends should be turned "outwards" slightly so that when the coils are inserted in the mount the actual turns of the two coils are about  $\frac{1}{2}$ -in. apart. The "mount" platform, by the way, is  $3\frac{1}{2}$  in. by 4 in., and about  $\frac{1}{2}$  in. "bend" of the ends of the coils achieves this.

**Short-Wave Coil Windings.**

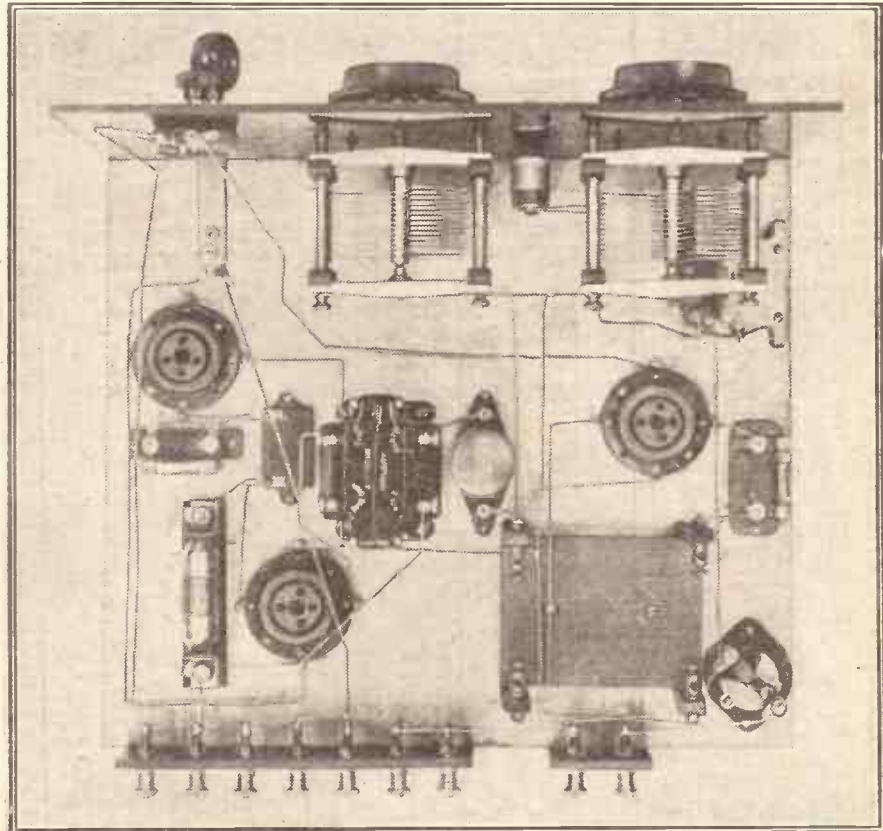
The interesting part of the short-wave spectrum is between 15 and 90 metres, and to cover this band the following coils should be made:

Two turns (one), 3 turns (two), 4 turns (two), 6 turns (one), 8 turns (two), 12 turns (one), and 18 turns (one).

The diameter of the coils giving these ranges was about  $2\frac{1}{2}$  in. (to which the coils sprang when wound on a 2-in. former).

Slight variations in the size of the re-

With regard to the coils, these may be left largely to the reader's discretion. A word or two on their sizes will probably be



As will be seen from this plan view of the baseboard, the wiring of the detector grid circuit is arranged so that the leads will be as short as possible.

all that is necessary. For broadcast waves, of course, any standard commercial coils may be used, and the usual sizes will be suitable,

action coil may be necessary, but in any case the coils are ridiculously easy to make, and it is as well to lay in a good stock of them!

(Continued on next page.)

# THE "ALL-PURPOSE" THREE.

(Continued from previous page.)

The following are generally found here to be the best arrangements of coils for the various wave-length ranges:—

Grid coil	Reaction coil.	Wave-range (with .0001) approx.
2	3	15-24 metres
3	3 or 4	18-30 "
4	4 or 6	22-35 "
6	8	28-42 "
8	8 or 12	38-60 "
12	18	48-75 "
18	12	67-128 "

The amount of the neutralising condenser which is kept in circuit (in series with the aerial), also has a bearing, of course, on the wave-length range covered.

For 15-20-metre work it will almost invariably be found necessary to keep this "all out." One need not be afraid of inefficiency even then, for the amount of capacity necessary to allow oscillations of this frequency to be "picked up" from the aerial is almost negligible. Indeed, signal strength will be almost unaltered if one disconnects the aerial at the earthing switch, signals being received simply through the capacity of the latter.

### Suitable Valves.

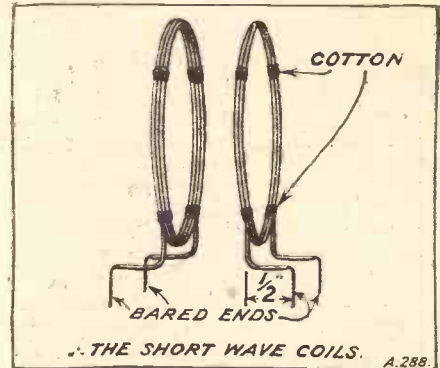
Regarding aeriels, it is not usually worth while to erect a special one for short-wave work, especially with a coupling scheme of this kind, but a long low aerial is often found to give excellent results, and if you have room to erect an aerial about 80 ft. long and 5 or 6 ft. high, it is decidedly worth your while to give it a trial.

With regard to the valves and H.T. voltages to use, here again no definite rule can be laid down, but the combinations originally used are given as a guide.

For the detector a valve with a "mu" of about 20, and impedance of about 30,000 ohms was used; the D.E.5B, P.M.5X, etc., are suitable. A similar

valve was used as the first note-magnifier; a fairly high-impedance valve is practically essential here in view of the fact that a resistance of 250,000 ohms is included in its plate circuit.

For the last valve a power valve should be employed. Three separate H.T. terminals are provided, and I used 45 volts



on the detector and 100 volts on the other two. Grid bias is another variable factor, but about 3 volts on the first note-magnifier and 9 on the other were used.

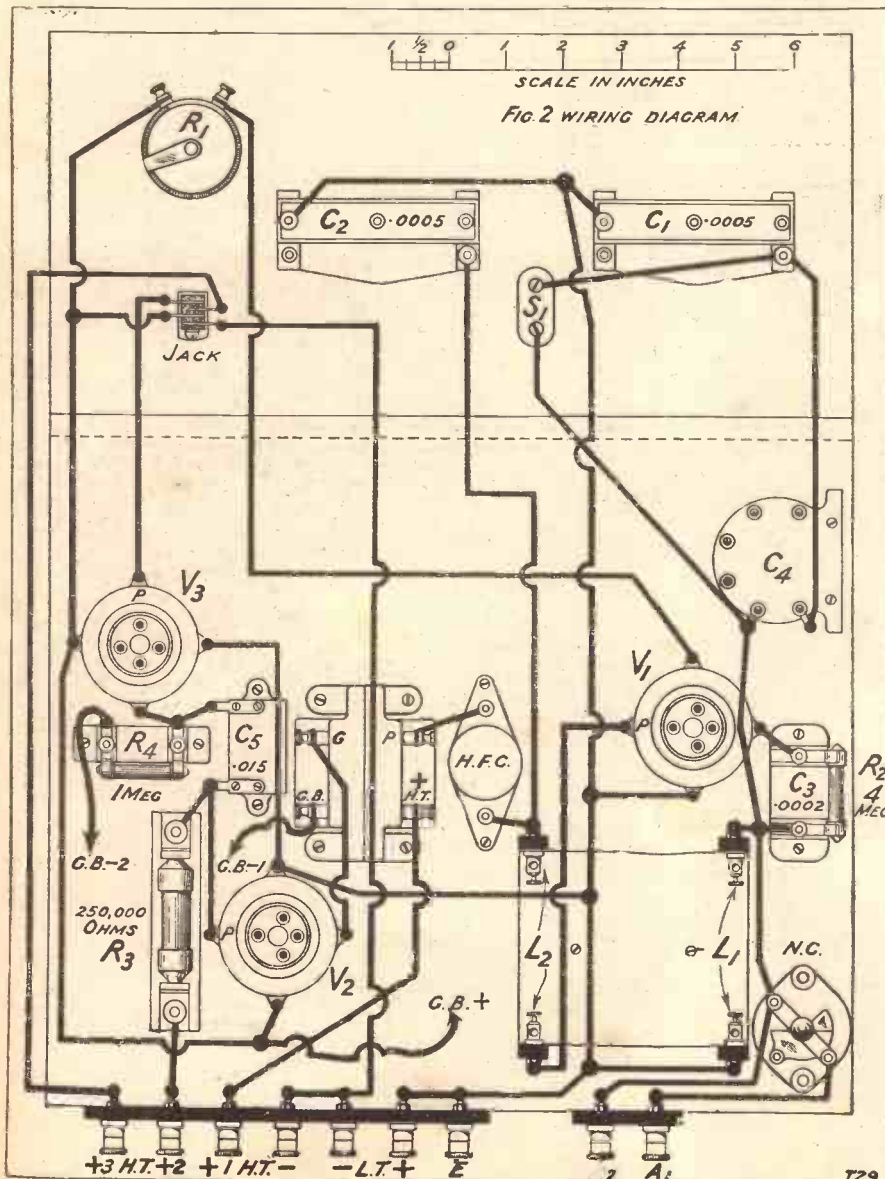
On the short-wave side the aerial should, of course, be connected to terminal A<sub>1</sub> and the neutralising condenser should be adjusted until the set is oscillating over the whole sweep of C<sub>1</sub> (with the switch "open," i.e. switched off), without having to put the reaction condenser C<sub>2</sub> more than about "half-in." If the reaction control is "ploppy" try reducing the H.T. on the detector. If, on the other hand, it slides into oscillation with a long-drawn howl, try the effect of reducing the filament voltage by the rheostat R<sub>1</sub>. If the control cannot be made nice, look to the detector grid-leak. A fair average value was found to be 4 megohms, with a grid condenser of .0002. There are, unfortunately, however, such things as defective grid leaks.

### Results Obtained.

With the 3-turn coil as grid coil and the other 3 or a 4-turn coil for reaction, 2 X A D should be found when he is transmitting at about 10 p.m. with no difficulty at all. On the original set he comes through on a good night at full loud-speaker volume. His wave-length is 21.96 metres, and a little way above him, and probably at about the same strength, you will find 5 S W on 24.3 metres. 2 X A D is usually audible from about 7 p.m., well into the small hours, but is not *always* on!

All the short-wave telephony going should be available when the set is working properly. In addition to this, amateur Morse signals from all over the world should be logged without difficulty. On practically the first test of the set (during the evening) I logged A 1-2 K T (Jubbulpore, India), A M-1 A B (Federated Malay States), A F-1 B (French Indo-China), F O-I S R (Southern Rhodesia), and many other Eastern stations on 20 metres or thereabouts. Next morning five New Zealanders and four Australians were logged in about fifteen minutes.

On the broadcast side, 2 L O and 5 G B may, of course, be received at loud-speaker strength by London readers, while at least three stations should be available on the loud-speaker to most. The "adjustable-fixed" condenser is now shorted out.





SUCH troubles as are likely to be experienced on the low-frequency side of the set may be classed under three main headings:

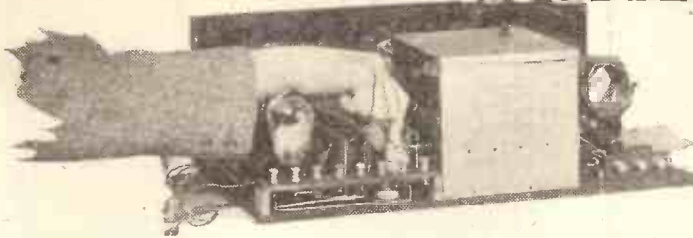
1. Break-downs or disconnections in the valves, components or wiring.
2. Instability.
3. Distortion.

Let us consider break-downs first of all. It may come as a surprise to many readers to learn that practically any failure of the low-frequency side to function may be tracked down, usually in a matter of minutes, so long as one simple instrument is available.

This is the milliammeter which, in the writer's view, is almost as essential a part of the valve-user's equipment as is the high-tension battery or the filament accumulator. With it any fault is instantly shown up and it is no long business to discover its exact location. There is no need to purchase an elaborate and expensive instrument of precision type.

All that is required is a moving-coil milliammeter giving a fair degree of accuracy, such as can be purchased for from 17s. 6d.

# TRACKING L.F. TROUBLES



\*-----\*  
 ♦ Simple and quick methods of dealing with any fault that is likely to occur in the L.F. end of a set. ♦  
 ♦ By R. W. HALLOWS, M.A. ♦  
 \*-----\*

a careful record of the reading which it gives when the batteries are up to the mark and the set is working thoroughly well.

### Your "Radio Thermometer."

Take also the readings for individual valves. This can be done in a set with a circuit like that seen in Fig. 1 by placing one valve at a time in its holder and seeing what current the instrument shows. Make a careful note of these readings and keep them by you. The milliammeter is your clinical thermometer and they are, so to speak, the normal temperatures of the different stages.

Now, let us suppose that the set ceases to function and that the rectifier and the high-frequency valve, if any, give normal readings when tested separately. The trouble is clearly on the low-frequency side of the set. Just where are we to seek for it?

The milliammeter will tell us. Look at the reading with only the low-frequency valves switched on. Whenever a break-down in the note-magnifiers occurs it will be either higher or lower than the normal.

An abnormally high reading indicates infallibly a break-down or disconnection in one of the grid circuits. You can see why in a moment you will examine Fig. 1 again. The only thing that can produce an extra flow of plate current in the note-magnifiers is a reduction in the negative bias applied to one of their grids or to both, supposing that there are two of them.

### Grid Bias Disconnection.

Switch off each L.F. valve in turn, keeping your eye on the milliammeter. If both are passing an abnormally high current the only possible cause, provided that the grid battery is in order, is a disconnection between the positive of this battery and the negative low-tension busbar, for that is the only way in which each valve can fail at the same time to receive its grid-biasing potential. Should only one valve, say,  $V_2$  in Fig. 1, be affected, then we must look for a disconnection or a break-down in the grid circuit of that particular valve.

Before doing anything else, splay out the grid-bias pin with the blade of a pocket-knife. If this does not effect a cure, and if

there is not a loose lead, then the transformer secondary (or the grid-leak, if resistance or choke coupling is used) is almost certain to be the culprit. We can verify this by the following test.

Having made sure that the grid battery is not run down, switch on the valve in whose grid circuit the trouble has been located, and pull out its grid battery

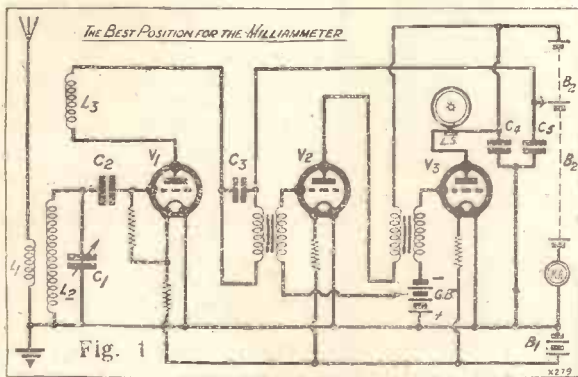
wander plug. If no change in the plate current occurs the transformer secondary or grid leak, as the case may be, has undoubtedly given way.

