POPULAR WIRELESS, October 19th, 1929. 1929 REGISTERED AT THE G.P.O. AS A NEWSPAPER.

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No. 385. Vol. XVI. INCORPORATING "WIRELESS" October 19th, 1929.

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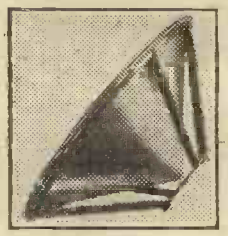

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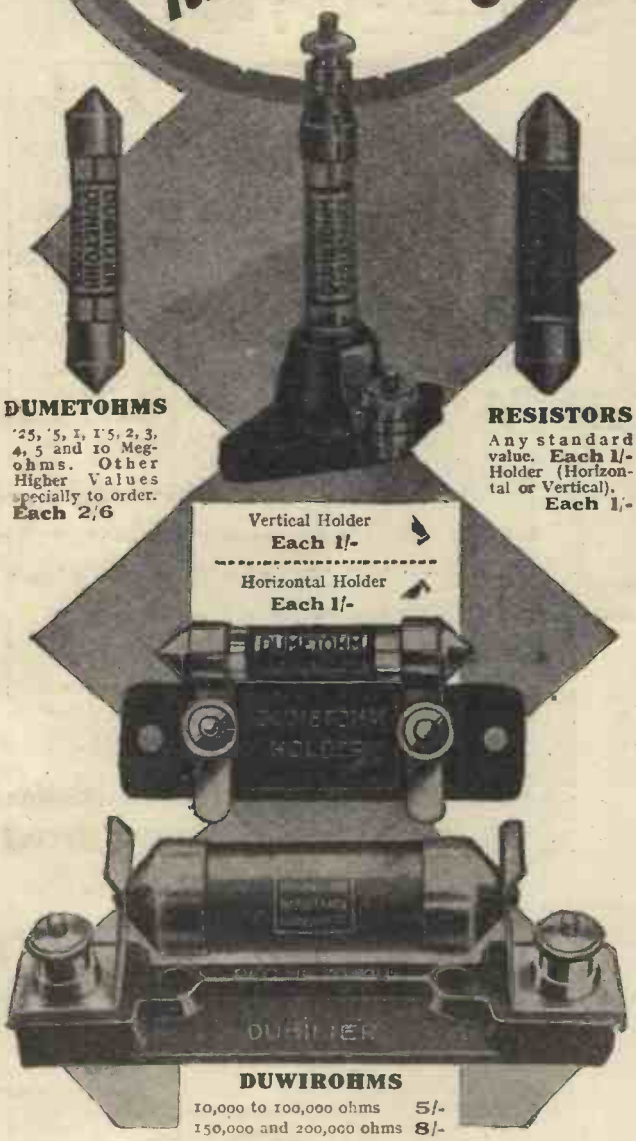

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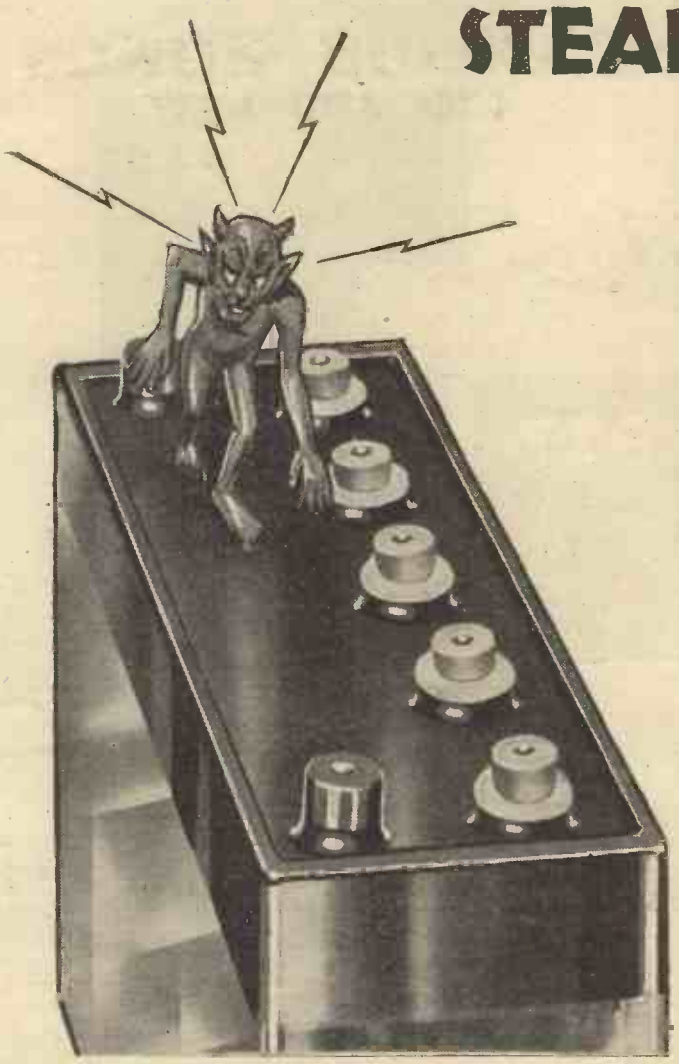

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Popular Wireless

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P. R. BIRD, G. P. KENDALL, B.Sc.,
A. JOHNSON RANDALL.

A NEW APPOINTMENT.
ARIEL'S LIBEL ACTION.
RADIO SOCIETY NOTE.
INSTITUTE OF PATENTEES.

AN INDIAN ENTERPRISE.
THE HEART OF P C J.
ROUND THE WORLD.
YOUR OLD LICENCES.

RADIO NOTES & NEWS

Relaying the Schneider.

THAT photograph of the Schneider Trophy Relay on page 136 of our September 28th issue, was not "part of the apparatus used by the B.B.C.," as stated.

As a matter of fact what it depicted was the Marconiphone installation fitted on Ryde Pier Hotel to broadcast the commentary to the spectators of the great thrill.

The Value of Dampness.

ALL through the long drought I neglected my "earth." Never gave it a passing thought. And almost imperceptibly my set's performance waned in strength from week to week, until I suspected the valves, the battery, the B.B.C., even my own ears. Then came a real soaking rain, and lo, the set became alive and zippy again as though by magic. I have a theory that the rain also washed out all the bad connections of my aerial and lead-in, which of course disobey all the rules in the book.

National Institute for the Blind.

I ALWAYS read the annual report of this Institute with interest and admiration. That for the year ending March 3rd, 1929, states that since Braille was invented no special apparatus has more influenced the destinies of the blind than the wireless set, and that the Institute has hundreds of requests for sets which cannot be supplied, although during the year it spent £819 on radio equipment. If you are going to make a new set, or treat yourself to a new "shop" set, why not send the old one to the Institute, and transform someone's life, maybe. Address, Great Portland Street, London, W.1.

A New Appointment.

IN succession to the late Mr. E. R. Tuck, the Association of Wireless and Cable Operators have appointed Mr. T. J. O'Donnell as their General Secretary. No doubt Mr. O'Donnell has a sort of "divine right" to the job, as he has taken a very prominent and useful part in the Association's affairs for many years, and has been secretary of the Marine Section since 1920. We wish him luck—lots of it, for there is stormy weather ahead.

New B.B.C. Station.

THE new B.B.C. receiving station, the successor of Keston, situated at Tatsfield, in Surrey, 900 feet above sea-level, is now hard at work, checking the wave-lengths of British and foreign stations. There are ten receivers, five being for short waves, and by their means watch is kept on the frequencies, so that if any deviate from the narrow path the offending station can be warned at once. This station is also continuing to pay attention to the relaying of broadcast programmes from other countries.

"Ariel's" Libel Action.

I GET no peace, what with septic programmes and sceptic readers. And I did think that the technical hounds had bitten the sceptics into a better, non-Thomas frame of mind. But on page 154 of "P.W." for September 28th, Mr. Gladstone bursts upon an amazed world with a list, to wit, two, of his fears, namely (1) That I publish a lot of fairy stories, and (2) that I do so in order to fill up space. Oh, naughty G.O.M.!

Fairy Tales and Space.

I PLEAD guilty to filling up space. It's what they give me the ink for, and the space. As to fairy tales—well, those which pass my examination and are published in good faith are a mere drop in the ocean of those I reject with a sigh for the lively imagination of the inexperienced dial-twiddler. Let the G.O.M. tremble—that'll be Fear No. 3—for the wrath to come from the noble army of Valve Barts. upon whose honourable titles he has cast such suspish.

The "Kuttemout."

WITH apologies to the G.O.M., I should like to precis a letter from G. E. A. C. (Canonbury Park, N.), who has tried our "Kuttemout" circuit. "Very selective and powerful," he says. He gets

(*Continued on next page.*)

LONGSTONE LIGHT-KEEPERS LISTEN-IN.

The Longstone lighthouse, where Grace Darling lived, on the outer Farne Islands, in the North Sea. The three light-keepers have recently erected an aerial to enable them to listen to the outside world.

NOTES AND NEWS.

(*Continued from previous page.*)

2 L O on a 120-degrees reading and 5 G B on 155 degrees. At 140 degrees there is no trace of 2 L O, and between these two extreme readings he gets "at good strength" Toulouse, Katowice, Rome, Lyon (La Doua) and Langenberg. Further, with this set Turin is picked up at good L.S. strength. Nurnberg, always very good. "These are only a few. Others too numerous to mention roll in after London has finished."

The "Fetchemin."

SO that's that. Thanks, G. E. A. C., for your pretty fairy tale, and good luck to your dial fingers. V. D. (Hammersmith) also is smitten with the charms of "Kuttemout," the circuit that makes young men dream dreams and hear "the horns of Elfland faintly blowing," eh, G.O.M. ? "Though I have made hundreds of sets, I do not want any more." Good-enoughski, as Mr. Henderson would say. By the way, V. D., your constructive criticism, always welcome, has been noted by the Editor.

Radio Society Note.