### A Transformer Failure.

"But," the reader may say, "transformer secondaries never do give way." Don't they? A couple of days before this article was written a break-down of this kind happened to the writer.

It was tracked down in five minutes with the help of the milliammeter, though, owing to the rarity of such an occurrence, hours might have been spent in fruitless trouble hunting had no such instrument been available. The transformer was one of the most expensive upon the market at the present time, and it was immediately replaced by the makers who were as much surprised as was its owner by the sudden failure of the secondary windings.

There may, of course, be a breakage within the valve-cap of the grid lead.

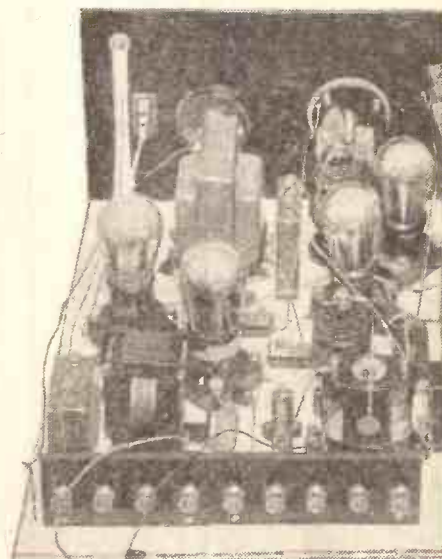


to 25s. Even the midget moving iron instruments which cost no more than 5s. or 6s. apiece are by no means to be despised as trouble detectors. As regards the range, from 0 to 20 milliamperes will be suitable for most cases, but a larger range may be desirable where a super-power valve is employed, for the milliammeter should be able to record the whole of the normal high-tension current passed by the receiving set.

### Record Your Readings.

The best of all ways to use the milliammeter is to keep it permanently connected into the common high-tension negative lead, as shown in Fig. 1. Placed as seen in the diagram, the windings are shunted by the H.T.B. condensers  $C_4$  and  $C_5$ , and no trouble through the effects of resonance or of the resistance of the windings need be anticipated.

If the instrument is not kept fixed in position in this way, a short flex lead connected to a wander plug may be attached to its negative terminal and one with a socket to the positive. It is then a simple matter at any time to place the high-tension negative wander plug in the socket and to insert the plug attached to the negative terminal of the instrument into the "zero" socket of the high-tension battery. To obtain the best from the milliammeter make



Many obscure faults can arise in the L.F. end of a receiver, and these evince themselves in various ways. If you read carefully the accompanying article you will be prepared to deal with them in the most expeditious manner.

Verify by substituting another valve in this holder.

High milliammeter readings in the case of a low-frequency break-down are the exception rather than the rule. What generally occurs is that the reading for the low-frequency side of the set is below normal. Should both L.F. valves, if there are two, and no others in the set, show low readings, we must at once suspect a "dud"

(Continued on next page.)



## HOW TO MAKE SPADE TERMINALS

You will probably have on hand the materials needed to make these useful devices.  
From A CORRESPONDENT.

FOR the sake of neatness, if not as a precautionary measure, all your battery leads should be fitted with ring or spade terminals. And tidiness also demands that the aerial and earth and loud speaker or telephone leads should also be so equipped. Ring and spade terminals are very cheap items, and can be obtained from any wireless store, but they can also easily be made from pieces of scrap brass. It is an interesting mechanical pastime turning out these little items.

With a small amount of patience and a little practice perfect specimens can be cut. This is how you should set about the task. First of all, with a pair of small tinman's snips, cut a piece of the brass 1 in.  $\times$   $\frac{1}{2}$  in. Ordinary scissors can be used, but they very easily blunted when asked to tackle sheet brass.

### Cutting "Shapes."

Centrally placed at one end of the small piece of brass, must then be drilled a  $\frac{1}{8}$  in. hole. If you have not a drill this size, a smaller hole can be bored and then reamed out to the required dimension with a reamer or a file. If you have not a vice in which to hold the piece of metal while it is being drilled, drill a hole of the correct size in the original sheet of metal before cutting it down to the 1 in.  $\times$   $\frac{1}{2}$  in. dimension. It is much easier to drill a large sheet of metal than a small piece.

The metal should then be cut as closely as possible to the shape illustrated in Fig. 2. A small file can be brought into service in order to polish off the rough edges. If the metal has become at all warped during this operation, it should be gently straightened with a hammer. The tab of the terminal—that portion which will eventually be turned over on the lead, should then be filed clean and tinned with solder. You need not use a soldering iron for this tinning process.

### Soldering Simplified.

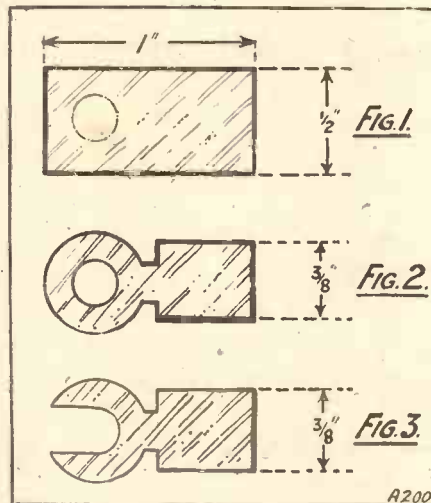
After having filed the metal clean, it should be smeared with soldering flux. Only a very thin layer of flux should be applied. Then a stick of solder should be taken and the end of it dipped in flux and put aside for a moment. The terminal should be held with a pair of pliers in the heat of a gas flame until a blue flicker appears around it. Then the solder should be applied.

You will find that the solder will "take" immediately. Withdrawing the terminal from the gas flame, it should be shaken to remove any surplus solder, and then it can be wiped with a rag and laid aside.

To fix the terminal to the end of a lead, this latter should first of all be tinned. Half an inch of the wire should be bared, cleaned, and dipped in flux. Then the soldering iron should be heated, tinned, and a blob of solder held on its face. Into this blob of molten solder the end of the lead should be held for a

moment until the solder has "taken," and the wire is thoroughly tinned.

You should shake away any surplus solder as before. Bend the tab of the terminal around this tinned end of the lead, and pinch



closely with pliers. A little flux, a hot soldering iron, and a very strong joint will result. To make a spade terminal, exactly the same procedure as before should be followed. Then two "snips," and the job is done, as shown in Fig. 3.

## TRACKING L.F. TROUBLES.

(Continued from previous page.)

cell in that part of the high-tension battery which serves only the note-magnifiers.

This can be verified by placing the wander plug attached to their high-tension positive lead in socket after socket of the battery. There should be a steady increase in the milliammeter reading as the plate voltage is made greater.

### Locating "Dud" Cells.

If, however, we find that the valves are passing, say, 8 milliamperes with 72 volts, and no more—or even considerably less—with 84, we may safely conclude that a cell in the portion of the battery involved has "gone." Since the part which serves only the note-magnifying valves has less drain upon it than any other, it is probable that

the whole battery is on its last legs and that a renewal is required. You may, however, be able to carry on for some time by shorting out the portion containing the dead cell.

### Is It the Filament?

If only one valve is affected we may be sure that the trouble is either in its plate or its filament circuit. Splay out the pins, if they are of the forked type, in the way previously described. Go carefully over all connections, seeing that none of them is loose.

In these days of glowless filaments it is impossible to discover visually whether the filament is intact or not. The best method is to substitute another valve and to see whether this shows the passing of any plate current.

If it does, then the filament of the first valve has probably broken. We can satisfy ourselves on this point by placing the valve temporarily in a holder whose plate circuit gives a normal reading. Should any current pass when the valve has been changed over, the filament is intact; if, on the other hand, there is no current, then a breakage has undoubtedly taken place.

### A Simple Business.

If we are satisfied that the filament is intact, then the only cause of a low reading on the milliammeter is a break-down in the transformer primary, choke or anode resistance that forms the plate circuit impedance. We can verify this by placing in the holders which give abnormally low or zero readings on the milliammeter valves that are found to be functioning perfectly well in other holders.

We see, then, that too high a current as recorded by the milliammeter for a particular note-magnifying valve means a break-down in its grid circuit, whilst a sub-normal or zero reading shows that either the filament or the plate circuit is defective. Working on these lines it is a simple business, with the milliammeter's aid, to trace any defect in valves, wiring or components.

## SOME INTERESTING ITEMS.

All the wireless transmitters belonging to the Westinghouse Electric Co. at East Pittsburgh (K D K A) employ crystal-control of wave-length.

When H.T. is taken from the mains great care should be taken with outdoor earthing systems, as rain or even fog can easily make a conductive covering across switch insulation, and so permit the passage of quite a heavy current.

Generally speaking, the grid condenser for a short-wave receiver should be a little smaller than that for an ordinary broadcast receiver (say .00015 instead of .0002 mfd.).

On account of its excellent reception in Polar latitudes, the Ottawa station, C N R O, regularly broadcasts messages to the Royal Canadian Mounted Police and other isolated Government officials, and also directs exploration vessels wintering in the Arctic.



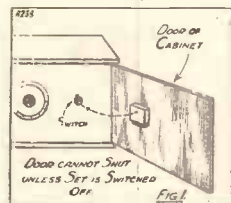
ONE does not tend to leave the L.T. of a single-valve set switched on after the closing down of programmes, for one is reminded of the necessity of switching off when removing telephone receivers from the head. But the most careful of listeners are liable to be guilty of forgetfulness in the case of loud-speaker outfits.



Towards the end of the evening there is generally dance music, and it is at this time that one is often using the transmission as a kind of background to a quiet read. Also one tends at such an hour to become somewhat drowsy. It is so easy in these circumstances to allow the brief closing down message (often there is not one at all) to pass unheeded.

**Bad For The Accumulator.**

One closes the book, one yawns, one does not hear any radio (i.e. set cannot be switched on) and one goes to bed. Probably the next attention paid to the set is that the next day someone notices that faint crackling noises are issuing from the loud speaker. Then the belated discovery is made that the receiver has been switched on all night. Perhaps, worse still, the accumulator might have been run right down and an invitation extended by this means to that dread enemy of battery cells, sulphation.



There are one or two things that can be done to reduce the possibility of such a radio tragedy occurring, although, apart from a very elaborate system of relays which

makes it possible for the broadcasting itself to switch the set on and off, there is little one can do to arrange a perfect safeguard against forgetfulness.

The ideas I am going to bring forward are really reminders, and although none is new possibly one or two may be fresh to "P.W." readers.

The first scheme is applicable to a receiver contained in a cabinet which has protective doors, and which is fitted with an on-off switch of the push-pull variety. This last must operate so that the set is switched off when the switch plunger is pushed in. Now look at Fig. 1. You will see that all one has to do is to fix a block of wood to the inner side of the door in such a way that the former hits the top of the switch when the door is closed.

**Two Things To Forget.**

If the block of wood is correctly dimensioned, the switch must be pushed in before the door can be made properly to shut. The snag is that a careless listener is just as apt to forget to close the door as to forget to switch the set off. But at any rate he now has two things to forget instead of just one!

Another quite good "reminder idea" is to have a small pea-lamp mounted on the

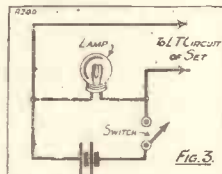
# SAFEGUARDING THE L.T.

Although it may not be realised by all amateurs, the L.T. can do as much real damage as the H.T. unless precautions are taken. Also, if an accumulator is used, the "on-off" switch becomes a really important item. Some "switching reminders" and other interesting L.T. items form the subjects of the following article.

By G. V. DOWDING, Grad.I.E.E.

front of the set in a prominent manner and so arranged in the circuit that it glows while the L.T. to the set is brought into activity. Fig. 2 illustrates this idea and Fig. 3 shows the simple connections.

You must make sure that the lamp comes directly across the switch and the L.T. battery, and that no rheostat or other such items are interposed. The current consumed by such a lamp can be of an almost negligible character. There are pea-lamps available which take the diminutive current of .06 ampere, although they glow quite brightly. A red-coloured lamp should be used for preference. The effect is rather novel and reminds one of the studio red lamp which glows when there is studio activity.



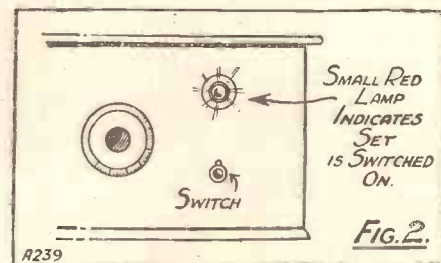
A dual use can be made of such a lamp if it is mounted above the condenser dials, and in this way made to illuminate the engraved readings. The .06 pea-lamps, by the way, are sold as H.T. fuses, and two or three available always prove useful. They cost a matter of only pence each. You must, of course, make sure that the bulb you use is suitable for the voltage of your L.T.

**A Combination Switch.**

There are various other ways of reminding oneself that the set is switched on. For instance, it is a simple matter to arrange an indicator of a mechanical nature to operate in conjunction with the L.T. switch.

But there is another L.T. danger which some of us have to face, and this is the unauthorised "operator." Small hands especially are liable to push in or pull out odd knobs that protrude from a radio set. To guard against this sort of thing, the L.T. switch can be mounted on the terminal strip behind the set or even inside the set itself.

Key switches are not unmixed blessings. The key is so easily lost! But a novel and



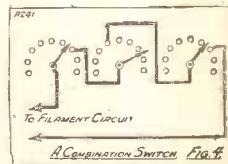
sockets can be used. And the idea can supplement the usual simple push-pull switch.

The switches are mounted on the front of the panel of the set, and the lid of this should be screwed down so that the connections to the switches cannot be seen. But there is one point in connection with this scheme which requires carefully watching.

**A Source of Danger.**

If the owner of the set makes a practice of running the switch arms from left to right until they are on the correct studs, and then to switch off the set runs them back again to the left, the combination will be immediately apparent, for the studs to the right of the "live" stud will soon be dull and those to the left will be bright. One should make a practice of running the switch arms to and fro over the whole of the studs, each time the switch is used. One can alter the combination at times by altering the connections.

The question of a fuse for the L.T. supply is one that is very well worth considering. In most sets there is more real danger in an L.T. short than in an H.T. short, as the current from a dry H.T. battery will always be limited to some extent by its comparatively high internal resistance. Not so with an accumulator "short," which can cause wires to become red hot and even melt and induce a real risk of fire.



**Accumulator Fuses.**

Thus a fuse close to one of the terminals of the accumulators is a safeguard which will commend itself to the thoughtful listener. One ampere fuse wire can be obtained and will be suitable for the majority of outfits. A small fuse box for direct attachment to one of the battery's terminals can very easily be made with a couple of terminals, a piece of ebonite and some pieces of wood or a small wooden box.