MR. C. H. PIPER, 77, Torridge Road, Thornton Heath, informs me, with justifiable pride, that the Thornton Heath Radio Society, of which he is the Hon. Sec., has met every Tuesday, summer and winter, since it was formed seven years ago. Such enthusiasm almost deserves to be aspirated. No, this libel action has upset me! I see that it is not the Sec. who tells me this, but J. P. F. Sorry, dear old J. P. for Thornton Heath! Meetings at St. Paul's Hall, Norfolk Road. Roll up, Heathers!

A "Blind" Airplane Pilot.

A REPORT from America says that Lieut. J. Dolittle, enclosed in a light-proof cockpit, took off and landed safely a few yards from where he started, doing all his navigation with the aid of lighted instruments on the dashboard. Instruments showed him his position with relation to the ground, and a wireless beam gave him his course. This claim has to be substantiated, of course, but evidently we have here the foreshadow of a new era in aviation and radio. There is yet hope for the Southern Railway on foggy days!

The Arbiter.

SPEAKING at a conference of adult educationists, Sir J. Reith said, of the B.B.C., that an arbitrary decision to do what they believe to be right has proved to be the best way to deal with the situation. So there we have the truth, packed small. The B.B.C. has decided to please itself and to follow some ideal of its own devising. Well, I wouldn't object to that if the devising were done by a different set of specialists. In my sober opinion there are too many highbrow theorists helping to plan the programmes.

Byrd Blows Another Horn.

THE Byrd Antarctic Expedition is certainly proving to be its own publicity agent. Manager: Commander Byrd. The latest performance is reported to be the blowing of a motor-car horn in Los Angeles (Cal.) by means of a radio impulse sent from Byrd's camp. The same impulse drew curtains from an enlarged picture of Byrd at the National Radio Exposition in Los Angeles. I will do the explorer the credit of being ignorant of this last-mentioned feat, for I don't care for the flavour of it at all.

Institute of Patentees.

WE bid welcome to a little stranger in the land of ink, namely, Number One of "The Inventor," the official organ of the Institute of Patentees. It is a most interesting production and one calculated to arouse or sustain the divine fire in the bosoms of men who invent things. There is a whole page full of "What's wanted in Radio" which ought to make the heads of some of you ingenious ones reel with ideas. Here's luck to the organ.

An Indian Enterprise.

BEFORE leaving the subject of literature, I should like to say a kindly word to "The Indian Wireless Magazine," now about two months old. In launching this enterprise someone has made a plucky attempt to focus the amateur radio movement in India under what are none too brilliant stars. We cannot but wish it well, though the statement that it is "the only amateur radio journal in India" is not correct, for "P.W." has been there for years. One anna a fortnight, and half of it printed in the vernacular. By the way, No. 1, Vol. 1, of "West Australian Wireless News and Musical World" has appeared. Salute, friend!

SHORT WAVES.

The wife of a B.B.C. lecturer says she can never recognise her husband's voice when he is broadcasting. Perhaps because it is not he who does the lecturing at home.—"The Star."

* * *

"The British Boredcasting Company" is what they call it now.—"The People."

* * *

A correspondent in the "Sunday Mercury" writes:

"There was (at the Radio Exhibition) a handsome mahogany cabinet set which can be converted into a double bed, or a roll-top desk, or a household ladder, simply by pressing a button; and all the time it goes on rendering programmes as long as there are programmes to render. A great boon to the busy."

The only drawback is there doesn't seem to be a way of turning it off.

* * *

A musician played the piano part in a concerto for violin and piano at Savoy Hill the other day for broadcast purposes. A Scot, seeing his name advertised, called to know what time he would be playing.

"But I thought you refused to have a wireless set in your house?" the musician exclaimed.

"Certainly," said the Scot; "but there's a shop I pass almost every day that sells them. I'll pop in just before you come on, ask to see a set, and get the shopman to try it out. So I'll be able to hear you just the same."—"Evening News."

* * *

"It is quite a mistake to suppose it needs a stout wire always to carry a high voltage," we read in some recent wireless notes.

But it needs a stout heart to listen to some of the programmes.

* * *

FROM BAD TO NO BETTER.

Wife: "Did you find out if there was anything wrong with your wireless set when you had it to pieces?"

Husband: "Yes. And now I'm trying to find out if there's anything right with it since I've put it together again."

Snobbery à la Mode.

I OBSERVE that a writer of a letter to a newspaper, complaining of the disturbance caused by loud speakers, refers to the loud speaker as a modern form of aspidistra. Now, although one can sympathise with the complainant in the matter of the over-generous use which some proud listeners make of their L.F. outputs, one is somewhat tired of covert sneers at the fashion of wearing aspidistras in the front parlour window. Aspies are very handsome, pleasant plants and a great advance on china dogs and waxen fruit. Anyhow, a parlour is obviously the place for a *haut parleur*. (French for loud speaker—Editor).

Wireless Society Note.

I HAVE received the 1929-30 Syllabus of the Edinburgh and District Radio Society, and note that its high standard is maintained. It includes an auction sale and two query nights. Hon. Sec., Mr. E. L. Robertson, 10, Richmond Terrace, Edinburgh. Meetings are held at 16, Royal Terrace every Wednesday at 8:0. p.m. The list of periodicals available in its Library is interesting, but I hope that "P.W." will qualify for a place there one of these days.

The Heart of P C J.

SOUNDS like the title of a best-seller, doesn't it? But I refer to actual studio and allied establishments from which P C J's programmes are operated. Someone who paid them a visit tells me that the place is an eye-opener. The announcer is a polylinguist, and knows the tastes and foibles of the numerous folk of the many nations to whom he speaks.

In addition to keeping the show merry and bright, he has to record the exact times of the announcements and titles of all music played in order to check reception reports.

Round the World in a Night.

BY means of a colossal collection of records, the station is able to broadcast the music of many nations. From 6 to 8 G.M.T. you may hear the European transmissions. At 10 p.m. begins the overseas tour, and from then onwards till dawn the broadcasting is directed to more and more distant countries, till even the remoter South American Republics have their share. For the amplitude of its appeal I should say that P C J is the most wonderful station in the world. A special article by the Editor on Short-wave broadcasters appears on another page in this issue.

Keep Your Old Licences.

THE persecution of the Bushey Heath lady by the Post Office because, although she had a licence she could not produce the one previously issued—she was fined 2s., by the way—furnishes a useful warning to those of us who may not be in the habit of storing up waste-paper. I have only the Press reports to judge by, but, prima facie, it does seem too bad to drag a person into court because she could not prove to the Post Office what the Post Office itself ought to be able to establish. Why did they not examine their records to verify the truth of her statement? And what is the use of a licence if of itself it cannot protect the holder?

ARIEL.

SELECTIVITY and the REGIONAL SCHEME

BY

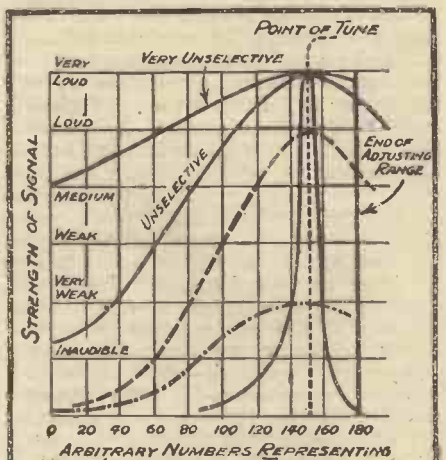
CAPT. P. P. ECKERSLEY

M.I.E.E

The new Regional Scheme "does not involve any scrapping of sets; it may involve modification or additions." Our Chief Radio Consultant here concludes his discussion on the "problems" that have arisen and will arise among listeners owing to the opening of Brookman's Park.

IN a previous article I showed that common experience teaches us that by adjusting the electrical constants of a set we are able to find a unique adjustment which gives us the loudest signal. In Fig. 1 of that article I showed how we could express this in graph form and plotted a resonance curve.

I ended the article by recording a well-known fact that some sets require but a fractional movement of their tuning adjustments to bring in or cut out a station, whereas others, whatever was done to the adjustment, never achieved complete silence even though the signal went louder and weaker. This, too, is easily explained in graph form. Thus, refer to Fig. 1 (above), where two types of resonance curve are shown.



Resonance curves of "very unselective" "unselective," and "selective" sets. With the former loud signals cannot be tuned out. Reducing the aerial size, and so the loudness at the "point of tune" makes the "very unselective" and the "unselective" sets O.K., though some signal strength is sacrificed at the "point of tune."

Selective and Unselective Sets.

For the sake of simplicity I have drawn instead of numbers representing the current in the aerial, lines to represent very loud, loud, medium, weak, very weak and inaudible. See immediately how the sharp resonance curve reduces the signal to inaudibility with a much smaller change in the constants of the receiver aerial circuit, while a larger range than available of adjustment is needed for the very unselective set before we can reduce the incoming signal to inaudibility.

In the case shown (full lines) the two unselective sets cannot tune out the signal at all. Now, however, we arrive at our first generalisation. With a crystal set, unless we add coupled circuits and increase our difficulties of adjustment by confronting the user with two-handled control, the resonance curve is apt to be flat, i.e. like the unselective curves. By analogy the crystal wears the crinoline skirt of simplicity instead of the revealing narrowness of the select.

But the edges of the skirt *must* sink below the inaudibility line and fashion still decrees, for crystal sets, the wide and ample spread. There is only one solution and that is to reduce the intensity at the point of tune from very loud to medium or loud, or weak (depending upon the initial shape of the curve) and at once the required selectivity is achieved.

This is a very important point and is the reason for the advice to certain people who want to know how to make their crystal sets selective, which is *to reduce the size of the aerial*. This means moving the whole curve downwards so that the edge of the skirt comes below the audibility line. This applies in a great many cases.

When the Dual Wave Starts.

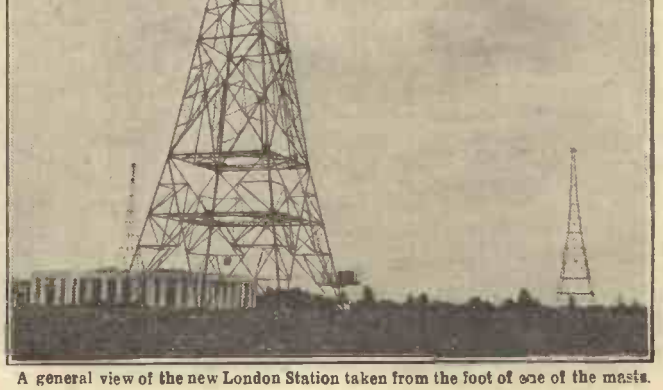
All those sets, valves or crystals or portable, in North London, will experience an overwhelmingly strong signal from Brookman's Park. This will lift up the curves above very loud—selective and unselective alike. Their valves may saturate, their loud-speaker may rattle and their quality may be filthy. The unsuspecting will mistune, i.e. find a place on the *side* of the resonance curve where it cuts the "very loud" line, and rest content until a second programme is introduced, see Fig. 2.

Then the trouble will begin, because there is no tuning left in the set, albeit the thing used to tune beautifully to much weaker Oxford Street.

Reducing the aerial size, or with a portable turning it round to nearly the minimum, brings almost the old conditions,

(*Continued on next page.*)

HOW DOES BROOKMAN'S PARK AFFECT YOU?



A general view of the new London Station taken from the foot of one of the masts.

SELECTIVITY AND THE REGIONAL SCHEME.

(*Continued from previous page.*)

however, and effectively shifts the curve down again because it is no longer necessary to mistune at all with an effectively small aerial, because such an aerial is just the right size to pick up enough signal to bring it to the "very loud" position, see Fig. 2.

This applies to a valve set as much as to a crystal set, the valve set only scores because the skirts of the resonance curve are narrower. This means the valve user with the proper amount of pick-up in his aerial can always tune to very loud and yet be sure that the tips of the skirt edge fall below the inaudibility line.

Sharpen the Curve.

All I mean to convey is that a too large aerial on *any* set will rob that set of the required conditions of selectivity. In general, then, it is a question of adjusting the aerial size so that we don't let the too ample skirts spread over the inaudibility line. With a crystal set we obviously have to sacrifice more signal at the point of tune than with a valve set which has a sharper resonance curve. The question is, do we, with a crystal set, sacrifice too much, and must we therefore sharpen our curve?

This depends. Certain iron wire aerials and lumped coils and low-resistance crystals produce so flat a resonance curve that the point of tune must lie even on "very weak" (see figure) before the skirts of the curve come below audibility. In this case we must *sharpen up the resonance curve, somehow,* IF WE WANT REASONABLE SIGNALS ON THE POINT OF TUNE. Coupled circuits can be very easily adapted to crystal sets. A copper aerial and a decent earth may work wonders. Gas pipe earths flatten the resonance curve as do these very lumped coils.

In sum, a proper study of the curves of Figs. 1 and 2 represent the whole problem in a nutshell. If you have a sharp resonance curve you can have lots of volume at the point of tune, and you can select anything you like, the flatter the resonance curve the more signal strength at the point of tune must you sacrifice to get more

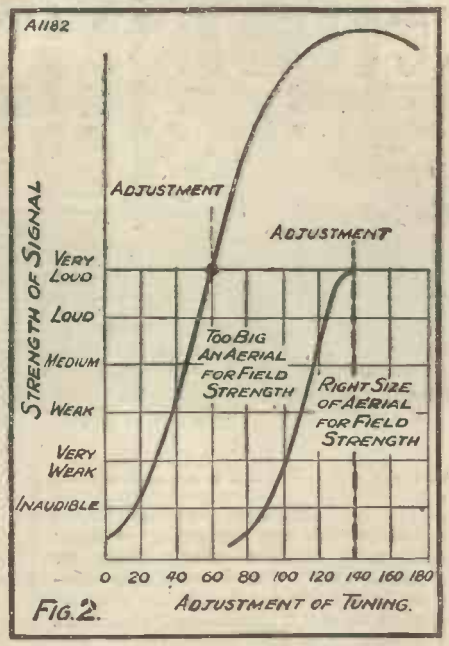


FIG. 2.

selectivity. And you can't make up again on note magnification nohow. There is, in general, a universal cure—cut down the size of your aerial until the signal at the point of tune is satisfactory.

Try a Coupled Circuit.

If, however, the device is still too unselective, you must set about sharpening up the resonance curve by fitting better components or using a coupled circuit or improving the earth, etc., etc.

I advise crystal and single-valve users to start trying some simple experiment now with 2 L O. Can you tune through, or is there a background of London wherever you set your dials? If London persists everywhere try a shorter aerial temporarily rigged, or—waiting for Brookman's Park—more sensibly use an aerial series condenser of ·001 mfd. in series with the existing aerial.

Practise Now.

The latter suggestion is by far the soundest until Brookman's Park starts, because you may get weaker signals from the new station (particularly if you live very close to Oxford Street now, when your aerial may even want increasing). But as an experiment try making your set selective and practise tuning through and be ready for the twin service when it starts.

I cannot—this article is over-long already—give advice to all and sundry wherever they may happen to live in relation to the old and new sites, but I can say with absolute definiteness that a properly designed crystal set with a suitable aerial will give a medium signal and the required selectivity.

If you want a loud signal and the required selectivity use a coupled circuit. All will depend upon the damping in your set. If you are really sensible get a small indoor aerial and a single-valve set when a spot of reaction so sharpens the resonance curves that all your problems melt away and you can have single-handle control and a fine factor of safety.

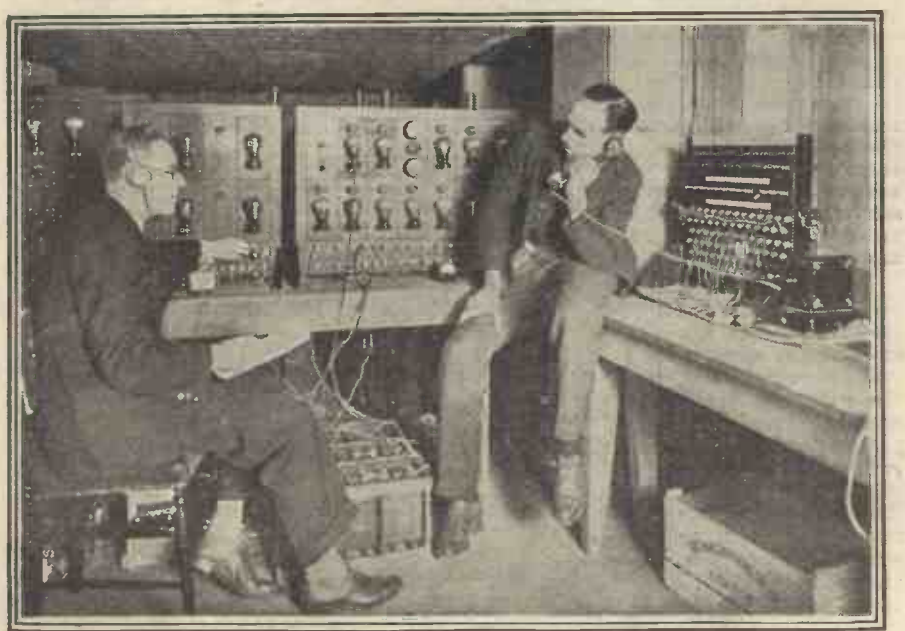
Watch that Aerial!

In general, the unselective set is a set with a too big aerial or a poor high-frequency circuit, valve, wire and earth. I can make a three-valve set behave on a tiny aerial 1 mile from the new station just exactly as its behaves on a big aerial 50 miles from the new station. I can make both resonance curves identical, but I shall never make a set work if I put up a huge great aerial in a huge great field strength.

Multi-valve, single-valve, crystal, portable, transportable, super this, or super that, all, all and all will be unselective if the aerial is too big, all, all and all will give perfectly good loud signals, and will be perfectly able to select between two programmes if they possess reasonable circuits and an aerial adjusted—physically or by aerial series condenser—to be the right size for the field strength conditions existing.

I have spoken!!

BEHIND THE SCENES AT AN OUTSIDE BROADCAST.



Two engineers controlling the output from a large concert-hall during an "O.B." At Savoy Hill the programme is divided and sent to the various stations for broadcasting.

POINTS TO REMEMBER.

If you are using a crystal set a good earth is quite as important as a good aerial.

* * *

If you use a counterpoise aerial this can be fitted with an earthing switch in the same way as an ordinary aerial.

* * *

A small glass nasal douche such as can be obtained from any chemist for a few pence is very good for filling small wet H.T. cells without making a mess, as it enables the flow of acid to be regulated exactly by the finger pressure upon the aperture.

* *

When a wet H.T. battery has started to "creep," it should be thoroughly wiped and dried before it is put into condition again, great care being taken not to splash the acid when refilling.

The MANCHESTER RADIO EXHIBITION

The "Northern" Radio Show is being held from October 16th to October 26th, and is an exceptionally interesting one. Here are some preliminary details.

By OUR SPECIAL CORRESPONDENT.

THE Manchester show is in every sense a national one. It gives northerners just as great an opportunity to see right-up-to-the-minute radio as Olympia does southerners, and those fortunate people who can travel great distances for the purpose.

There is a tendency to regard the Manchester Radio Exhibition as a sort of "after-annexe" to the London show. It is, of course, nothing of the kind. It is quite capable of standing by itself, on its merits, as a national exhibition.

It is promoted by that most enterprising newspaper, the "Evening Chronicle," in conjunction with the R.M.A. and Provincial Exhibitions, Ltd. The "Evening Chronicle" has done a great deal to popularise broadcasting in the North, and it has always devoted considerable space in its columns to articles of interest to home constructors.

Larger and Better Than Ever.