You cannot use pea-lamps as L.T. fuses, for these will take less current than the L.T. itself and would burn out before they were needed to do so.

Above I specifically referred to a dry H.T. battery, and I must not forget to add that an accumulator H.T. battery is a very different thing. This can deliver both high voltage and large currents and should, therefore, be treated with great respect.



# BROADCASTING POWER.

Are there any foundations for the startling speculations which are being circulated regarding certain American short-wave experiments.

By THE EDITOR.

WE have already made editorial comment upon the news of the production, by the General Electric Company of America, of a wireless valve capable of creating electric waves with the extraordinarily short length of ten centimetres; and many of our readers have no doubt seen in the newspapers accounts of the startling and interesting experiments made in connection with this new valve. It is perfectly true that when it is in operation very peculiar things happen—that measuring instruments behave in a violent and irresponsible manner, etc., and that rats in the vicinity first of all become terribly excited and eventually die.

As a result of the publicity in connection with this American designed valve, a considerable amount of tosh propaganda has also appeared in print: propaganda to the effect that the valve may make possible the broadcasting of power in such a way as to enable one's house to be lit by electricity—generated and disseminated by a broadcasting power station. And so on and so forth, very much in the way in which some newspapers have dealt with television.

But it is gratifying and illuminating to notice in a recent issue of the "Times" an article on the question of power by wireless which, for clarity, sanity, and scientific accuracy, makes one wish that all the newspapers would treat wireless inventions and wireless developments in general in the same common-sense manner, instead of indulging in high-falutin', spectacular, and sensational descriptions which can, at the most, only prove misleading to the general public.

The "Times" points out that previously the record in the production of short waves was the generation of waves about thirty centimetres in length, according to the well-known method of Barkhausen and Kurz. In this method, the grid of the valve is kept at a high positive potential while the plate is kept at a slightly negative potential.

## Alarming Predictions.

However, the Barkhausen and Kurz method is not very suitable for the creation of high-power oscillations; and there can be no doubt that the American method is an advance, because of the reduction in wave-length from thirty centimetres to ten centimetres, and because the production of these ultra short waves at great intensity is another improvement.

But it is developments like these which give rise to so many misconceptions. We are all aware of the fact that when publicity is given to any experiments in connection with the atom there is always sure to be an article published in some paper which raises the old scare of the explosion of the atom and the consequent likelihood of the disintegration of the world. The same attitude applies to this new valve.

As the "Times" says, these discoveries have given rise to a series of alarming pre-

dictions concerning their use in the broadcasting of power by wireless.

But many people seem to forget that broadcasting, even as at present carried out, is really the broadcasting of power, although, of course, the amount broadcast is infinitesimally small. And, in any case, the high cost of a station for the broadcasting of power sufficient to supply the electric light in one's house would rule it out of the sphere of practical commerce.

## "Cost Would Be Prodigious."

The problem is very analogous to that of television. Television, of a sort, is an accomplished fact; but television for home use, even if carried out according to the experiments made by the Bell Telephone Company of America, would mean the expenditure of so many thousands of pounds, and the upkeep would also be so high that it would not be commercially practicable to run a service.

A broadcasting station of two kilowatts, for example, would only light fifty small electric lamps, even if—and note the "if"—all the energy could be collected and used, and so our readers can imagine what size of station would be required to broadcast power in the way suggested in some newspaper articles. The cost would be prodigious.

The energy we pick up on our aerial is infinitesimal, and, although a loud speaker may be heard all over the house, it must be borne in mind that the energy which creates that loud-speaker noise is derived from the local batteries, although, of course, the

energy received from the transmitting station does control the output of the receiver batteries.

It would not be right to say that the broadcasting of power from the commercial point of view is *definitely* impossible; but there are certainly no definite signs, despite recent advances in valve construction, which would justify the extraordinary statements which have appeared in the lay Press in connection with broadcasting and power.

As every reader knows, the shorter the wave-length in wireless transmission the more easy it is to direct the transmitted energy into a beam, and it may be that on these lines future experiments will reveal methods of transmitting power for special purposes in one specific direction, and it is in connection with this possible development that the American valve experiments are valuable and interesting.

## Radio Death Rays.

Possibly the so-called Death Ray may yet be developed along these lines, and, although we do not wish to introduce a note of sensation in this article, there is no doubt that the experiments of Tesla, for example, have shown that energy can be directed into a beam over a short distance in such a way as seriously to interfere with electrical mechanism.

If this sort of beam could be made really practical, it is possible to imagine, with some justification, some new development in warfare whereby energy by wireless could be directed in a beam, say, at an attacking enemy aircraft, with disastrous results to the latter. But stories of wireless beams which, when directed against anything will cause them to blow up, or to disintegrate, are, of course, freaks of imaginative fiction, and should be regarded as such.

However, speculation at the moment on the question of power by wireless must be limited, just as speculation on the question of television should be limited. It is no good jumping ahead of facts, just as it is no good trying to run before one can walk.



The Vicar of Eoringblow, Burton, has installed this radio set in his church with a view to the broadcasting, over a limited area, of the radio services.



**ECONOMIC H.T.**

The Editor, POPULAR WIRELESS.

Dear Sir,—I very often benefit by reading of the experience of others through your "Correspondence" columns, and I wondered if the following might be of any use to other readers, who do not mind a little trouble and thereby save some expenditure on H.T. batteries. The receiver I generally use for L.S. work on 5 G B and 5 X X is a two-valve modified Reinartz circuit (Det. and 1 L.F.). As I use a power valve for the L.F. stage, I naturally find my H.T. battery, made up of the small flash-lamp patterns, does not last any too long. I use 36 volts on valve 1, 90 volts on valve 2. When I find that each battery only reads 3 volts I take them to pieces and very often find perhaps one or two (of the three cells in each flash-lamp battery) of these cells still go the full 1½ volts. These I put in the small glass jars (that can be obtained from several firms who advertise in your paper) with just a pinch of sal ammoniac, then with the jars half filled with water, these cells very often keep their voltage for two or three months, thus I make a good saving in my H.T. battery costs.

I have been a reader of POPULAR WIRELESS for two or three years, and always find it the most interesting and useful of wireless papers.

I recently roughly constructed the "Antipodes Adaptor" as published in a recent issue of POPULAR WIRELESS, and am very pleased with results obtained.

I got 2 X A F at fair loud-speaker strength. Also British 2 N M, Caterham, Surrey (on 32.5 metres, Sundays about 8 p.m.) and K D K A and 3 L O, Melbourne, Australia, at loud-speaker strength.

Also many Continentals which I have not yet identified.

Wishing success to POPULAR WIRELESS.

Yours truly,

WM. JOHN CHARLES.

Warwickshire.

**THE "PROGRESSIVE" ONE.**

The Editor, POPULAR WIRELESS.

Dear Sir,—It may interest you to know my results on the "Progressive" One attached to an indoor aerial, which is a double 26-foot aerial slung along two thick wooden beams, and very close at that! The earth also wanders down the side of the house by a rather circuitous route to the ground.

In spite of these, however, I receive 2 L O and 5 G B almost too loud for 'phone strength; Langenberg and Toulouse both quite intelligible, and numerous other stations hardly loud enough to identify. For one valve and such an aerial and earth system, this is not a bad result?

I look forward with interest to the outcome of the second stage, which I am about to add.

Yours truly,

H. F. (Miss).

Middlesex.

**THE "LO-COST INDUCTO-CRYS."**

The Editor, POPULAR WIRELESS.

Dear Sir,—On reading the article in the current week's issue of POPULAR WIRELESS re the "Lo-cost Inducto-Cryst." I determined to give it a test on my present set, which gives excellent results from the local station, Daventry, and Daventry, jun., also a few Continental stations faintly when darkness sets in. I have not adhered specifically to your instructions, as I have only taken three tappings, 15, 30, 45 turns to a stud switch. After finishing the alterations on Friday night I tested the set. The reception on the local was about the same, 5 X X ditto, and Daventry, jun., slightly louder. After the local station had closed down at 10.45 p.m., I obtained several foreign stations at good audible strength.

**CORRESPONDENCE.**

**ECONOMIC H.T.**

**THE "PROGRESSIVE" ONE—  
THE "STANDARD" TWO.**

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.

On the next night (Saturday) I did not test till after midnight, about 12.30 a.m. on Sunday morning, and I was surprised to hear a voice with a nasal accent talking quite clearly about the Irish nation on a wave-length of about 280 metres. This (a Continental-American relay) continued until 1.30 a.m., when the programme was terminated with the announcement "We are now going over to Schenectady, New York."

This, to me, appears a very good test of its capabilities, last night bringing in its crop of about ten stations, amongst which being Langenberg, Stuttgart, Hamburg, Cologne, and Zeesen.

Yours faithfully,

JAMES R. WILDE.

Hull.

**THE "SYDNEY" TWO.**

The Editor, POPULAR WIRELESS.

Dear Sir,—Having made up the "Sydney" Two I should like to add my word of praise to the many readers of your valuable paper who have already done so.

It is a wonderful little set. Early this morning I picked up four American stations and this evening heard 2 N M's programme from beginning to end. P C J J comes in at loud-speaker strength, but of late a heavy Morse station comes in right on his wave-length, and almost blots him out.

Wishing "P.W." the success it deserves, and thanking you for such a splendid circuit.

Yours gratefully,

W. A. CARR.

Sussex.

**THE "EVERY-PURPOSE" TWO.**

The Editor, POPULAR WIRELESS.

Sir,—Having numerous spare components lying about I thought I would use them to make up the "Every-Purpose" Two, as published in the POPULAR WIRELESS some time back, and I was rather astonished at the results obtained.

On the short waves I tuned in our new station Chensford, 2 X A F and 3 L O, Melbourne. On the Australian station I used two pair of 'phones at good strength. I have listened in to this station on three successive Sunday evenings, January 12th, 19th, and 26th, on the 26th very little fading was experienced, the programme was mainly of gramophone records, and towards 8.30 p.m. a short speech

ailing this, make one up out of a piece of strip brass ½ in. wide.

Make a foot by bending a ½ in. length at right-angles and slot both this and the vertical portion. Now procure an old terminal, cut off the screwed portion at the bottom of the shank and drill a hole in the centre of the ebonite or moulded cartridge holder so that the remaining screwed portion of the terminal can pass through. With the aid of the milled nut and a washer the holder may be gripped against the side of the bracket, the screw passing through the vertical slot and the holder.

Easy to Alter.

The photograph illustrates the idea carried into effect and the position of the grid-leak holder can be altered at will, being vertical, horizontal or inclined as best fits the job in hand. Since both the foot and the vertical portion of the bracket are slotted the whole arrangement can be turned round the screw fixing it to the baseboard, or the holder moved up and

was broadcast to Gt. Britain, I think by someone just taking up an appointment in Australia, I did not catch the name of the man.

On the ordinary broadcast band the following stations came in with ease, 5 G B (loud speaker), on the 'phones Toulouse, Stuttgart, Frankfurt, Bournemouth, London, and three others I did not wait to identify.

On the long wave 5 X X (loud speaker), on the 'phones Radio Paris, Hilversum, and one station not identified. My aerial is 60 ft. long and about 40 ft. high, but rather badly shielded on one end and side.

Yours faithfully,

"RICE."

Portsmouth.

**THE "P.W." STANDARD WAVE-TRAP.**

The Editor, POPULAR WIRELESS.

Dear Sir,—I see in your section of "P.W." every week references to various letters you have received from readers of your excellent paper.

I therefore thought you might like to hear from one of your regular readers who is across the seas. The reason I finally decided to write was that I am having such wonderful results with the "Standardised Wave-trap" described in a fairly recent number of "P.W." I can't remember the date of the number I mention, but it seems recent as I have been a regular reader for some years now.

When I arrived here a year ago there was no radio, but one was installed just before Christmas. Then the difficulty of cutting out our local station, Regina, cropped up. As usual, when in distress, I picked up my pile of "P.W." and searched until I found the one I needed, and then had the wave-trap made up. I have no tools here myself. It is just as described, except that it has a '0005 "Devicon" low-loss square law condenser instead of the one specified. The results are almost uncanny. I can tune Regina, 312.3 metres, right out, and get K O I L Council Bluffs, Iowa, 319 metres, and the G.E.C. station K O A, Denver, Colorado, 325.9 metres, comes in as clear as a bell.

I find that the tuning is almost the same as it was without the wave-trap, and with careful tuning the volume actually seems to be greater with the wave-trap than without it. Wishing you and "P.W." the best of luck.

Yours truly,

R. THOMAS A. DALTON.

Fairy Hill, Sask., Canada.

**THE "STANDARD" TWO.**

The Editor, POPULAR WIRELESS.

Dear Sir,—It gives me pleasure to record that a transmission from London was heard in Calcutta this evening. The receiving set used is a copy of the "Standard" Two (Reinartz) as published in your blue print No. 31, but with a few rough modifications. For instance, home-made short-wave coils of bare copper wire were employed. The station call sign was not heard, but it seems evident that the signals emanated from 5 S W, on 24 metres. "Fading" was very noticeable, but a lady was heard singing "The Pipes of Pan" ("The Arcadians"), this being succeeded by instrumental music. Then a clock chimed the quarter-hours and a single resounding "one," followed by a voice announcing: "This is St. Michael's, Cornhill." Calcutta time was then 6.50 p.m.

Many thanks for publishing this useful circuit, which, with appropriate coils, is used also to get stations on the medium wave-band in this country.

Yours faithfully,

W. G. BROCKWAY.

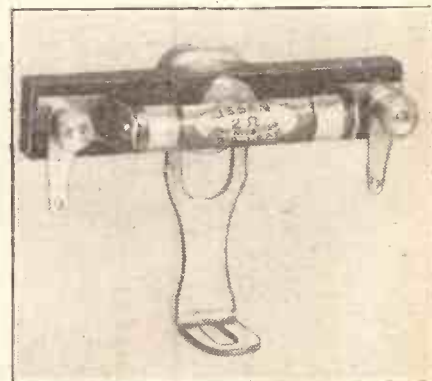
Calcutta.

**AN ADJUSTABLE  
GRID-LEAK HOLDER.**

THERE are times when it is either advisable or expedient to mount a grid leak or anode resistance in a receiver in a position differing from the normal one of screwed to the baseboard in its holder. Considerations of space, or the run of the wiring may give rise to the necessity for a vertical or inclined mounting, and when cases such as this occur the following plan can be adopted.

If an actual holder is not available, then it is a simple matter to make one up out of a strip of ebonite 2½ in. × ½ in. × ¼ in., recessing the back of the ebonite so that the heads of the terminal screws sink below the ebonite surface. A rummage over the contents of the junk box is sure to bring to light a small right-angled bracket, but

down the vertical slot to adjust the height. With the aid of a bracket such as that described and shown, mounting in all sorts of odd corners is possible, and the scheme has proved very useful on several occasions.



The holder can be placed in practically any position.





Practical hints and tips which will help you to tune in 3 L O and other distant broadcasters.

By GEORGE T. KELSEY.

THE successful reception of Australian short-wave broadcasting is no longer a matter for scepticism, and comparatively few people familiar with the handling of short-wave sets have failed at some time or other to hear signals over the intervening ten thousand miles or so.

Admittedly, and for the comfort of the pessimists, the strength of signals received in this country varies considerably and on occasions the programmes are badly jammed. Nevertheless, it has to be a very bad night for signals to be missing altogether.

#### Regular Reception of Melbourne.

As an example, in a recent period of six weeks, the weekly transmissions from 3 L O, the Melbourne Station, were received quite audibly every Sunday evening. Although on one or two occasions the transmission was inclined to be weak, it was never necessary to use more than three valves.

Do not for one moment imagine from the above that 3 L O, or for that matter any of the other Australian short-wave stations, can be used as an "alternative programme." For one reason as far as known schedules go the transmissions are seldom more than once a week, and for another night-distortion and fading are at times far too bad.

Nevertheless, my first statement is still true; and there is sufficient thrill in listening over such a colossal distance to make the writer (normally, alas, something of a "middle-to-lowbrow") thoroughly excited about nine consecutive "highbrow" records!

But, despite the fact that at times signals are so strong, there are a number of people who, judging by correspondence, are still unable to obtain successful results on the short waves.

#### Tips to Try.

For the benefit of these, and others who are in the act of making a short-wave set, it is proposed to devote a few paragraphs to the most common sources of failure, and how they may be overcome.

Supposing you have just made a short-wave set and, as is often the case, are unable to make it oscillate. The first thing to try, assuming, of course, that the connections are right, is increasing the H.T. voltage on the detector valve. Incidentally, if the valve employed in this position is of the "H.F." variety, it is worth while trying a valve with a lower impedance, such as an "L.F." valve.

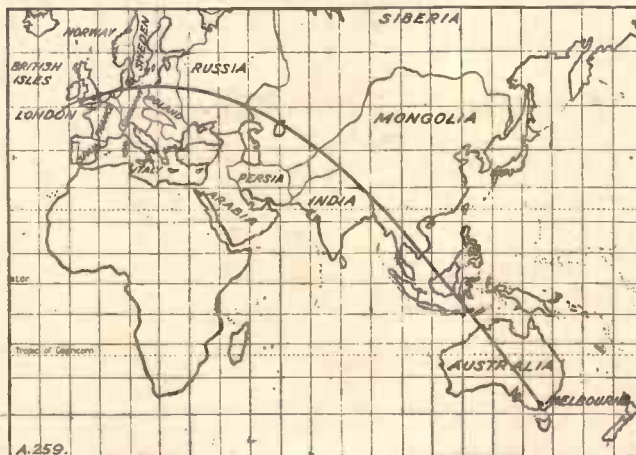
Should this have no effect, it is possible that the damping caused by the aerial is too great, in which case steps should be taken to reduce the aerial coupling. Let me digress for a moment to explain this in greater detail.

With many short-wave sets, one end of the grid coil is utilised as an aerial-coupling coil.

To this end the aerial lead is usually connected, while the earth lead is tapped on to the coil by means of a clip. Such an arrangement as this was employed in the "Sydney" Two receiver, and to reduce the coupling with this set it is merely necessary to move the earth clip nearer to the aerial end of the coil.

#### Easy Oscillation.

There is another type of set in which a separate coil is used for aerial coupling, and in this case, to reduce the damping the distance between the aerial coil and the grid coil should be increased.



The shortest route to 3 L O is via Russia, and follows the line shown in the above map. This line indicates what is known as a "great circle" round the world, and can be checked up on a globe in the manner detailed in the accompanying text. It is a good illustration of how misleading an ordinary map can be in certain respects.

In the case of a very large aerial it is often helpful to use a small fixed condenser (.0001 or .0002) in series with the aerial lead. The effect of a few more turns on the reaction coil is also well worth trying.

The H.F. choke in a short-wave set has a very important effect upon the oscillation, and it is necessary to use one with a low self-capacity. If you are in possession of a short-wave set which will not oscillate, and you have tried everything else without result, try replacing the H.F. choke with a 50 or 75 plug-in coil.

"Plippy" reaction is perhaps better than no reaction at all; nevertheless, it is not good enough. For the successful reception of short-wave stations the reaction control must be very smooth.

In this direction usually the first thing to try is varying the H.T. voltage on the detector valve. This may stop the set oscillating altogether, in which case, of course, another method of obtaining smooth control will have to be found. First try reducing the number of turns on the reaction coil. If this does not have the desired effect, a higher value grid leak up to four or five megohms may be helpful.

#### Step by "Steppe."

So far as the set is concerned, once it has been made to oscillate smoothly, it should not be difficult to receive short-wave stations. The actual operation, although not difficult, calls for more delicate handling than is the case with a broadcast receiver. At about 30 metres it is often possible to get two or three stations in one degree, from which it should be quite apparent that a slow-motion dial or at least some form of vernier control on the grid-tuning condenser is absolutely necessary.

When once the knack of operating a set on short waves has been obtained, it should not be a difficult matter to hear signals from "down under," provided, of course, that you listen at the right times.

The Melbourne Station, 3 L O, can be heard almost any Sunday evening between 8.30 p.m. and 10.30 p.m., B.S.T., and when first you succeed in receiving this really distant station, just pause for a moment to consider in which way signals are coming.

It is almost certain that you will be

receiving 3 L O across the half of the world which is in darkness, but it may come as a surprise to know that his signals in getting to England are coming via Russia, since this is the shortest route. This interesting point can quite easily be checked up by stretching a piece of cotton between two pins stuck in a globe of the world at "London" and "Melbourne," and the result is shown in the diagram.

Finally, for the benefit of those readers who are able to read the Morse code, a great number of Australian and New Zealand amateurs can usually be heard (bed permit-

ting!) between the hours of 5 and 8 o'clock in the morning on waves between about 20 to 45 metres, and some of them come over at very good strength.

### NEXT WEEK

Owing to the enormous success of the "P.W."

### ANTIPODES ADAPTOR

— a simple unit which, fitted to any ordinary loud-speaker set, enables it to

### PICK UP AUSTRALIA DIRECT

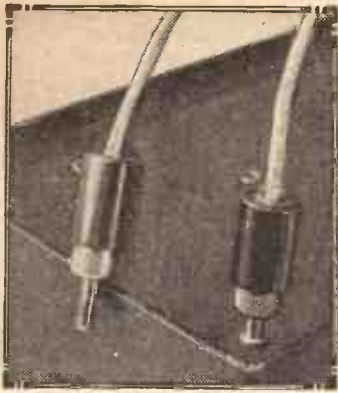
Next week's issue of "P.W." will contain full details for making The Antipodes Adaptor

### STAR MODEL

ORDER YOUR COPY NOW



# MAKING RADIO PLUGS AND FUSES



Constructional details of some useful gadgets designed to save money and facilitate experiments.  
 By H. J. BARTON CHAPPLE,  
 Wh. Sch., B.Sc. (Hons.), A.C.G.I.,  
 A.M.I.E.E.

THE benefits accruing from the regular use of H.T. fuses in the high-tension battery connections have been stressed on several occasions by contributors to the wireless journals, and as the writer has mentioned before, in his opinion the best location of a fuse is at the battery plug position.

As the following article shows the constructor can make up these fuses for himself in a very simple manner, making use of the popular low-consumption flash-lamp bulbs. The cost is only a few coppers, but the benefits conferred by their use far outweigh the expenditure involved.

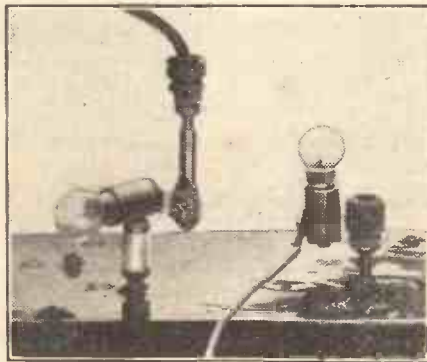
### Two Simple Methods.

Two alternatives are illustrated and the reader can make his own choice. Take a "heavy" brass flash-lamp holder, normally provided with mounting feet, such as the pattern illustrated, and enlarge the hole in one of these feet so that it passes over the screwed brass portion of an ordinary wander plug, and screw the nut and insulated top of the plug down over this so that the holder is thus held parallel to the plug.

The remaining foot can be cut off as it serves no useful purpose. The end of the H.T. lead usually joined to the plug must now be taken to the small screw at the side of the holder, and the lamp, when screwed into the holder, is then in series with the lead and gives full protection.

In the other fuse shown, the head of the small screw at the side of the lamp holder (a pattern similar to the previous one being employed) is sweated into the metallic top of a wander plug so that the fuse lamp is held horizontally.

Now, with the aid of a nut and screw, attach to one of the lamp-holder feet an "eye" adapter which has its end suitably drilled to take the split pins of the ordinary wander plug. This accessory is now placed into the H.T. battery socket and the H.T. lead terminating in a wander plug is inserted into the hole provided in the adapter.



The two simple but effective H.T. fuse devices which, as is explained in the accompanying article, can be made for a few pence each.

Either of these schemes can be employed with great satisfaction to the user, it being only the matter of a few minutes, as far as constructional time is concerned, and the possibility of burning out valve filaments will be rendered very remote.

There are undoubtedly a large number of small refinements which are being introduced into wireless at the present time and, in addition, countless gadgets make their appearance on the market for incorporation into receivers with the object of simplifying their operation.

### Useful Loud-Speaker Switch.

As far as loud speakers are concerned, there is a great improvement in the quality of reproduction and their ability to handle power, and very often it comes about that it is desired to compare or contrast the merits of two loud speakers on one particular receiver.

Now, to secure the best results the change from one to the other should be almost instantaneous, as thereby the ear is impressed by the contrast, whereas if time is taken in changing over connections the test is not so definite.

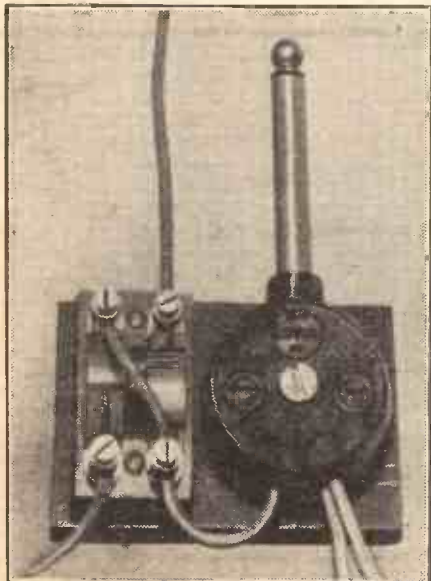
Where the loud speaker is connected to the set by a jack and plug arrangement the following idea will prove of great value. Any loud-speaker plug can be employed, but those lending themselves to the simplest modifications are patterns with a flat end, such as the Lotus model illustrated. The scheme is simply to include with the plug a single-pole change-over switch, and a very compact one suitable for this purpose is the particular model seen in the photographs.

Procure a piece of ebonite  $2\frac{1}{2}$  in. by  $1\frac{1}{2}$  in. by  $\frac{1}{4}$  in., or cut a piece that size from any scrap which is sure to be lying about in the junk box, and drill a  $\frac{1}{8}$  in. hole at a distance of  $\frac{1}{2}$  in. from one edge, and a 6 B.A. clearance hole  $\frac{3}{8}$  in. from the opposite edge.

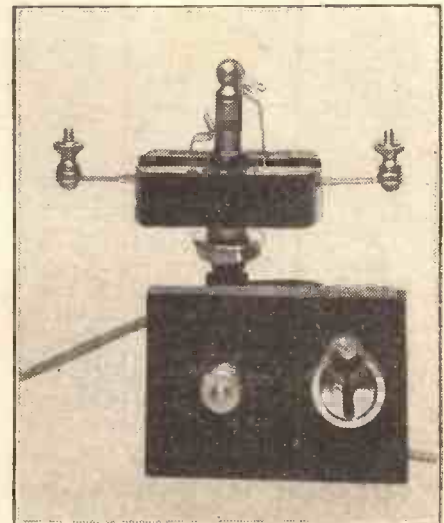
### A Valuable Asset.

The larger hole is for the one-hole fixing of the change-over switch, while to hold the plug in position pass a 6 B.A. screw through the centre hole in the plug moulding and hold it against the ebonite face by means of a nut and washer, as shown. Actually the switch is modelled to act as two single-pole switches, so two similar terminals must be made common by connecting them together with a short flex and then passing the end of this wire into one of the plug connections. Now join the two positive or the two negative leads from the two loud speakers under test into the other plug connection, and join the two remaining leads so that there is one to each switch position.

One of the photographs shows quite clearly how this is carried into effect, and the comparative tests are made by inserting the plug into its jack and moving the switch knob to and fro, thus bringing first one and then the other loud speaker into commission. The scheme is a very neat one, and has proved a valuable asset on many occasions.



This useful loud-speaker plug device is fashioned from an ordinary plug and a change-over switch.



Here the switch-plug is shown inserted in a radio jack.



## TECHNICAL NOTES.

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

# THAT VALVE MUDDLE

OVERLOADING—PLATE CURRENT—A POPULAR AMERICAN  
DIAPHRAGM—MOUNTING THE UNIT.

## That-Valve Muddle.

VALVE manufacturers have for some time past made persistent efforts to get radio users to employ special valves for various special purposes; for example, the correct type of H.F. amplifier for the high-frequency stages, a detector valve, designed and specified as such, for the detector stage and low-frequency amplifiers, with one or more power valves, for the low-frequency stages. This is as it should be, but at the same time there is a great deal of haphazard use of valves by a large percentage of listeners, who force so-called "general-purpose" valves to play the rôle of jack-of-all trades.

This means that a valve is frequently placed in service under conditions never intended or contemplated by the manufacturer. In this connection the question arises "What constitutes overload?" on a valve which will result in shortening its life. You might think that the last valve in a receiver tuned in on a strong local station, with the volume turned up far beyond the best point for clear reproduction, was being destructively overloaded, but generally speaking, this is not so. This latter is a form of overloading, it is true, but it is a kind which results in distorted reproduction without seriously affecting the life of the valve.

## Overloading.

On the other hand, a type of overload which may seriously affect the valve, and threaten its useful life, takes place when the manufacturers' specifications as regards filament, plate and grid voltages are disregarded and higher plate and filament voltages, or lower grid voltages, than those specified are used.

Take, for instance, a valve rated at 5-volts filament and 90- to 135-volts plate, with the grid bias specified as minus  $4\frac{1}{2}$  and minus 9 volts respectively. If the grid bias of  $4\frac{1}{2}$  volts recommended at 90 volts plate is omitted, this is about equivalent to adding 35 volts to the plate voltage, or is about the same as operating the valve at 125 volts with minus  $4\frac{1}{2}$ -volts bias. The overload is correspondingly more severe if, in addition to omitting the grid-bias voltage, or using a grid bias of too low a value, the plate voltage is at the same time increased beyond the specified value.