It appears to be one of the very few newspapers in the country that early realised that radio was going to prove an extremely vital department of our modern social amenities and, further, the "Chronicle" did not exploit the art as a "stunt," but persevered with its valuable pioneering until to-day it can truly be said to occupy as honoured a position in the radio world as it does in its wider sphere of general journalistic activities.

This is the sixth radio exhibition we primarily owe to the "Evening Chronicle," and it is larger and better than ever. It is no provincial bazaar held in a mission hall, but a huge assembly of products arranged by Britain's leading manufacturers. Indeed, there are this year over a hundred firms exhibiting.

The show is being held in the City Hall, and it opened on October 16th, while it was arranged that no less a personage than the Right Honourable J. H. Clynes, M.P., the Home Secretary, should be present at the opening ceremony.

By the way, it will be appreciated that while all this lies in the future at the moment of writing, by the time these words appear in print the Manchester Exhibition will be in full swing.

The show runs to Saturday, October 26th, and is open daily from 11 a.m. to 10 p.m.

A great feature are the excellent concerts which are given daily by many of the leading radio artistes, and which are being broadcast.

One cannot help thinking that in at least some respects, the great Manchester Exhibition manages to score over its Olympia predecessor.

Facilities are being provided for exhibitors to demonstrate loud speakers on their stands. Lines are run to these from a common amplifier specially built for this by Messrs. Ferranti.

This stand demonstration idea originated in Manchester and was, as readers will remember, duplicated by Olympia this year for the first time. That an exhibition of radio gear can be held in muteness is almost absurd—loud speakers are so far removed from the purely decorative class of article.

A TELEVISION STUDIO.

It was hoped that Television demonstrations could be given at the Manchester Radio Exhibition on the lines of the above, which shows a Baird experimental studio in action.

However, the instruments can be heard as well as seen at the Manchester City Hall, and northerners should take advantage of the opportunity to listen to all the leading makes of speakers.

There is another very special feature of this year's Manchester show in the form of another scheme permitting demonstrations of apparatus. There are four silence rooms. Each room contains eight cubicles, these cubicles being covered by curtains.

No names are displayed, each cubicle carrying only a number. Behind the curtains there are radio-gramophone outfits.

The idea is that the exhibitor who happens to have the use of one of the silence rooms at any particular moment reveals only his own gear; the visitor does not see any of the other radio-gramophones unless their owners escort him into the silence-room for the particular purpose.

Special Exhibition Critique.

We have mentioned that there are over one hundred exhibitors and it should be noted that there are included important firms that did not show at Olympia for some reason or other. This, then, is the reason, if there is no other, why everyone should make an attempt to visit the Manchester Radio Exhibition, even although they have been to Olympia.

"P.W." is making a very special effort to include a review of the exhibits in next week's issue.

As we go to press some few days before publication this task is not as easy as it may sound. But by an intensive speeding-up of all our resources we are endeavouring to present an interesting and informative critique which will be in our readers' hands while the show is still running. As "P.W.'s" special representative, I am visiting Manchester for this important business, and if all goes well my "copy" will be delivered to the printers in just sufficient time for it to "catch" next week's number.

The attendances at Olympia this year reached record-breaking figures, and on at least one occasion police reserves had to be called out to deal with queues over a mile in length. Now then, Manchester, what is your rejoinder to this challenge from the South?

LATEST BROADCASTING NEWS.

5GB NEWS.

PORT OF LIVERPOOL ON THE AIR—A 600th CONCERT AT MANCHESTER — SCOTLAND'S OWN WEATHER — NATIONAL ORCHESTRA OF WALES. THE B.B.C. BIRTHDAY.

AMONG several particularly interesting forthcoming musical programmes arranged by the Birmingham Station for 5 G B listeners is one on Sunday evening, October 27th, when Sir Arthur Sullivan's Oratorio, "The Golden Legend," will be broadcast from the Broad Street Studios. The soloists are Stiles-Allen (soprano), Esther Coleman (contralto), John Adams (tenor), and James Coleman (bass).

On the following Friday evening listeners will hear another Violin and Organ Recital by Frank Cantell, Leader of the Studio Symphony Orchestra, and the Midland Pianoforte Sextet, and Mr. Gilbert Mills relayed from the Church of the Messiah, Birmingham. The transcription of the accompaniments will be to the arrangement of Mr. Mills.

There is great satisfaction in Birmingham because of the visit there on October 10th of Lord Clarendon and Mrs. Philip Snowden to explore for themselves the local broadcasting situation. It will be interesting to see if Savoy Hill makes any changes in its policy of eliminating Birmingham from the scheme of things in broadcasting.

Port of Liverpool on the Air.

A special feature programme for listeners in the Northern area has been arranged for Tuesday, October 29th, when scenes representative of the Port of Liverpool are to be broadcast. It will be followed at 8.30 by the relay for half an hour of speeches from a Port of Liverpool Banquet.

A 600th Concert at Manchester.

More than usual interest is attached to the broadcast from Northern stations of the Manchester Tuesday Mid-day Concert Society on October 29th. The concert is the six hundredth of a series which began as far back as 1915 with the object of assisting necessitous artistes in war time, and providing concerts at the hospitals around Manchester.

Until 1922 the concerts were managed by a committee formed by Mr. Sydney H. Nicholson, Organist of Manchester Cathedral, when the Tuesday Mid-day Concert Society was formed. The concert on October 29th at the Houldsworth Hall will be given by the Orchestra of the Royal Manchester College of Music, and will be conducted by the new Principal, Mr. R. J. Forbes. Arthur Catterall, Leader of the Hallé Orchestra, will also be heard in violin solos.

Scotland's Own Weather.

Scottish listeners are in future to have their own Weather Forecast. Hitherto only the Western area of Scotland has been dealt with in the weather forecast, but this is now to be extended to the whole of the country.

The forecast, which will be specially prepared by the Meteorological Department of the Ministry of Air at Renfrew, will be broadcast in the early evening so as to give farmers, for whom it is specially intended, ample time to make their plans for the following day.

National Orchestra of Wales.

Three concerts by the National Orchestra of Wales, conducted by Warwick Braithwaite, have been arranged for the last week in October, and two of them will be broadcast from the Cardiff and Swansea Stations. There is one on Sunday, October 27th, in the Park Hall, Cardiff, when the vocalist is Tatiana Makushina, and listeners will hear the last part of this concert after the "news."

The B.B.C. Birthday.

Thursday, November 14th, the official birthday of the B.B.C. will as usual be celebrated with a short programme by the Staff at Savoy Hill. It is difficult to decide who gets the greatest enjoyment from this annual break away from the conventional type of programme, the staff who give it, or the listeners who unfailingly write to Savoy Hill demanding more frequent doses of the really clever entertainment which the staff invariably provides.

TO BE HEARD FROM 2 L O.

Mr. H. G. Wells will be heard from 2 L O on Monday next, when he is to speak for half an hour, commencing at 9.15 p.m.

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

DESIGN OF COILS.

AN INTERESTING DISCUSSION ON THE VARIOUS TYPES OF COILS NOW USED IN BROADCAST RECEIVERS.

I OFTEN receive enquiries from readers with regard to various matters relating to the coils used in a wireless receiver, and as some of these enquiries indicate that the writers are in doubt about what are really comparatively simple points (in some cases amounting to nothing more than a question of terms), I thought it might be rather useful to say a few words about the various kinds of coil which are in use.

To treat this matter properly, perhaps we should go back to the first type of coil, known as the solenoid. As most of you will remember, this was the only type of coil used in the very early days of wireless and it consists of a plain cylindrical coil, generally wound upon a tube of insulating material, either of a fixed size, provided with tappings so as to give a range of wavelengths up to perhaps 2,500 metres, or alternatively having a slider to make contacts at various points which, of course, comes to very much the same thing.

Short-Wave Coils.

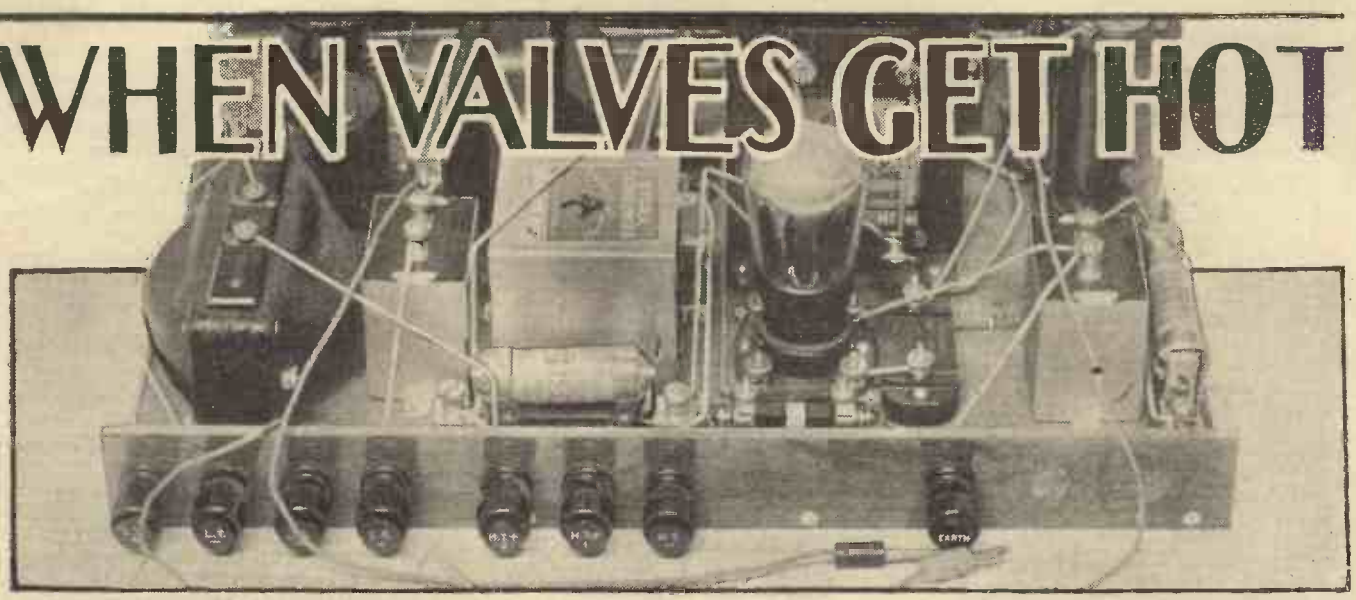
The solenoid is still in use for short-wave reception, where it is more especially in favour. For ordinary wave-lengths, however, it has the disadvantage that it is apt to be unduly large as compared with other types of coil which may be used in its stead and also—in common with many other types—it gives a distributed electro-magnetic field. By this I mean that the field created by the coil spreads out and around in the neighbourhood of the coil, very much after the fashion of the spider-web diagrams you see in elementary books on magnetism, showing distribution of the lines-of-force around a permanent magnet.