## Plate Current.

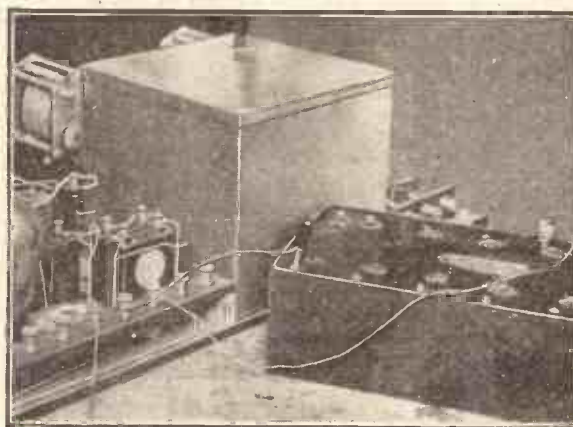
In the above-mentioned case it was found that when the valve was working at 135-volts plate and minus 9-volts grid, it carried a plate current of  $2\frac{1}{2}$  milliamperes. When the plate volts were 90 and the grid bias zero, the plate current was 6 milliamperes. With the plate 120 volts and grid bias zero, the plate current reached 12 milliamperes, representing nearly 400 per cent overload.

Some valves, of course, will stand overloads better than others; but, in general, it is always very desirable to adhere as

nearly as possible to the manufacturers' specifications.

## A Popular American Diaphragm.

I have a letter from a friend in the United States describing a type of loud speaker, or rather loud-speaker *diaphragm*, which is easily made by the home constructor and which is becoming very popular over there. The experimenter who already possesses a cone-speaker need only purchase the necessary aeroplane cloth and the dope with which to treat it. In some of the radio shops, according to the letter before me,



the complete kit (apart from the unit) may be had from about 6s. upwards.

The principle of the scheme is to use a wooden frame (which may be 18 in. wide, 24 in. high and of a sufficient depth from front to back to accommodate the particular loud-speaker unit you are using) and to cover one side of this frame with a sheet of aeroplane cloth stretched tightly over and tacked at frequent intervals to the wood. In order to get the cloth really tight it may be better to immerse it first in hot water and secure it in position whilst still wet.

When the cloth is thoroughly dry, which will take two or three days, it should be treated with "aeroplane dope," which is another name for various slightly-differing varieties of thin celluloid solution.

## Mounting the Unit.

The loud-speaker unit may be mounted upon a couple of wooden cross-bars at the rear of the frame, but owing to the varia-

(Continued on page 434.)

## A CONDENSER WARNING.

In the great majority of multi-valve sets a large fixed condenser is shunted across the H.T.— and H.T.+ wiring. If dust or old age impairs the efficiency of such a condenser, the result will be a steady drain upon the battery, and a shortening of its life.

## NEWS FROM SAVOY HILL.

## FROM OUR OWN CORRESPONDENTS.

# "NOISES"—A SPECIAL PROGRAMME

A SUNDAY CHANGE—THE RELAY STATION CRISIS—TROUBLE AT  
CARDIFF—ETC., ETC.

## "Noises."

THIS is the enigmatic title of a special programme from London at the end of the month. It is understood that there will be startling representations of nearly all the animals of the Zoo, as well as of many other sounds common and uncommon. This will be the first real test of the success or failure of important recent experiments in "effects" at Savoy Hill.

## A Sunday Change.

Beginning on Sunday, May 20th, the afternoon programmes, S.B., will run until 6.30. The Bach Cantatas have been extended. Children's services or Missionary talks will come on before the Foundations of Poetry series, instead of afterwards as hitherto. Meanwhile, the Rationalists and others are hammering away for an alternative to religious services.

## The Relay Station Crisis.

Apparently the position with regard to the effective range of relay stations at night

has become critical. It is believed by competent engineers who have been studying the problem that the B.B.C. relays working on international common waves might just as well shut down at nightfall.

They are quite good during the daytime, but as soon as the Continental stations get busy reception is hopeless beyond half a mile or so from the actual relay aerial. If nothing is done to relieve this situation there will be a heavy decline in licence revenue in the autumn, if not before. Heroic measures are imperative. It is no use talking about a solution in the Regional Scheme, which is still years off. If the B.B.C. is not careful there may be no licensed listeners when the Regional Scheme is completed!

## Trouble at Cardiff.

The B.B.C. showed conspicuous reserve in the recent washing of dirty linen in public at Cardiff. The position is still obscure, but some amusing points have emerged. The

(Continued on page 432.)





**YOU CAN BE  
ONE OF THE CROWD**  
*—yet far away*

Miniature lights, swaying lanterns, magic music by the hand of some famous regiment, playing to you in your own home as enjoyably as it has played to you on holiday many times before and will play again. You will hear this band as clearly as the crowd that listens on the spot, providing you are using a Lissen New Process Battery in your set. For the energy of this battery is pure D.C. current, it yields you pure reception, and its power lasts. In no other battery do you get the new process and new chemical combination which Lissen uses. The public have been quick to realise the improvement in reception which comes with the use of the Lissen New Process Battery: and now 10,000 radio dealers are selling the Lissen battery. One of these is somewhere near you. Next time you want a good battery ask for Lissen New Process and show plainly by the way you ask you mean to take no other.

60 volt (reads 66)	7/11	66 volt Super Power ..	13/6
100 .. ( 108)	12/11	9 " Grid Bias ..	1/6
		4½ volt Pocket Battery, 5d.	

**LISSEN LTD., 8-16, FRIARS LANE, RICHMOND, SURREY.**  
Managing Director Thomas N. Cole.





## THE B.B.C. THROUGH AMERICAN EYES.

We have become accustomed to the views of the B.B.C. on the alleged deficiencies of American Broadcasting or, for that matter, of Broadcasting anywhere in the world outside these islands. These views, for the most part, are not complimentary. It is right, therefore, to give opportunities of reversing the rôles.

By Dr. GEORGE HENDERSON.  
(University of California.)

I AM frankly impressed with the orderliness, compactness, and general atmosphere of efficiency of the B.B.C. I readily acquiesce in the advantages of unified control and parliamentary supervision without parliamentary interference.

Your B.B.C. is remarkably well "sold" to the British Public. Wherever I go, I hear such good accounts of your broadcasting that I have been timid in offering any criticism. Curiously enough, however, it has come to my observation that by no means all of those who praise the B.B.C. ever listen to its programmes. In fact, I would go so far as to say that, in my experience, barely one out of ten of its most enthusiastic advocates has any practical knowledge of what he is talking about. Now if this impression is correct, it means that the propaganda of the B.B.C. is way ahead of its performance.

### Amateurish Provincial Programmes.

I have now listened attentively for more than a month. During this time I have followed the programmes of all the B.B.C. main stations. My outstanding impression is that those programmes which come from London are of a consistently high average, but definitely lack novelty, showmanship, and distinction. The programmes which come from the provincial centres are amateurish to a degree that would not be tolerated in any Middle West small town.

But I would concede that on the average your London Programmes are not vastly inferior to some of our better programmes.

To come down to particulars, I consider that the musical side is by far the stronger. Your B.B.C. people turn out some excellent Symphony and Light Orchestral Music. Then the Military Band is easily the best I have heard. I should think that Mr. O'Donnell is something of a genius in his way, and I am going to put my people on to him as soon as I get back to the States. Having said these nice things about music generally, I regret I cannot praise the Dance music as well. This, I think, is disgraceful. There would be a riot if this kind of Dance music was dished up at a Red Indian Pot-Latch in Wyoming. You should shake your fellows up and get some real life into this radio dance business.

### "An Impossible Task."

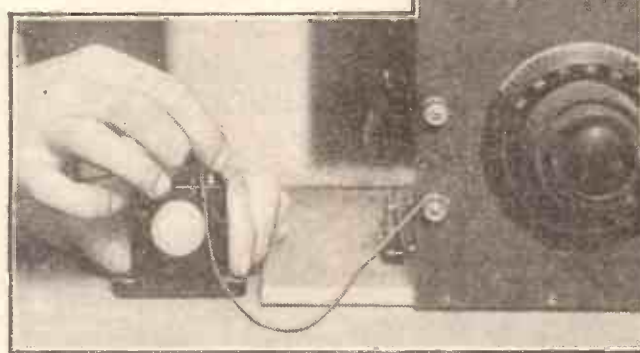
And as for what you call Radio Drama—well, words utterly fail me. It isn't drama at all. We in the States have long ago discovered that it is no earthly use to try to put drama over the radio. You still appear to be wallowing in the uncertainties and perplexities of what you should know is an impossible task.

If I find difficulty in describing my feelings about Radio Drama, goodness knows how I can convey a remote resemblance to my

thoughts on the perfectly amazing transmissions which the B.B.C. dignifies with the name of news. Why, it's all old stuff, dished up in a heartless, dispirited way. Then it's put out at the wrong time. Really I don't understand it.

Now, having had several bangs, I must in fairness hand out a few bouquets. Where your fellows really score is on the

### DON'T FORGET TO DO THIS!



When you instal a D.C. H.T. Mains Unit you must remove the earth lead from the set and insert a fixed condenser (about .5 mfd.) in series with this connection. Otherwise there is a possibility that you may short your supply mains to earth. Provision for avoiding this is made on some units, but by no means on all.

## SHORT-WAVE NOTES.

By W. L. S.

I HAVE this week been trying out a short-wave receiver of rather novel design, constructed by a friend. It is of the conventional "det. and notemag." type, but instead of using an oscillating detector a separate oscillator is used, the detector itself being provided with reaction, but worked just below the oscillation point.

The set would appear to have numerous advantages, chief among which is the fact that a strong atmospheric or very nearby station does not have the effect of making the whole receiver "spill over," as it sometimes does when one is straining one's ears right on the point of oscillation. Consequently, the "mush" which is always present on any short-wave receiver is reduced to quite reasonable proportions and weak signals can be copied with much greater ease.

Naturally, this is more beneficial to the real "DX man" than the would-be broadcast listener on short waves, for the latter has (or should have) no use for an oscillator at all for the reception of telephony.

One is apt to lose sight of the fact that what we are really after on short waves is

Sabbath. Say, boys, for sound, dignified, emotional, back to the homestead uplift. I give the B.B.C. full credit and then some. Another thing which I like is the quiet reserve, the cultured accent, and the general standard of your announcing. The only fault I have to find in that connection is that the B.B.C. carries the shibboleth of anonymity to absurd lengths.

They should let the public know the names of those bright boys who are on the air every night. Not only that, but they should let them loose a bit. Your only natural broadcaster is Captain Eckersley, who, I understand, acquired his microphone technique in America. Anyway, he is right there with the goods, has all the flair and freedom from affectation which mark our best announcers.

There is one more thing you do well, I refer to the running narratives of sporting events. These you do better than we do in the States. But in education we have you beaten to a frazzle. The B.B.C. has not yet learnt how to adapt education to radio.

We discovered the way two years ago, and since then, believe me, our radio is ten times as powerful an educational force as all the schools and universities put together. And how did we do it? By intelligent concentration. We set a squad of professors to work night and day for six weeks, and at the end of that time, they had prepared a pretty complete summary of everything in a really compressed form.

not the production of strong signals but the production of clear and "un-interfered-with" signals, however weak they are. This separate oscillator circuit certainly seems a step in the right direction.

Which is the most difficult part of the world from which to receive signals? Three years ago it would have been pronounced as the Antipodes, but since then the Australian and New Zealand stations have been quite easy to receive. Until quite recently I thought it must be the 6th and 7th districts of the U.S.A. (the states down the Pacific coast), but recently I heard over a dozen of each in one morning! Opinions from readers would be welcome.

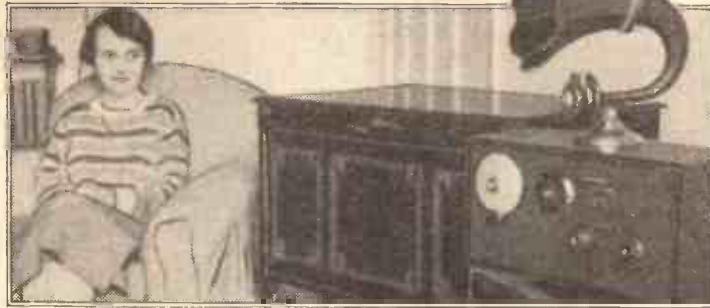
### Asiatic Signals Scarce.

The two Indian stations that have been heard most regularly of recent months, 2 K T and 2 K X, are both "off the air" for the time being. Mr. Drudge-Coates, the operator of 2 K X, is, I believe, in London at the present time, and Lieut. Redman, of 2 K T, is on his way here now. Asiatic signals are scarce indeed nowadays.

Who are the owners of the flock of small signals always to be heard between 37 and 42 metres with calls like G 4 J, K 2 X, C 8 L, etc.? I have a shrewd suspicion myself that they are not unconnected with Army operations on Salisbury Plain, but I am not at all sure of this. It is quite interesting to listen to them all occasionally and to take down the astonishing stuff that they send to one another.



# YOUR ALTERNATIVE PROGRAMME



IT has been said that variety is the spice of life, and this might easily be travestied to "variety is the soul of broadcasting," for without it the programme would be dull indeed.

Sometimes, however, even with an alternative programme on the ether, we are not satisfied with the fare that is given us. On these occasions it is very useful to be able to turn to the gramophone and to reproduce records in a manner which makes them indistinguishable from broadcasting. This is easily done by what is known as the gramophone pick-up, and of which you probably have all heard and know something.

The gramophone pick-up is a device which, when attached to the tone-arm of any gramophone in place of the sound-box, enables the variations on the record to be electrically reproduced and amplified through a wireless receiver or L.F. amplifier, and then turned into sound by a loud speaker. The volume can be controlled by the amplifier, while the tonal quality depends upon the pick-up, the amplifier, and the loud speaker.

### Attaching the Pick-up.

If the pick-up is a good one, the amplifier above reproach, and the loud speaker really good, then the reproduction will be hardly distinguishable from the reproduction obtained from the local station when broadcasting is on, assuming that the record employed is a good one.

There are one or two things about the use of pick-ups, however, which I would like to put before you and one of these concerns the fitting of the pick-up to the tone-arm.

Most pick-ups are supplied for fitting to any type of tone-arm, and you merely put them on instead of the sound-box, and there you are. This is all right provided the pick-up is made so that the needle comes at exactly the same angle as it did from your sound-box, but if it does not, then you should alter your tone-arm or use a fresh one (one can be obtained for about six shillings), and re-centre the pick-up.

### Checking the Track.

This consists in placing the tone-arm with the pick-up attached so that the needle in its passage across the record describes an arc of a circle from the outside of the record towards the inside, passing through the centre of the record, i.e. through the central pin of the turn-table.

Furthermore, the pick-up and needle should make an angle with the record of 60° from the horizontal, when looked at from the side, and 90° when looked at from the front. If you look at your ordinary sound-box before you remove it you will see that that has an angle of about 60° looked at from one direction, and about 90° when looked at from a direction at right angles to the front.

Also, the pick-up, as in the case of the sound-box, should be so aligned that when it is half-way across the playing surface of your record the needle is in line with the tangent drawn to the groove that runs

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When radio broadcast items are dull you can provide your own programme with the greatest of ease if you have a gramophone and pick-up attachment.

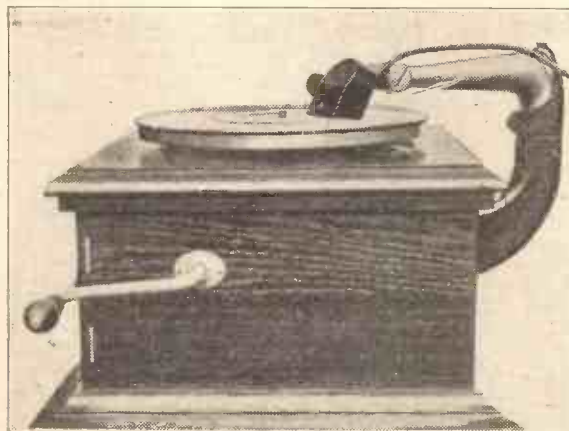
By K. D. ROGERS.

\*-----\*

round the record half-way across the playing surface.

This may sound a little complicated, but if you look at your tone-arm and pick-up when it is laid down upon a record you will see exactly what I mean. You will find that the pick-up will trace an arc across the surface of the record and that this arc can be divided into two parts, so that each arm of the arc, or each side of the arc, is equal to the other side.

At this centre point you will find a groove of the record it is crossing; one of the many grooves which are on the playing surface



This photograph shows how the pick-up takes the place of the sound-box on the ordinary gramophone tone-arm.

of the record. At this point where the needle touches the groove the needle should be in line with the tangent drawn through that groove. In other words, it should be travelling straight down the centre of the groove.

### Wear Minimised.

It will be obvious, upon examination, that if the pick-up is bearing either one way or the other, the needle gradually bears at an angle on the groove and does not travel right down the centre. But if you get it to travel down the centre of that

groove nearest the middle of the playing surface then you will find that the pick-up does not diverge very greatly from the centre position during the playing of the record.

In this way undue wear on the record is avoided and the purest reproduction possible is obtained.

### Question of Needles.

With regard to the needle to use, I have found that where the pick-up is inclined to chatter on loud passages, then a loud needle will help to stabilise this. I have found that a soft medium needle seems to chatter far more

than a loud one under these circumstances, although from the point of view of wear on the record, I prefer to use the medium tone needle.

Tungstyle needles, and other semi-permanent types are extremely good, and save a lot of bother in changing needles, but on the whole I think I prefer the medium type for general use, especially if the record to be played is fairly consistent in its tone and does not contain any sudden loud passages of music and similar types. The experimenter should try different types of needles for himself, because these must be chosen according to the pick-up he is using, and it is impossible to lay down a law on this point.

Finally, I would advise all who take up pick-up work to have a volume control. This merely consists of a 250,000 or 500,000 potentiometer connected right across the pick-up, with the tapping taken to the grid circuit of the first amplifying valve. This enables very fine modulation control to be employed, and is, in my opinion, an essential for perfect pick-up reproduction.

## \*-----\*

## TECHNICAL TIPS.

## \*-----\*

When using a screening box it is of the utmost importance that the coils should be placed centrally and not near to the sides, top or bottom of the box, or otherwise the presence of the metal will adversely affect the efficiency of the coil.

The Zeesen, Berlin, Station now has a 50 kw. short-wave transmitter in operation, working from 10 a.m. to 12 noon and from 6 p.m. to 9 p.m. on 37.65 metres.

Unexpected discrepancies in dial readings at this time of the year are generally due to the fact that the earth connection needs overhauling.

When cutting threaded brass rod this should be held between two pieces of soft wood, these in turn being gripped by the vice. Otherwise the thread on the rod will be damaged.





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

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

The constructional articles which appear from time to time in this journal are the outcome of research and experimental work carried out with a view to improving the technique of wireless receivers. 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.

#### MOVING-COIL LOUD SPEAKER.

OF the advantages of the moving-coil type of loud speaker little need be said, for readers will have read of them in various articles which have appeared from time to time in "P.W." One, of course, needs a fairly powerful type of set to get the best from this type of instrument and, needless to say, the input should be of a distortionless nature. Otherwise, one might as well have the cheapest of horn models.

A complete moving-coil loud speaker is a very expensive item, and can only be of interest to the amateur who has plenty of money to spend on his hobby. But sets of parts are now becoming available at reasonable figures. The assembly of some of these sets of parts necessitates a considerable degree of skill. With other designs sacrifices are made to bring the assembly within the scope of the home constructor. There are a few sets of parts on the market, however, which are not hard to put together and which, when assembled, are well up in point of sensitivity and general efficiency to commercially assembled models.

In this category we would place the Squires sets of parts, the design of which is ingenious and has several points of interest.

For instance, the diaphragm is cut so that it can be modelled into cone form in a few minutes with the aid of a little "Seccotine." The moving coil also is so arranged that it cannot possibly come in contact with the metal of the magnet core and so short. Centering, which is one of the knottiest problems concerned with the design of moving-coil loud speakers, appears to be a simple and reliable business in this particular construction. The results given by the assembled speaker are excellent.

## QUESTIONS AND ANSWERS.

### ARE RHEOSTATS NECESSARY ?

T. L. J. (Aylesbury, Bucks).—"I am getting the parts together to build a good two-valve set, and to my astonishment I find that the instructions give no sign of filament rheostats, and no provision is made for these in the wiring diagram. I have only built one set before, and this was a couple of years ago, but at the time great stress was laid upon

the necessity for adjusting the filament rheostats correctly.

"I cannot help wondering whether the new arrangement with no rheostat at all is really efficient. Do you advise me to put in my old rheostats, which are in quite good condition still?"

There is no valid reason why you should not put in your old rheostats if you particularly wish to do so, but, on the other hand, there is very little advantage in doing so, and you might, for simplicity's sake, leave them out. A few years ago valves were far more critical as to their filament requirements in the way of voltage than they are to-day, and the modern valve, especially the nominal "2-volter," is uncommonly obliging in this respect and works almost as well from a partly discharged accumulator, (say 1.8 volts), as it does when the accumulator has been newly charged and reads over 2 volts.

The fact is that the present valve is a far superior job to those in use a couple of years ago, and therefore the rheostat for the exact adjustment of the filament voltage is often hardly necessary nowadays.

### LOUD-SPEAKER ADJUSTMENTS.

D. C. (Berwick-on-Tweed).—"Having read in 'P.W.' that the output to a loud-speaker set should be through a filter unit, I made up one of these consisting of a low-frequency choke and two large fixed condensers. Just at first I was a little disappointed with this and the results obtained, because with this arrangement the clarity was excellent, but the volume did not seem to be quite so great as formerly.

"Whilst fiddling about in the hope of improving this, I discovered that my loud speaker (which is a cone) was not adjusted to its most sensitive point (near where it knocks), although it had been perfectly O.K. for this when used without the filter.

"By turning the adjusting screw at the back six or seven times, the reproduction became very much louder and, in fact, now I think that with the choke filter unit the set is much louder and purer than it ever was before.

(Continued on page 428.)



## APPARATUS TESTED

MOVING-COIL LOUD SPEAKER — PRIMARY CELLS FOR L.T.—A "MASTER THREE" COIL, Etc., Etc.

Traders and manufacturers are invited to submit wireless sets and components to the "P.W." Technical Department for test. All tests are carried out with strict impartiality in the "P.W." testing-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.

It is sensitive and will work quite well with two stages of ordinary L.F. amplification. The bass comes out roundly and cleanly and speech is crisp, and has all its original human inflection. The strings on the higher notes retain their timbre with uncanny faithfulness. We understand Mr. F. Squires supplies field windings suitable for all kinds of voltages from six volts for an accumulator drive to 240 mains. The moving coils can be obtained in either high or low resistances. In the latter case

a transformer of the order of 25 to 1 ratio is essential.

### PRIMARY CELLS FOR L.T.

Of interest more particularly to owners of smaller types of valve sets, is an L.T. battery we recently received for test. It consists of two large sac Leclanché cells contained in a neat case. It is claimed that the battery will deliver .25 ampere at 3 volts. It is as easy to recharge and

(Continued on page 432.)



# Build this two-valve amplifier with

# LISSEN parts for

# 28/6

**Y**OU can build a 2-valve amplifier—to give perfect loudspeaker results in conjunction with your present crystal or 1-valve set—at a cost of only about £1 8s. 6d. The parts required for a conventional 2-valve amplifier are as under:—

1 Lissen L.F. Transformer	- - - - -	8 6
1 Lissen R.C.C. Unit	- - - - -	4/-
1 Lissen Rheostat (7 ohms)	- - - - -	2 6
2 Lissen Valveholders at 1/- each	- - - - -	2/-
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## RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from page 426.)

"But what I cannot make out is why the loud speaker should have to be adjusted because of the choke filter. What is the cause of this?"

Before you used the choke output filter for the set you were passing a comparatively heavy current through the windings of your loud speaker. This current, passing through the coils of the loud-speaker windings, produced quite a powerful electro-magnet, which worked in conjunction with the permanent magnet inside the loud speaker.

When the two magnets were working "side by side" in this way, the adjusting screw at the back could not be tuned very far before the diaphragm commenced to rattle. When, however you changed over to the filter output circuit you relieved the loud-speaker windings of the current which they formerly carried, and this current was passed through the L.F. choke in the filter unit to the plate of the valve without traversing the windings of the loud speaker.

This is all to the good, and undoubtedly it acts as a protection to the loud-speaker windings, but, on the other hand, the magnetism, which the loud speaker formerly possessed by virtue of the current, has now been diverted and, as a result of this, the permanent magnet of the loud speaker is called upon to do more work than formerly.

For this reason it has to be placed closer to the operating mechanism than formerly, and consequently it was necessary to screw up the nut at the back of the loud speaker. Once this adjustment has been made it can be left in the new position. The permanent magnet will then be actuating the diaphragm more effectively than when it was assisted by the electro-magnetism due to the plate current of the last valve.

### JOINING CONDENSERS IN PARALLEL.

B. M. H. (Rotherham).—"If I place one .0005 mfd. condenser in parallel with another of the same capacity, do I get in effect a .001 mfd. condenser? If so, can any other condenser capacities be added in the same way?"

Yes, the total value of condensers connected in parallel is simply the sum of the respective values—i.e. .0005 mfd. plus .0005 mfd. plus .001 mfd. equals a .002 mfd. condenser, etc.

### DANIELL CELLS FOR H.T.

S. R. (Sheffield).—"Towards the end of last year you gave in the 'Correspondence' column some interesting facts from a reader who had been using Daniell cells successfully for several years to charge his H.T. He mentioned several hints about upkeep, and I should be glad if you could repeat these or tell me where I could find his letter."

The letter to which you refer was published in "P.W." No. 272, August 20th, 1927, issue. The following is a brief summary of the points recommended:

1. Use large outer jars so that plenty of copper sulphate solution is present.
2. Near the surface of the copper sulphate solution suspend cloth bags or copper cages full of the crystals to keep the solution strong.
3. Sulphuric acid is unnecessary, and uses the zinc more rapidly than the current warrants. Epsom salts (magnesium sulphate) or zinc sulphate, which is constantly produced in these cells from the erosion of the zinc, is much better. Only a weak solution is required to start the cells.
4. Do not allow either the copper foil or the zinc to touch the porous pot, as this tends to cause "globules of pure copper" to adhere to the porous pot. The zinc can be conveniently suspended from an ebonite or hardwood bar across the top of the porous pot. If these "globules" do appear, however, they can be removed with care and a strong knife. If more than a few crystals of copper sulphate are left at the bottom of the jar these also tend to cause the "globule" trouble.
5. To prevent "creeping," the cells are best kept in a cool, damp place, such as a cellar. It is extremely difficult to stop "creeping" in a warm, dry room.

### TRYING ANODE-BEND RECTIFICATION.

L. W. C. (Bourne End, Maidenhead).—"My set is a Det., 2 L.F., using a grid-leak detector and capacity-controlled reaction on the Reinartz system. As the detector is a high-impedance valve I should like to try anode-bend rectification to see whether I get improved purity at all. What modifications would be necessary in order to try this?"

We note that you are using reaction, and we would remind you that an anode-bend detector is generally not very satisfactory unless the input to the set is very strong. If you generally have to

use a little reaction in order to get good signal strength, we certainly do not think you would get improved results with anode-bend detection, as this only gives really good results when used comparatively close to the transmitting station.

If, however, you would like to try it you can short your grid condenser, remove the grid leak, and disconnect the first valve's tuning coil and condenser from L.T. Join these two instead to a black plug to be plugged into a grid-bias battery, the positive end of which is connected to the L.T. negative terminal.

### REVERSING H.T. BATTERY ELIMINATOR.

L. W. (Seven Kings, Essex).—"Some weeks ago I bought an H.T. battery eliminator for use on the D.C. mains, with which my house is fitted. Although it gives pretty good results it is not so satisfactory as another eliminator of the same make which is in use in a friend's house a few streets away. He tells me that at first his gave a little bit of humming, too, but the man who fitted it up 'reversed' it, and this cured the trouble. Unfortunately, he is not at all sure how this was done, so I should be much obliged if you could suggest a method of reversing mine so as to give as good results as his is doing now."

Probably in the unit you are using only one low-frequency choke is incorporated for smoothing purposes. The efficiency of such a single choke really depends upon whether it is connected in the positive or in the negative mains, and the reversal of a simple H.T. battery eliminator simply means that the connections are changed over so as to bring the smoothing choke in the other lead.

To do this switch off at the mains. Then take out the negative plug and place it right at the positive end of the unit tapping, leaving the positive plug about half-way along the unit. Then reverse the input leads of the eliminator (or turn the lamp holder round the other way in the lamp socket.) Then switch on and finally readjust the H.T. positive plug until the correct position is found.

### SWITCHING OFF THE 'PHONES.

T. S. (Norwich).—"When the workmen were in the house I got them to lay wires (see sketch) so that we had three different loud speakers in use, one in the dining-room, one in the drawing-room, and another pair in the kitchen. These all work excellently, but I should like some stunt whereby I could switch out any loud speaker at will, because very often one wants to listen in only in one room and not in both the other rooms, or perhaps sometimes in two of the rooms and not in the other.

I do not want to undo the wiring in any way, as it is very neatly done out of sight, but I should like some little means, preferably on the speakers themselves, by which I could put them out of action when desired."

If the loud speakers are fitted with plugs so that they can be removed from the wiring, all you need do is to purchase another plug like the ones on the ends of the loud-speaker leads, and short its two terminals together. Then, when any loud speaker is removed because it is not required, simply replace it by one of the shorting plugs which will automatically reconnect up the circuit.