Limiting the Field.

As a matter of fact, in solenoid coils as used to-day the "distributed field" is largely overcome by the very simple process of winding the two halves of the coil in opposite directions. This limits the field very much and is in some ways preferable to the use of a large amount of shielding. Shielding naturally prevents interaction

(*Continued on page* 356.)

WHEN VALVES GET HOT



Many a good power valve has been ruined because it has been overrun. This article tells you how to avoid this.

By K. D. ROGERS.

I HAVE had several letters recently from readers telling me that their output valves get very warm after they have been in use for half an hour or so, and asking whether anything is the matter, and if it is quite a normal occurrence.

Unfortunately, this is not an easy question to answer, because the reply may be two-fold. It is quite possible that this heating-up is perfectly normal; but, on the other hand, it is just as possible that it is caused by some fault either in the valve or in the way it is being operated.

Some power valves of the output variety get quite hot—even too hot to touch—and operate quite normally. The L.S.5 A, for instance, has a plate which very often gets red hot and makes the valve far too hot to touch, although no harm comes to the valve owing to this fact.

The P.625 A gets very warm under normal operation, and the P.625 also undergoes a rise in temperature. These are quite normal occurrences and are nothing to worry about, but there are other cases where valves get hot which denote there is something wrong. Such instances usually indicate that the valve is being overrun and is giving too freely of the electrons from its filament, with the result that before long the valve will give up the ghost.

The Only Sure Test.

Unfortunately, unless you have considerable experience with valves, it is difficult to decide whether the valve is working normally, or whether the heat is a sign of wastage. A milliammeter in the plate circuit of the valve is the only sure test.

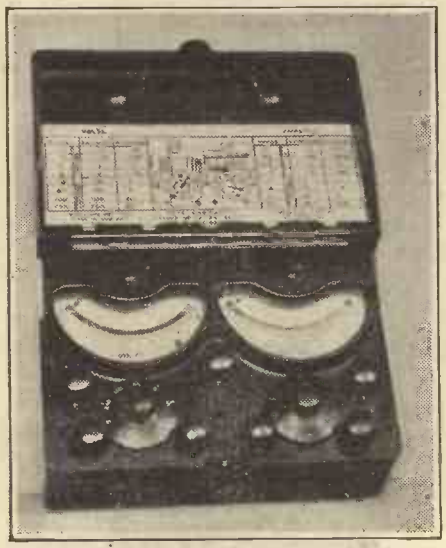
If you find that the valve is giving the correct milliamps at the correct H.T. voltage and grid bias, then you may assume that if the valve is hot it is quite a normal state of affairs, but if at any certain H.T. voltage you find that the valve is getting very hot and there are more milliamps flowing than are shown in the maker's curve, although the grid bias is adjusted correctly, then it is ten to one the valve is what is known as "soft"—that is, there is too much residual gas in what should be the vacuum of the valve.

The only thing to do in such a case, to check the excessive emission, is to drop the H.T. voltage or very greatly increase the grid bias in the hope that the emission will "slow down," as it were, and then the valve will have something more like a reasonable life. Reproduction, however, with a soft valve is generally unsatisfactory.

Insufficient Grid Bias.

One of the causes of valves losing their emission, apart from softness is due to too much H.T., with insufficient grid bias, or an accident with the grid-bias connection. I have come across many cases where a valve has been ruined by the positive or one of the negative plugs in a grid-bias battery being knocked out, or by the grid leak in a resistance-capacity-coupled circuit being out of contact with its holder, thereby breaking the grid bias to grid connection.

In such cases the internal resistance of the valve is far too low, and too much emission from the filament is allowed.



A test meter is of great value when you are doubtful about the health of your valves.

So, if your valves start running hot, make sure that the grid-bias tappings are properly connected and that the proper grid bias is used. Similarly, check up the H.T. voltage and see that proper H.T. is being used. Too much H.T. on a valve makes it run very hot indeed, and, though it may appear to do no immediate damage, it will greatly shorten the life of the filament.

Rectifying valves in mains units tend to run hot, and this is quite a normal state of affairs, so that no worry need be felt here, but when receiving valves start running hot, then is the time to sit up and take a little notice, and to make sure that nothing is out of order, that the grid-bias connections are correct, and that the H.T. voltage is not excessive.

I recently came across a case where the changing over from an H.T. battery to a mains unit cost the lives of several valves before the owner of the set rumbled what was taking place. Not having a high-resistance voltmeter, he was relying on the calculation of the maker's figures for the H.T. voltages he was obtaining from his mains unit, and, assuming that he was getting something like ordinary voltages as when he had a battery, he made the grid bias of the output valve of the same value as he had formerly.

Use a Milliammeter.

Unfortunately, however, the H.T. from the mains unit was a great deal in excess of that from the battery, so that the valve was very seriously under-biased. The result was it got hot owing to far too much emission, and very soon after the valve ceased to work.

I have known valves which have been on the soft side, and whose plates have got so hot (there being no visible sign owing to gettering on the bulb) that they have become unwelded from their supports, and the internal structure has finally collapsed.

There is only one sure away to watch your valves and to see that if they do get hot it is not due to any fault either in the valve or in the way it is being operated. That way is to keep a milliammeter in the negative H.T. circuit of all the valves, or in the plate circuit of the output valve, and to watch this meter and see that its reading is not greater than it should be at the H.T. voltage and grid bias you are providing.

HOME LISTENERS FIRST.

By THE EDITOR.

FROM time to time complaints crop up in the Press dealing with the inadequacy of the Chelmsford short-wave broadcasting station. These complaints, according to the "Daily Mail," are received from all parts of the Empire. This is quite likely, for we ourselves have received from time to time letters from overseas readers grumbling at the so-called Empire Broadcasts.

But let us look at the subject impartially. Is there any reason for these complaints, and also have overseas listeners any right to complain? After all, they are receiving a service which is supplied by the B.B.C., and that service is paid for directly out of the pockets of British listeners.

The Limitations of 5 S W.

Now a short-wave broadcasting station is not the slightest good to listeners in this country; apart from the fact that we have our own broadcasting stations to supply us with programmes more suitable to listeners actually living in this country, there are technical reasons why a short-wave station is of no practical value to the average listener.

The B.B.C. declares that it can do nothing further in the matter. As it is, in our opinion, it has done quite enough; and if the B.B.C. says it has no more money to spend on Empire Broadcasting, that answer should suffice, for what money is spent takes the form of a present to overseas listeners, and it cannot be said that listeners overseas—or, more particularly, overseas Governments in the various parts of the Empire—have reciprocated any too well.

At one time we strongly urged the inauguration of an Empire broadcasting short-wave service, because we believed that the various Empire Governments would, in turn, start a service which would be of interest to listeners in this country. But although something has been attempted it is, on the whole, rather meagre, and certainly the B.B.C. has given far more than it has received.

Expecting Too Much.

The B.B.C. rents 5 S W at Chelmsford after 7 o'clock every evening, so listeners need not run away with the idea that 5 S W is the personal property of the B.B.C. The station is owned by the Marconi Company, and, by arrangement with the B.B.C. (who, of course, stand the expense) it radiates 2 L O's programmes. If overseas listeners expect the B.B.C. to provide special programmes to be broadcast only from 5 S W, we think they are expecting far too much.

It is a complaint that Empire listeners are forced to depend on other countries for short-wave programmes. For that matter, so are British short-wave listeners in this country. They have to depend chiefly on American short-wave stations, and on P C J and other well-known short-wave transmitters.

It is true that one or two short-wave stations in Australia are to be received from time to time, but the service given is not comparable to that given by other foreign short-wave stations. It is rather ungrateful when one considers the letters published in the "Daily Mail" the other day from a correspondent who lives on a Ceylon Tea Estate. This man wrote:

> "The whole programme from P C J came at full loud-speaker strength. I think that 5 S W, Chelmsford, should be ashamed to broadcast at all."

Another listener in India wrote:

> "One gets tired of waiting for the day when the British station will transmit a regular service to suit the whole Empire."

Well, if British listeners care to start a plebiscite on the question, and the majority are in favour of the B.B.C. spending much more money on 5 S W, no doubt the Chelmsford station will improve, and British listeners abroad will be satisfied. But we cannot see any reason why B.B.C. listeners' money should be spent on supplying programmes for listeners abroad when, if it is a case of propaganda, that job should be undertaken by the Government; and, further, why we should supply a service gratis and for nothing and get only a very inadequate service in return—if any service at all.

NEXT WEEK:

"REFINEMENTS FOR THE MAGIC THREE."

Order Your Copy Now.

Our suggestion is that the B.B.C. continue as they are continuing, that British listeners abroad should be very lucky to get the service at all, and that the main idea is that British listeners' money subscribed in this country in the form of licence fees should be devoted almost entirely to the improvement of British broadcasting programmes and to the improvement of a British broadcasting service.

* * *

A good deal has been said about the inaugural television experiments which took place a fortnight ago. The first official tests of television were made through 2 L O and, as far as we know, these tests will be continued until Christmas, when the B.B.C. may decide to give the Baird Television Development Company three months' notice to terminate the transmissions.