If, however, the loud speaker plugs are not removable in the wiring system, but are permanently attached, all you need do is to arrange a wire to short across the end terminals of each loud speaker or telephones. In most cases this is very easily arranged, and you should not have any difficulty in arranging an easy and inexpensive "cut-out" from pieces of stiff wire.

### CURE OF NOISY RECEPTION.

"DEALER" (Wolverhampton).—"I wonder whether you can give me any help with regard to the hisses and other extraneous noises which can be heard on receivers even when electric light is not being used in the house, or when a crystal detector is being used in conjunction with an amplifier. I often get customers in trouble with hissing noises or other unwanted sounds which spoil their programmes, and

although I am often able to trace the trouble to a faulty soldered joint or something of that kind, I should also like to know in a general sense a little about faults of this kind in the various forms of amplifiers."

It is rather difficult to lay down a law regarding the causes of noises of this description, as much will depend upon the type of amplifier in use and also upon the type of noise which is heard on it. The following brief notes upon the different types of amplifiers may, however, assist you in tracking troubles of this nature.

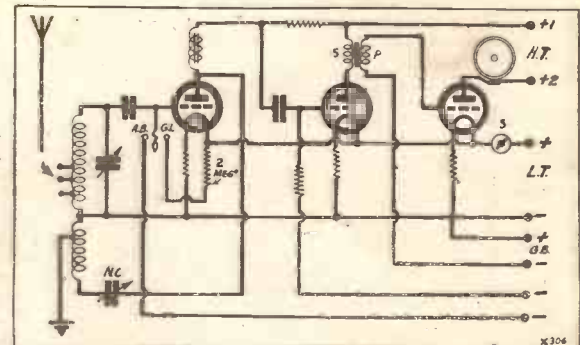
1. *Transformer-coupled amplifiers.*—The transformer itself is often the cause of noises in this class of amplifier. If one of the windings develops a break in continuity, signals will become very weak or perhaps disappear altogether, and there is also an almost constant frying sizzling sound, generally weak, with short bursts of the programme coming through at reduced strength. (See also 3.)

2. *Resistance-capacity-coupled amplifiers.* Any defect in the anode resistance in an amplifier of this type will result in voltage variations causing irregular amplification. The coupling condenser in this class of amplifier must be above suspicion, for if it happens to be leaky the plate potential of the preceding valve is partially applied to the grid of the following valve, and may stop signals altogether, or may cause unexpected fluctuations and noises. Furthermore, defects in a grid leak will also cause noises in this class of amplifier.

3. *Low-frequency choke amplifier.* Faults in choke amplifiers may resemble either those of (1) or (2) given above, as the circuit conditions partly resemble those for both the other classes of amplification. The following defects will also affect all three types of amplifiers.

(a) Variations in the filament current supply due to imperfect connection, such as a loose connecting bar on the accumulator (this, of course, results in variation of the filament emission, causing current to rise and fall).

### WHAT IS WRONG?



The above diagram is supposed to represent the connections of a Det. and 2 L.F. receiver, with alternative anode-bend or grid-leak rectification. But it is wrong and would not work properly.

Next week the correct diagram will be given, and to test your skill we shall continue to publish from time to time a diagram in which a mistake (or mistakes) has been inserted. The correction will be published the following week.

No prizes are offered, but by following this series and trying to solve the problems, the reader cannot fail to learn a lot about radio circuits.

- (b) Imperfect contact in the H.T. battery circuit.  
(c) Imperfect contact in the grid bias battery circuit.

Note.—Either of these latter may arise within the battery itself, as well as in the external leads from them.

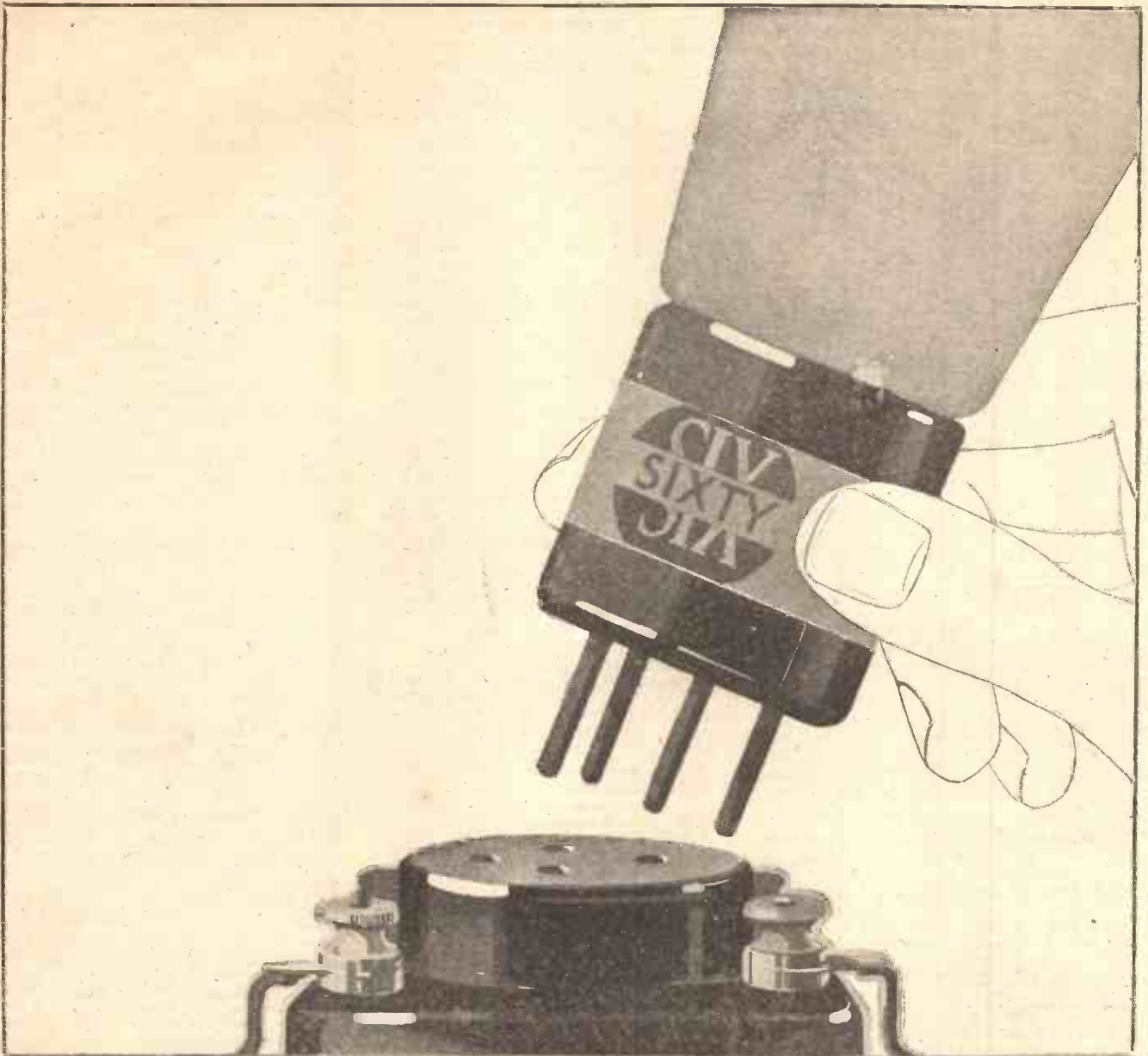
### NO REACTION WITH A REINARTZ SET.

W. P. (Clacton-on-Sea).—"The set is a one-valver, built exactly according to the diagram, which I am enclosing. But, although I can pick up London with it, it is really very unsatisfactory because it is really not at all strong, and I cannot get any reaction at all. As you will see, I cannot reverse the coils for reaction, because instead of a coil it is using a condenser for reaction. I have tried reversing the leads to this condenser, but still no effect—I cannot get reaction. What is wrong?"

We are afraid that you are wrong in thinking that because the set has condenser-controlled reaction you cannot reverse the coil, and thus obtain a reverse.

(Continued on page 430.)



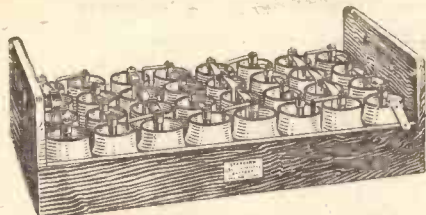


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# RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from page 428.)

in the reaction connections. If you will look at the diagram (see marking on the sketch which we are returning) you will notice that connected to the reaction condenser is a reaction coil, the two end connections of which you can reverse.

This coil is the reaction coil, just in the same way that the old moving reaction coil used to be called the reaction coil: but in a set of the "Reinartz" type, such as this one you are using, the current through this coil is not necessarily flowing all the time that the valve is alight, but is a high-frequency current, the amount of which is controlled according to the setting of the reaction condenser.

At present you are running the current through the coil in the wrong direction, and when the two ends of the coil are changed over this will be remedied, and you should begin to get reaction effects. We notice, however, that the value of your reaction condenser is only .0001 mfd. This is rather small in conjunction with the number of turns of reaction winding that you are using.

If, therefore, reaction is not sufficiently strong even when the connections are altered, try the effect of putting a few more turns on the reaction coil. (This can be done quite easily, being careful to keep the direction of the winding in correct relation to the aerial coil.)

When you have added a few turns, try connecting up again, and if reaction is too strong you can easily take off one or two of the turns until the correct number has been ascertained.

The reversal of the connections to the reaction condenser would make no difference at all to the

## "P.W." TECHNICAL QUERY DEPARTMENT

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reaction effect, but the connections to the coil are of the greatest importance, and it is essential, whether the set has Reinartz or swinging-coil type of reaction, to get the correct relation between these connections and those of the aerial coil.

## TRYING CHOKE-COUPLED L.F. AMPLIFICATION.

B. J. (Bromley, Kent).—"As you will see from the accompanying sketch, my set is a Det., L.F., using an L.F. transformer for coupling the two stages together. Recently I had a large L.F. choke given to me, and I should like to try this form of coupling if it can be done fairly easily without much alteration to the set. I understand that the only new parts required are a coupling condenser and grid leak, and these I have, providing that an ordinary grid leak is O.K., and a .1 mfd. coupling condenser. What would be alterations required?"

The alterations are very easy to carry out, and can be done as follows. Disconnect all the connections to the L.F. transformer and remove this from the set. Now connect the L.F. choke across the two wires which previously went to the primary of the transformer—that is to say, connect one end of the

choke to H.T. positive, and the other end to the reaction coil.

The second step is to join the grid leak to the two wires which previously went to the secondary of the low-frequency transformer. That is to say, connect the grid of the valve to one end of the grid leak and the other end to the grid-bias negative plug.

All that now remains is to put in the coupling condenser, and one side of this is connected to that end of the choke which is nearest to the plate of the valve, i.e. that end which is now joined to the reaction coil; the other end of the coupling condenser being joined to the grid of the second valve at any point on the lead from the valveholder to the grid leak.

The value of the coupling condenser you have on hand is quite suitable, so we think that with this arrangement you should get good results.

## BACK NUMBERS OF "P.W."

J. E. (Nottingham).—"As I find a difficulty in getting them through my booksellers can you tell me where I can purchase back numbers of POPULAR WIRELESS? (And, by the way, should my query be addressed to Fleetway House, Farringdon Street, or to Tallis House, Tallis Street, London, E.C.4., as I note both these addresses are appearing in POPULAR WIRELESS?)"

Back numbers of POPULAR WIRELESS are obtainable at the Back No. Dept., The Amalgamated Press, Ltd., Bear Alley, Farringdon Street, London, E.C.4., price 4d. each post free. As stated in "P.W." all Editorial communications should be addressed to the new offices at Tallis House, Tallis Street, London, E.C.4., but it is important to note that technical queries are not to be sent to this address, but to The Fleetway House, as previously.

## WHAT KIND OF DETECTOR ?

F. G. S. (Southampton).—"I have decided upon building a detector and low-frequency two-valver, and I cannot make up my mind as to what kind of detector to use. Do you recommend the grid leak and condenser, with the end of the grid leak going to L.T. positive, or do you think anode bend is better?"

Theoretically, anode bend is better, but there are certain circumstances in which we prefer the grid leak and condenser method. The only cases where full advantage can be taken of theoretically-perfect anode-bend detection is where the input to the set is very strong, and there is no necessity to use reaction.

In other words, anode-bend detection is extremely good when you are going to use it for listening at a comparatively short distance and to one station. It is not good for long-distance work where reaction is required, or for sets not situated within a few miles of the local station.

For average conditions, where long-distance reception is occasionally indulged in, and where the input of the set from the local station is not particularly powerful, the grid-leak method makes a better form of detector. Comparatively, its sensitivity is enormous, and the amount of distortion introduced is really negligible unless an extraordinarily good loud speaker, such as one of the Ricc-Kellogg moving-coil type, is used. (For ordinary purposes, and with ordinary loud speakers, the amount of distortion introduced by this form of detection is not appreciable.)

## OVERLOADING THE VALVE

L. F. M. (Wandsworth, London, S.W.) "The set is a detector and two low frequencies, and when I use it at my home, which is near Epsom, results are simply perfect on the loud speaker. There is absolutely no trace of distortion.

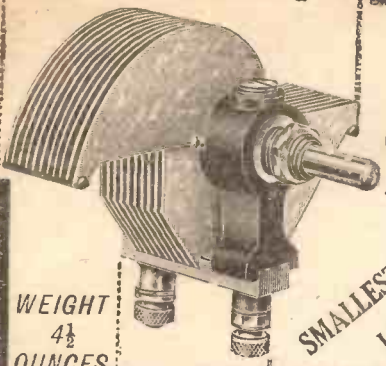
"But what puzzles me is that, whenever I bring it to Wandsworth, where my parents' home is, and connect it up (on a very similar aerial), it always distorts on certain notes. As I have a motor-cycle combination for carrying them I use the same batteries and accumulator, etc., so I cannot make out why it should behave so perfect at Epsom, and yet I always get this unaccountable distortion when I connect it up at Wandsworth. What is the cause of this?"

By bringing the set into Wandsworth, which is comparatively close to L.O. you are, in effect, increasing the input to the set, from 2 L.O.'s aerial. And, undoubtedly, you are increasing it to such a degree that overloading takes place at the shorter distance, though this is not occurring when the set is installed at Epsom.

Probably the overloading is taking place on the last valve, so though a power-valve can be used in this position when the set is "at home," a super-power valve, with more G.B. and H.T., will be necessary to handle its larger output when it is moved to Wandsworth.



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## APPARATUS TESTED.

(Continued from page 426.)

maintain as the wet H.T. battery which has of late become so popular. Some little time may elapse before we can issue a full report concerning this new battery, as we have placed it on a long and extended test under the conditions it is likely to meet with in the hands of the average listener.

### "POPULAR GUIDE TO RADIO."

This useful and comprehensive book has just been published in this country by Bailliere, Tindall and Cox, of Covent Garden, London, at 16s. net. It is by B. Francis Dashiell, and although the technical phraseology naturally conforms with American practice, the book is, with its 101 illustrations, an excellent production.