As usual, a lot of exaggerated matter has appeared in the Press in connection with these television experiments, and although we—and, we trust, our readers—have learnt to discount a good deal of this exaggerated propaganda, the fact remains that it is a good thing these experiments have been inaugurated, for the opportunity may now soon be given to British listeners to judge for themselves whether television is in a state of development which would warrant television broadcasts being included as a regular feature in the B.B.C.'s programmes.

But, as we write, it is interesting to note that, although these television transmissions have been in operation for nearly a fortnight, so far there is not the slightest sign of television sets coming on the market. Consequently, we doubt whether more than one or two expert listeners who have constructed their own television outfits have had an opportunity of tuning in these transmissions and judging for themselves what television is really like.

Exactly why the Baird Television Development Company have missed the psychological moment for putting on the market kits of parts for television receivers, or complete television receivers, we are unable to say definitely, but we are under the impression that, although the Baird Company are willing for various manufacturers to take out licences to market television receivers, manufacturers are not particularly keen to do so because they do not wish to stock these kits of parts and complete sets, etc., until they are certain that the transmissions will continue.

A Television Deadlock?

In a sense this is understandable. Perhaps it would help matters if the B.B.C. would state definitely how long they intend continuing these television transmissions. We understand on good authority that the B.B.C. have agreed not to discontinue them without giving three months' notice, but even that does not seem to satisfy manufacturers who might otherwise take out licences from the Baird Company and begin manufacturing and marketing televisors.

It may be that some sort of a deadlock has been reached, for there is certainly no indication at the moment that the public will shortly have an opportunity, if at all, of "seeing in." And if nothing is done to provide the public with the means of judging television, there will not be much sense in continuing these television transmissions unless, of course, the B.B.C. are willing to do so in order to assist Mr. Baird in his experimental researches.

But for over two years now we have heard about these television receivers which would be available for the public as soon as the B.B.C. toed the line and granted the necessary facilities for television transmissions. We, ourselves, have had a television receiver on order for two years and, although we have made repeated enquiries, we can get no satisfaction as to when we shall get delivery.

Let the Public Judge.

However, we sincerely trust that the effect of these transmissions will not be prejudiced by the delay in marketing television sets. The sooner these sets are on the market the sooner the public will be able to judge for themselves, and the sooner will the controversy which has raged around television for over two years now be settled one way or the other.

If the transmissions appeal to the public, then undoubtedly the B.B.C. will have to continue them, and possibly include them in regular broadcasting hours, but if they do not meet with interest, then the B.B.C. will have no justification for continuing them.

WHY NOT CRYSTAL SHORT-WAVERS?

An article of interest to all short-wave enthusiasts, for it answers a question that often puzzles listeners.

By A. JOHNSON-RANDALL.

"WHY can't I use my crystal set for reception on the short waves?"

This was a query sent in by a reader quite recently to the "P.W." Technical Queries Department. The number of short-wave enthusiasts is steadily increasing and it is only natural that many of them should wonder why crystal receivers should not be employed on wave-lengths of 20 to 50 metres, provided suitable coils are available.

A crystal set appeals chiefly because of its economy and simplicity, but its limitations become very apparent as the wave-length decreases. In the first place our crystal receiver has no amplifying properties of its own. A crystal will rectify but it will not magnify. Our aerial picks up the weak high-frequency impulses which are transmitted from a broadcasting station, and the amount of energy actually picked up is dependent solely upon the efficiency of the aerial and earth system.

A Good Aerial Essential.

If our aerial is high, unscreened, and has reasonable length, then we may expect good sensitivity or pick-up from it. These high-frequency impulses which the aerial absorbs are passed on to the wireless set and, of course, have to be rectified by a detector before they become audible as speech or music in the telephones or loud speaker. Now a crystal will rectify these impulses and pass them on to a pair of telephones, and thus we are able to hear what the broadcasting station gives out.

This is perfectly straightforward in the case of the local station or a high-power transmitter situated within range of our aerial. Unfortunately, however, the aerial has only a limited pick-up and, moreover, a crystal has but a fair sensitivity, and in consequence will not respond to impulses below a certain intensity. For instance, it will not respond to very weak signals, such as those from a distant station.

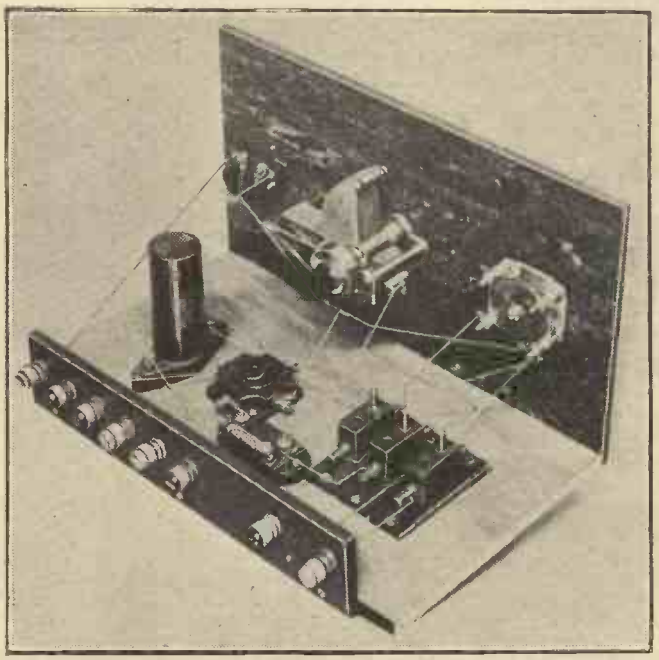
A Valve More Sensitive.

Now let us take the case of the ordinary reacting detector valve. Here we have a device which will do two things. First, it will rectify. Secondly, it will magnify and we are able to react, that is to say, "feed back" energy, into the tuned circuit, and by so doing increase the sensitivity of the set very greatly. This property of reaction enables us to obtain a very simple but extremely efficient and sensitive arrangement with which to receive distant stations. We are enabled to pick up and magnify impulses which would not be audible in the case of a straightforward crystal receiver. Thus, a reacting valve detector is many times more sensitive than a crystal set ever can be. Short-wave transmissions are often sent out from stations many thousands of miles away. Some are in Australia, others are in America, and so on, and it is this fact that the waves are travelling over such vast distances, and from countries so far away, that makes short-wave reception so extremely interesting.

Crystal Damping.

These short-wave impulses, when they reach this country, are extremely minute, and no crystal receiver can be expected to detect them and render them audible in a pair of telephones. Readers who have themselves operated a short-wave receiver will know quite well from practical experience that the success of their reception depends entirely upon the intelligent use of reaction and it is a fact that most of these transmissions are received with the set very near the oscillation point.

That is, of course, the condition when the detector valve is in its most sensitive state. Hence, for short-wave reception a crystal detector alone is hopeless.



A simple single-valve receiver will give excellent results on the short-waves. The essential feature is smooth reaction control.

There is also another point. A crystal is connected across the tuned circuit, either directly or indirectly. Because of its comparatively low resistance it exercises what is termed a damping effect upon the tuned circuit, and produces a decrease in efficiency. As the wave-length gets lower we have to cut down all losses in order to gain the greatest possible tuning efficiency and the lowest high-frequency resistance.

Therefore, our friend the crystal becomes a much greater nuisance on the short waves than on the long waves, because the crystal damping exercises a much bigger effect upon the circuit as a whole. Thus, apart from the question of sensitivity, our tuning difficulties are increased, and for short-wave work a crystal cannot in any way be compared with a reacting valve detector. Finally, even if the crystal were highly sensitive, there is still the fact that it requires constant adjustment and that its sensitiveness varies with pressure, and sometimes with the atmospheric conditions. The more sensitive the crystal the more is its adjustment upset. This is a disadvantage not possessed by a three-electrode valve which, provided it is operated correctly, is perfectly stable day in and day out.

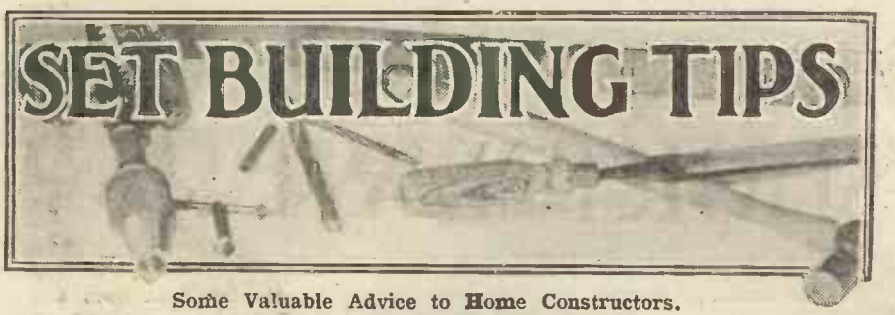
Again, there is the question of short-wave Morse transmissions. Messages are sent out on what is termed the continuous wave (C.W.) system, and to receive them it is necessary for the set to be in an oscillating condition. A crystal will not oscillate and therefore could not be employed for C.W. reception.

Not Worth While.

Possibly something could be achieved by using a separate reaction valve to "feed" oscillations into the tuned crystal circuit, but this would not be worth while. If one has to utilise a valve and its attendant circuit why not do so in the ordinary conventional manner and employ a straight valve detector?

Therefore, the answer to our reader's question is that, first, a crystal, in itself, is far too insensitive for general short-wave work. Secondly, reaction cannot be used to increase its efficiency and thus to make it more sensitive to weak signals, such as those from stations on the short wave-lengths. Thirdly, a crystal will not oscillate and consequently cannot be used for the reception of continuous waves.

SET BUILDING TIPS



Some Valuable Advice to Home Constructors.

By A. E. ANSON.

THE enthusiast, having built his one-valve set, is generally so elated he immediately wants to go full speed into a superhet. or 6 H.F. plus 8 L.F. Unfortunately the ordinary arithmetical laws do not hold good. It is not merely a case of adding valve after valve to get results multiplied by the amplification factor of the valve. Optimists set out to do this just after the war and soon discovered the pathway was set with snags.

Indeed, it might be fairly said that for the last ten years the best radio brains in the world have all been busy cleaning up these snags.

To-day, huge amplifications are possible, but it is still advisable for the constructor, for whom this is written, to get the ambitious schemes he sets himself properly in focus. It will save much weeping and gnashing of teeth over impossibilities.

Go Slow at First.

Therefore go slow—make the best of your one-valver, test it, learn all it will teach you before you lay it on one side for better things. There is much to learn from the humble one-valve set, in fact, if mathematicians really understood its inner secrets radio would be given an immense impetus.

Before another set is contemplated it is imperative to learn how to distinguish oscillation. If half the ambitious constructors had learnt this lesson we should have all the fewer whistles prowling round the world at night.

If reaction is increased there comes a moment when a weird, rushing sound is heard. A wetted finger lightly touched upon the aerial terminal will cause a plop—a distinct plop. Just before this plop occurs reaction will cause music or speech to become distorted. The plop test shows the moment oscillation has commenced. If the set is tuned to a carrier-wave a whistle will be heard. By careful tuning this whistle may be made to turn into a low growl and speech, although distorted, will be almost intelligible. Meanwhile, your neighbours for a mile or two around will be wishing to slay you, for they also hear your growls.

Adding an L.F. Stage.

If you can't get that distant station on your one-valver go slow, don't try to dive before you can swim. A more expert enthusiast will probably astound you—with a few deft adjustments of reaction and tuning he will make the far-off station take on new strength.

Copy him, learn to tune. All the valves in the world won't help till you have learnt this.

After a time the first thrills of the first radio set will lose their charm. Now is the time to add an L.F. valve. It is a simple matter. There have been many designs in the pages of POPULAR WIRELESS. It will open out a new and interesting field. But don't get carried away by an excess of enthusiasm and clap on a couple more L.F. valves. You will come a cropper.

Motor-Boating and Distortion.

Three L.F. transformer-coupled valves probably marks the L.F. limit. But great care is required. All sorts of tiresome things happen. Motor-boating, howls, squeaks, distortion, and other parasitic noises creep in. There is a cure for them all up to a point.

Provided you realise these limitations there will not be gnashing and sorrowing over the poppings of an unstoppable motor-boat pouring out of your loud speaker in a melancholy and monotonous fashion. If this happens with only one L.F. valve there is something definitely wrong, probably the primary connections should have been connected up the other way round.

In the same way remember that each L.F. valve will probably amplify the input some thirty times. A mere ·1 of volt on the grid of the first L.F. valve will have become 3 volts on the grid of the second valve, and 90 volts on the grid of the last valve. Unless very special attention is paid to the last valve distortion will be horrible.

In fact, a 90-volt grid swing calls for special valves and circuits, special H.T., special loud speakers, and a large hall in which to hear results. Obviously three L.F. valves require special thought to grid bias.

Besides, if three L.F. valves are relied upon to get those distant stations you are putting the cart before the horse. It can be done better with less L.F. amplification and more H.F. amplification. But go slow, don't rush into a multitude of H.F. valves.

H.F. circuits are tricky brutes. Thanks to the screened-grid valve they are undoubtedly simpler, but there are still snags. One H.F. is not too bad. Anyone who has mastered his one-valve set is competent to add an H.F. valve. The chief snag is the tendency to oscillate. With screened-grid valves interelectrode capacity plays a more humble part. But stray coupling must be avoided.

In practice this means a sheet of metal between the aerial coil and the tuned-anode coil. Don't be satisfied until you get the L.F. set quite tame. A little judicious screening will soon cure any tendency to oscillate on the normal broadcast waves.

Screen the H.F. Side.

It is inadvisable to build a set involving two H.F. valves without a careful study of designs produced by experts. Anyway, such a set means complete screening. Even if screened-grid valves are used it is necessary to isolate each H.F. coil and its associated wiring in a separate metal compartment, preferably of soldered copper with an overlapping lid.

Even then quite absurd little details will spoil results. Fortunately, if the ambitious constructor has appreciated the problems of his earlier sets these snags are easily detected.

An appreciation of what lies ahead is just as important in radio-set construction as in exploration.

You would not consider yourself competent to swim the Channel on the strength of being able to float in the bath.

Well, it is the same with radio. Don't try to make impossible sets—unless you want your radio friends to smile at you a smile of bitter experience.

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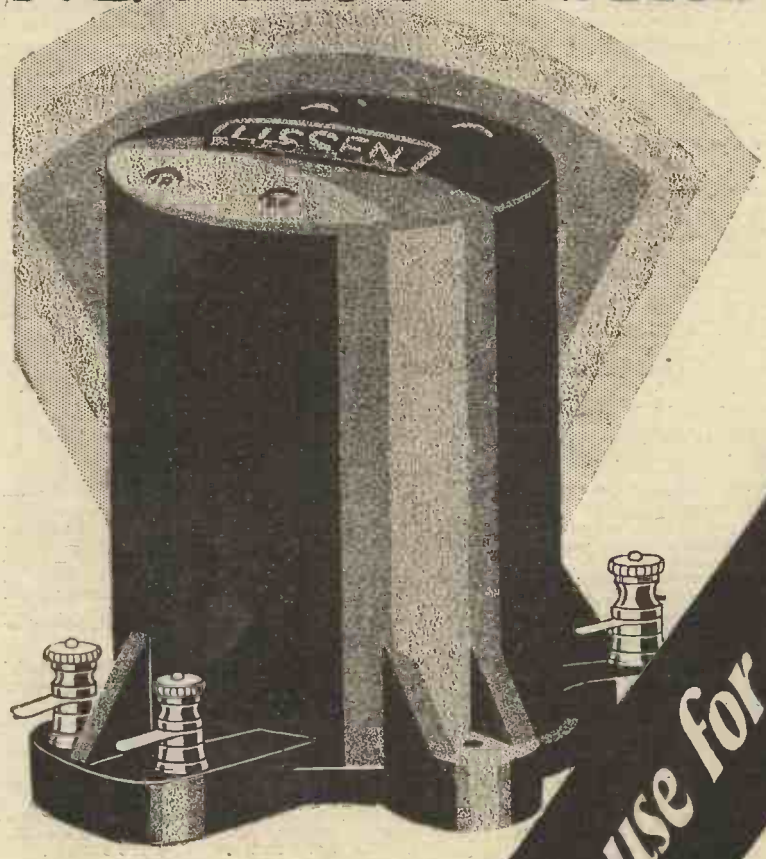

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CORRESPONDENCE.

FROM A NEW ZEALAND READER.

THE "SHORT-WAVE" TWO—RESULTS WITH WET BATTERIES—CAPACITY EARTH.

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.

FROM A NEW ZEALAND READER.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have been a subscriber to "P.W." weekly since August, 1928, and I do not think I have missed a copy since that date, but the purpose of this note is to tell you all about, and to thank you for the circuit by W. L. S. of an S.G. short-waver which appeared in "P.W." on April 20th, No. 359, Vol. XV., and which I have just made up and operated, with results that far exceeded my expectations.

I have been listening for exactly one week, and during that time I have logged U K 2 M E (Sydney, Australia) on 28·5 metres; W 2 X A D, on 19·56 metres; W 2 X A F, on 31·4 metres; W 6 X N (K G O), on 23·35 metres; P C J, on 31·4 metres; V P D (Suva), on 25·4 metres; R F M, on 70·1 metres; W 8 X K (K D K A), on 25·4 metres; G 5 S W and G B X, on 27·86 metres. With the exception of 5 S W and G B X all the foregoing have been asked for verification.

Each morning I have listened for 5 S W I have heard the station working, but always there is a very strong ripple. G B X I have heard on Duplex Telephony Tests with 2 M E, and on one evening during the week I heard portions of a conversation between an English lady speaking through G B X to her crippled son who linked with 2 M E.

I am hoping to receive both of these stations at good strength, when I will be right after verification.

Components as specified by W. L. S. were rather difficult to obtain, so I used any old parts I could find. My extra purchases being a P.M.5B, a P.M.16 S.G. and a panel.

Other valves in use are Philips' 615 det. and Philips' 609 first audio. I added a resistance-coupled last stage.

My coils are crude but convenient—two turns 3 in. 18-gauge enamelled wire, self-supporting for the aerial coil; two turns 30-gauge D.S.C. on a home-made 4-pin 3 in. former for reaction, and two turns of 24 D.C.C. on same former for grid coil, these cover the wave-band from 10 to 35 metres. Another set on Colvern formers covers the band from 33 to 85 metres; and still another set on Colvern formers aerial 30 turns, 30 D.S.C.; reaction, 33 turns, 30 D.S.C.; grid 93 turns, 30 D.S.C., gives me the broadcast band from 250 to 550 metres.

I enjoy loud-speaker reproduction of all the New Zealand and Australian A class stations, and a good many of the B class.

Using ·00025 variable tuning condensers I found that by using a ·0005 variable condenser for reaction I had a receiver that was practically single-dial control, in fact, I use a knob only to tune the R.F. side and make all final adjustments between C_1 and C_2. My broadcast receiver is a six-valve Crossley Armstrong circuit, and I have a log of approximately 70 stations on it, among the more distant being V U C and V U V (India), J O A K, J O H K, J O G K (Japan), and W E N R (Chicago).

From Christmas to the beginning of the winter a whole heap of American B.C. stations come in very well here. At the present time K F O X, K N X, K M O X, K H J, and K 3 O are the only stations audible, and they never get to better strength than R 5.

While once again thanking W. L. S. for a splendid circuit, might I be permitted to make a correction re his Short-Wave Notes of June 8th, and say that if there exists a dead spot between New Zealand and South Africa it does not apply to the North Island of New Zealand, for 7 L O (Nairobi) on 33 metres rolls in here in good style in the mornings, and some little time ago one of our "hams," a Mr. Roy Clarke (Z L 2 A W), of Wellington, succeeded in establishing two-way communication with five continents in one hour, and South Africa was one of the list.