### DUCO MASTER BATTERY SWITCH.

Messrs. Brown Bros., of Great Eastern Street, London, E.C.2, recently sent us a sample of their Duco master battery switch. It is of the push-pull variety and is designed for single-hole panel mounting. It appears to be a well designed and made component, and has two conveniently placed terminals. It has a positive action which will appeal to the listener. A definite click accompanies the action of switching on. The contact is good and of a self-cleaning nature.

### A "MASTER THREE" COIL.

Automobile Accessories (Bristol), Ltd., of 17, Redcliffe Street, Bristol, have produced a short-wave coil suitable for insertion in the "Mullard Master Three" receiver. This set is very suitable for the easy, stable reception of short waves. The only additional accessory required is a short-wave coil unit which should replace that used for the reception of the ordinary broadcasters. There are, of course, H.F. chokes which will not allow a set to go down to the short waves, and if the constructor has one such in his Mullard Master Three, it will be necessary for him to replace it if he desires to tune in 3 LO and such stations.

We tried the P. D. Short-Wave Coil, as it is called, in a normal Master Three assembly, and we found no difficulty in tuning down to about 20 metres. As we have already said, the Master Three makes a good short-waver and is noticeably free from hand-capacity effects, mainly through the employment of an earthed metal panel. Using the P.D. coil, several American short-wave broadcasters were tuned in during the interval of test. 3 LO was heard, but not well, because conditions were bad at the time. The P.D. coil retails at 7s. 6d.

### THE "SOVEREIGN" H.F. CHOKE.

We recently received for test a "Sovereign" H.F. choke from Messrs. J. R. Wireless Co., of Rosebery Avenue, London. In appearance it is a small black cylinder fixed to a circular insulating base upon which are two terminals. It is not the most compact choke we have seen, although it is nearly so. Undoubtedly it is a good choke, and we found it satisfactory on all wave-lengths. It was contributive to a smooth reaction control and effective operation of a Det. L.F. Reinartz set in which it was incorporated.

## NEWS FROM SAVOY HILL

(Continued from page 422.)

Lord Mayor of Cardiff is also chairman of the National Orchestra of Wales. It is reported that the Lord Mayor wrote to the chairman (that is to himself) telling him that a certain "date" for the orchestra to play in the City Hall was cancelled. In view of the fact that all arrangements had been announced, there was a tremendous "shindy," with much recrimination exchanged.

The B.B.C. wisely held their hand until the smoke had cleared away. It is believed that the scheme of the National Orchestra, thus proving unworkable, will be washed out, and the Welsh left to their own devices after the present season. This will entail another big row with the Welsh; but it is at least doubtful whether the B.B.C. should ever lend itself to supporting local organisation such as the National Orchestra of Wales. Licence money is for broadcast material, and not for artistic philanthropy.

### Double Broadcast Tattoos.

Last year, when the negotiations between the B.B.C. and the Aldershot Command failed to produce any agreement of terms for broadcasting the Searchlight Tattoo from Aldershot, a substitute was found later in the summer by giving the Southern Command Tattoo from Tidworth. This year listeners will hear both events.

The Aldershot Tattoo broadcast takes place on Tuesday, June 19th, when between 9.40 and 10 o'clock and 10.57 and 11.30, music by massed bands, the Highland pipers and bugle bands, will fill the ether as the troops carry out their evolutions, which will include a representation of an assembly of all the implements of modern warfare marching to the front through the ruins of the old Menin Gate.

A stirring spectacle for those who can witness it and a stimulating broadcast for the many others who will hear it. The Southern Command Tattoo, Tidworth, does not take place until some weeks later, and details of it will be given in due course.

### Underworld by Radio.

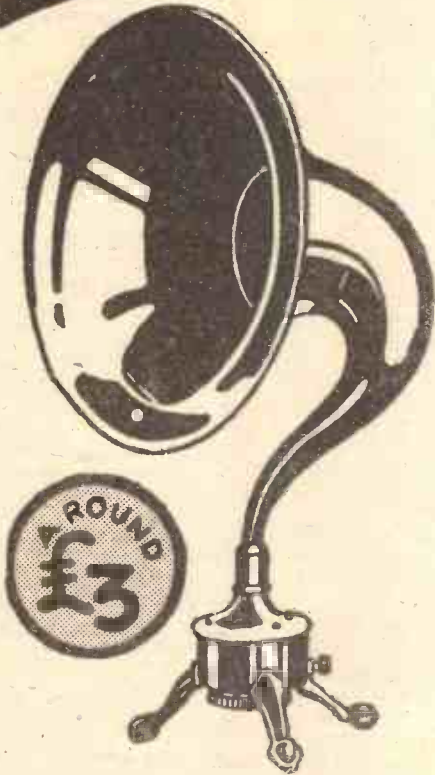
Recent events in the underworld have been responsible for quite a lot of people fancying their chances to distinguish themselves as investigators in those baffling problems of crime such as confront the police. All amateur detectives will have an opportunity of putting their skill to the test on Tuesday, May 29th, when a mystery play called "The Survivor," by Mabel Constanduros and Michael Hogan, will be performed in the London Studio. Two people die in a cave, and the vital point at issue is which one died first. There will be an interlude of five minutes between the second and third acts in order that listeners can discuss the situation and solve the question for themselves. Sherlock Holmes will have a busy time in a million homes that evening.

### An Interesting Event.

The Metropolitan Works Band, which, besides having a well-deserved reputation in the Midlands, holds the distinction of having won national honours at the Crystal Palace, is giving the afternoon programme from 5 G B on Sunday, May 27th. Their performance should be interesting.



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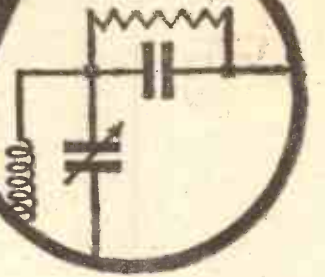
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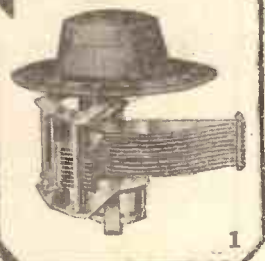
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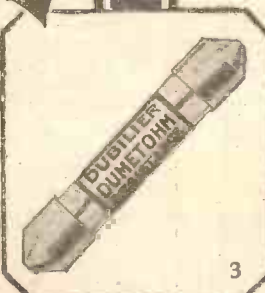
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TECHNICAL NOTES.

(Continued from page 422.)

tions in different types of loud-speaker unit the constructor may have to make his own particular arrangements for supporting the loud-speaker unit. The driving-pin is then secured to the centre of the aeroplane-cloth diaphragm by means of washers; these latter should be of light-gauge metal, but of a fairly large area, say not less than 3/4-in. diameter.

According to my correspondent, this type of speaker is giving excellent results and, in addition to being very popular amongst constructors, is also on sale in many of the stores, both in parts for assembly and in the completed form.

Single-Wave or Double?

I have had several enquiries lately from readers with regard to the question of single-wave and double-wave rectification, and particularly as to whether there is any advantage in double-wave rectification over the other. Sometimes a reader will say that in-so-far as double-wave rectification "uses both halves of the wave" it must necessarily "give twice as much power" as single-wave rectification.

This, of course, is entirely wrong, and is about equivalent to saying that a motor-car with a 30-horse-power engine must necessarily "go twice as fast" as one with a 15-horse-power engine! The fact is that both cases depend entirely upon the way in which the device—rectifier or the motor-car, as the case may be—is employed.

Suppose a rectifier is used in conjunction with the secondary of a step-down transformer, giving an output, on load, of 12 volts, and suppose in these circumstances the rectifier with single-wave rectification delivers a rectified current of 1 ampere. If the other half of the wave were used it also would give a current of about 1 ampere, so that the total current would be about 2 amperes. On the other hand, if it is one ampere that you want and you decide to use double-wave rectification you have to lower your voltage until the single-wave rectifier is only giving 1/2 ampere, and then with the double-wave you obtain another 1/2 ampere, which makes up the 1 ampere required.

No Loss.

In other words, you can take it that for practical purposes single-wave rectification will do everything that is ordinarily required, and it is much simpler and also less expensive in apparatus than double-wave rectification. The point I want to bring out is that the idea that single-wave rectification must necessarily result in the "loss" of half the power which would otherwise be gained is entirely erroneous. One ampere from a single-wave rectifier is just as much 1 ampere of current as it would be if it consisted of two half-amperes alternately derived from a 1-ampere double-wave rectifier.

A Super-Power "Tube."

The latest power-valve introduced on the U.S. market is the UX 250, which is designed as a power amplifier to supply large amounts of undistorted power for the operation of loud speakers. The use of this type of valve prevents any possibility of

(Continued on page 436.)

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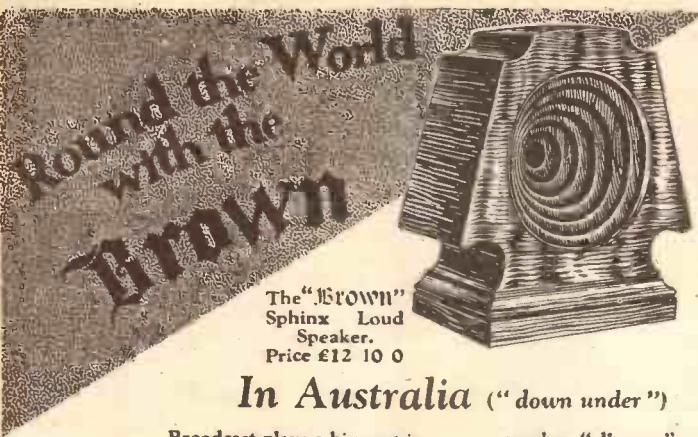
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- THE "ALL-WAVE" ONE, ETC., ETC.

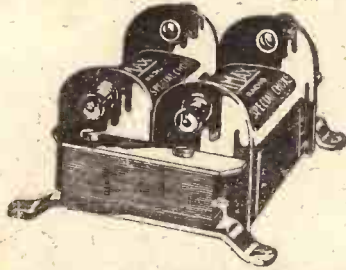
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**TECHNICAL NOTES.**

(Continued from page 434.)

overloading the last stage of an audio amplifier.

The filament rating is 7.5 volts 1.25 amperes. The "filament" is the rugged coated-ribbon form, similar to that used in certain other types of American valve, and operates at a dull-red heat. The filament current may be supplied from the 7½-volt winding of a power transformer. The low operating temperature and the increased size of this type of filament result in minimum voltage ripple or "hum."

**High-Plate Current.**

The plate current is 55 milliamperes at a plate-voltage of 400 volts, and the grid has a negative bias of 70 volts. In the corresponding valve UX 210 (previously introduced) the grid bias is negative 3½ volts, the plate-current being 18 milliamps at 400 volts.

Owing to the much higher plate-current and to the fact that the grid bias required by this new valve is practically double of that in the previous UX 210, constructors find that it is not always possible to replace the latter valve with the new one without certain changes in the circuit. Some interesting details of the specification of this valve are as follows: Plate voltage 250-400 with a maximum of 450; negative grid bias 45 to 70, maximum 84; plate-current 28 to a maximum of 55 milliamps; mutual conductance 1,800 to 2,100 micromhos; voltage amplification factor 3.8; undistorted power-output 900 to a maximum of 4,500 milliwatts; overall height of valve 6¼ in., diameter 2½ in.

**Obtaining Grid Bias.**

I have mentioned once or twice previously in these Notes the importance of using the correct grid bias, especially in the last stage or stages of the L.F. amplifier, where its influence, not only upon the quality of the reproduction, but also upon the power consumption from the H.T. battery, is very pronounced.

Large grid-bias voltages must, of course, be obtained either from separate G.B. batteries or from tapings on the H.T. battery (in which term I include any alternative source of H.T. supply).

Small values of grid bias are often obtained from the filament battery, and although the various ways of obtaining these small values of bias are very simple they are not always clearly understood, especially by beginners, as I frequently find from inquiries which reach me from time to time.

The bias voltage on the grid of a valve may be specified with respect to the negative end of the filament. If the grid is connected directly to the negative end of the filament, the grid bias is zero. If, on the other hand, a filament resistance be introduced in the negative filament lead and the grid be connected direct to the negative terminal of the L.T. battery, then it is obvious that since there is a negative drop of potential in the rheostat, the actual negative end of the filament is at a higher potential than the negative battery terminal; or, in other words, the negative battery terminal is at a lower potential than the negative end of the filament.

**Bias Due-to-Rheostat.**

Since the grid in this case is connected to the negative battery terminal, it is at a lower potential than the negative end of the filament; or, in ordinary terms, there is a negative bias, and the amount of this bias is equal to the voltage drop in the filament rheostat.

If a grid-bias battery be introduced between the grid and the negative filament, the grid being connected to the negative terminal of the grid-bias battery and the positive terminal of the grid-bias battery being connected to the negative terminal of the filament battery, then the grid has a negative bias equal to the voltage of the grid-bias battery.

If, in addition to this, the filament rheostat is introduced in the negative lead to the filament, the grid has an additional negative bias equal to the voltage drop through the filament rheostat. To take a case in point, if the voltage drop in the filament rheostat in the negative filament lead is 1½ volts, and

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The MAY "M.W." is on sale everywhere price 1/-, and a 1/- blue-print is being presented free with it.

there is also a 4½-volt grid-bias battery properly connected to the grid, the total negative bias applied to the grid is 6 volts.

**Use of Potentiometer.**

If the grid be connected to the positive terminal of the low-tension battery, and assuming that the filament rheostat is in the positive lead, then the grid has a positive bias of 6 volts (assuming a 6-volt low-tension battery be used). Again, if the grid be connected to the positive low-tension battery terminal, but the filament rheostat is in the negative lead, the negative bias applied to the grid will be equal to the low-tension battery voltage minus the voltage-drop across the filament rheostat.

A simple way in which grid bias may be obtained is to connect a fairly-high-resistance potentiometer across the low-tension battery and to connect the slider of the potentiometer direct to the grid. Since the actual grid current is negligible, it does not materially upset the drop of potential along the potentiometer.

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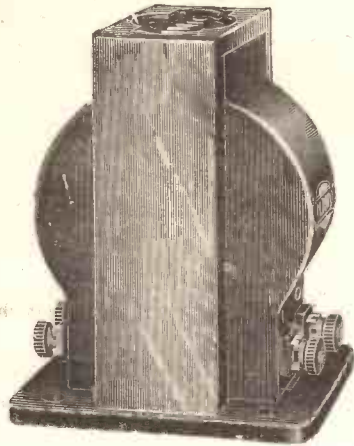
Milliammeter, 0-38 Milliamps. Voltmeter, 0-6 and 0-120 Volts. Think of the advantage of this instrument. You can test your receiver for distortion. Find H.T. consumption. Test voltage of H.T. and L.T. Batteries. Accurate. Dependable. High Resistance.  
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It has a very compact form of the famous honeycomb winding, giving it a very low self-capacity and high inductance together with a negligible external field. Effective on all wavelengths up to 3,000 metres.



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