Under separate cover I am forwarding a copy of our Radio Paper, and my only regret is that the chief short-wave contributor, Mr. Sellens, is at present on the convalescent list, although I have no doubt you will find the notes of other correspondents of interest.

Kia Ora, Popular Wireless.

Yours fraternally,

HRY. JAKEMAN.

Huntly, Waikato, New Zealand.

THE "SHORT-WAVE" TWO.

The Editor, POPULAR WIRELESS.

Dear Sir,—You may be interested to know of the results I have obtained with the "Short-Wave" Two, December 22nd, designed by W. L. S.

My list of stations is as follows: W 2 X A D, W 2 X A O, W 2 X A F, W 8 X K, G 5 S W, P C J, Monte Grande, Drummondville Beam station, a Dutch Beam station, and an American Beam station working with Sydney, Australia. Several English amateurs, also French and German. The following stations I have put on speaker: W 2 X A D, W 2 X A F, P C J, G 5 S W, Drummondville Beam station, and a German station.

On Broadcast Band: Radio Turin (good strength), Radio Toulouse (good strength), Radio Barcelona, Nurnberg, Bournemouth 6 B M., and several stations unable to identify. On long-waves 5 X X comes in with splendid volume. Like W. L. S., I heard the arrival of the Graf Zeppelin at Los Angeles relayed by W 2 X A D at wonderful strength. Considering that the coils I use for short-wave work are home-made plug-in type, this is a good performance for a two-valver.

Yours truly,

E. J.

P.S.—The Drummondville station I heard some three months back.

In reply to your request for details of the new Regional station now working from Brookman's Park, I received splendid signals on the Guaranteed Reflex from this transmitter when at Potter's Bar from mobile van.

Portsmouth.

RESULTS WITH WET BATTERIES.

The Editor, POPULAR WIRELESS.

Dear Sir,—With reference to the correspondence a few weeks ago from the Wet Battery Company, I fully support their claims as to the efficiency of the Leclanche batteries.

In a back number of "P.W." (No. 265, July, 1927) this firm gives practical details of same for L.T. supply.

Having made and used several types of primary batteries previously this particular type was made and given a severe test to supply a two-valve set, and I am pleased to say it has given satisfactory results for just a year without trouble of any kind.

My own four-valve set, H.F., Filadyne det., and two L.F. transformer-coupled, is supplied with this type of cell for H.T. 108 volts, and this has lasted 14 months without changing same.

It is also interesting to note the "grid bias" which was made of 6 cells, 9 volts. It was built up two years ago in August, and is only a shade under 9 volts at the present time. I fully realise current is not taken from this battery, but it shows the efficiency and reliability of this type of cell.

Wishing "P.W." future success.

Yours faithfully,

F. CRAMPHORN.

Coventry.

CAPACITY EARTH

The Editor, POPULAR WIRELESS.

Dear Sir,—I have been trying the relative efficiency of a capacity earth as against that of an outdoor earth, and perhaps the following may be of interest:

Data: Aerial—indoor under roof. Set—Crystal set with Hertzite detector. Outdoor earth—Earth pin 2 ft. in damp ground (it had been raining all night) with 25 ft. lead of insulated cable to set; 20 ft. of this was stretched from window sill to set at an average height from floor of about 2 ft. Capacity earth—25 ft. of insulated cable on floor close to skirting board. Cullercoats distant about 10 miles. Newcastle distant about ½ mile.

Using the outdoor earth I tuned in to Newcastle and got very poor crystal strength. On tuning to Cullercoats, signals could be heard some feet from the 'phones.

Using the capacity earth the signals from Newcastle could be heard several feet from the 'phones, whilst those from Cullercoats were as nearly as possible inaudible.

Perhaps some of our experimenters can suggest a reason why the two earths should behave in opposite ways with signals from the above two stations.

Yours truly,

BERT THOS. ORD.

Gateshead.

SHORT-WAVE NOTES.

By W. L. S.

THIS week I have to thank several correspondents for interesting letters, particularly Mr. N. C. Hardman (G 2 P O), who has sent three long letters concerning the transatlantic 'phone, about which I asked for details a week or two back.

He has put matters completely right, as far as I am concerned; but I will not publish all the details in full. A notable point is that on each side of the Atlantic there are two transmitters and receivers dealing with the same speech, presumably with a view to the elimination of fading.

That on the American side is mostly handled by W M I and W N D, both of the American Telephone and Telegraph Co. Rugby, G B T and G B U, handles the outgoing traffic at this end, while the receiving stations at this end are in Fifeshire

Transatlantic Telephony.

Mr. Hardman has had a long-wave and short-wave receiver coupled to the same output transformer and has been able to get both ends simultaneously. Many correspondents do not seem to realise that the transmissions from this country are chiefly on 5,000 metres odd, using the side-band system of telephony.

The 'phone that everyone seems to be receiving is just below the amateur 20-metre band, the lower limit of which is 20·8 metres, so presumably this is one of the stations working from W N C, wave-length given as 20·73 metres. This also works on 30·77, 22·4 and 16·1. There are some twelve short-wave transmissions on this side from Rugby, but it does not seem as if they are always in operation, whereas the long-wave side is apparently always to be heard.

Just recently, the 20·73-metre station has been working with the loud speaker on which they receive the replies within earshot of the microphone, so that one has been able to hear both ends on the same setting. Another effect of this has been the setting-up of an awful microphonic howl which makes the outgoing speech rather difficult to follow.

Another correspondent reports using the "P.W." "All-Purpose" Three, described in May, 1928, and has got down to something in the neighbourhood of 14 metres with it. He is getting W 2 X K on 17·34 metres on about 140 degrees on his dial! I don't think you can have reached 10 metres, "E. F. B.," as a single-turn of much smaller diameter than you mention is the coil I use for the job.

Short-Wave Journals.

"H. E. H." asks what journal or journals one can take who desires to interest himself solely in short-wave transmission and reception. There is rather a large choice here; in this country the purpose is best served by the R.S.G.B. official organ, "The Bulletin," published monthly to members. From the States there is Q S T, obtainable monthly from bookstalls, or by joining the American Radio Relay League. To do this one has only to be interested in amateur radio and send three dollars to the Headquarters at 1711, Park Street, Hartford, Conn., U.S.A.

Regarding the 75-cm. transmitter I mentioned some time back, fuller information on this is obtainable from Q S T, or from the A.R.R.L. Handbook, which contains all that the average person is ever likely to want to know about short-wave radio communication.

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If you are buying an eliminator, be sure to see a Lissen Eliminator. Your dealer will be pleased to show you one that will suit you.

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D.C. Model "A."
Employs 3 H.T.+ tappings: H.T.+1 giving 80 volts for S.G. valves; H.T. +2 giving 60 volts at approx. 2 mA. for detector valves H.T. + 3 giving 120/150 volts at 12 mA. Price **27/6**

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Employs 3 H.T.+ tappings: H.T.+1 and H.T.+2 are continuously variable (by means of two control knobs) and capable of giving any desired voltage up to 120/150 volts at approx. 2 mA.; H.T.+3 giving 120/150 volts at 12 mA. for power valves. Price **39/6**

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„ 577	„ „ „ „	220-230
„ 578	„ „ „ „	240-250
„ 639	„ „ „ „	100-110

PRICE **£3 : 0 : 0**

A.C. Model "B."
Tappings as in D.C. Model B.

LN 579	for A.C. Mains voltage	200-210
„ 580	„ „ „ „	220-230
„ 581	„ „ „ „	240-250
„ 640	„ „ „ „	100-110

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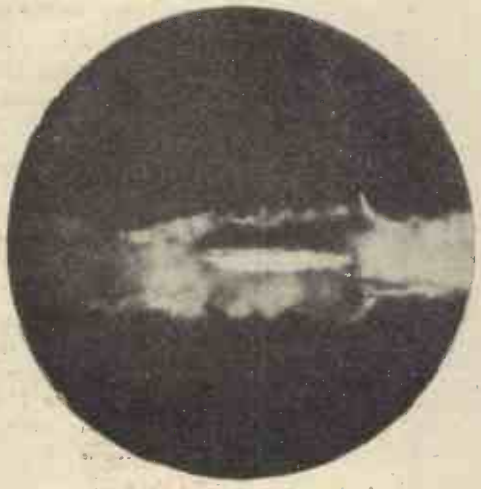
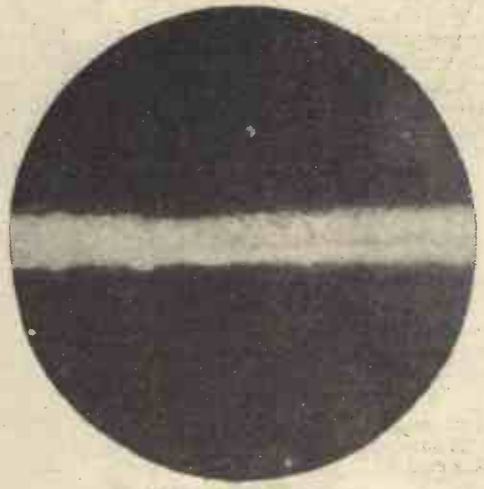


A BAD Filament
WITHOUT
"TENACIOUS COATING"

This reproduction shows part of the filament of a badly coated valve before use, showing a serious gap in the coating. A gap such as this starts the valve off in its life with a poor performance. The valve then prematurely fails.



A GOOD Filament
WITH
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Reproduction from an untouched micro-photograph showing the coating typical of all OSRAM VALVES. Notice the absolute evenness of the coating. There are no gaps, the coating clings, so that the full benefit of the coating is maintained. The secret is the startling discovery of the scientific process of "TENACIOUS COATING."

WRITE *for booklet "OSRAM WIRELESS GUIDE" (1929 edition) giving full particulars of the full range of OSRAM VALVES with the "TENACIOUS COATING." Also helpful wireless information of importance to every listener. Sent post free.*

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A SURVEY of the B.B.C.

By the Editor

This is the second article of a short series in which the machinery of the British Broadcasting Corporation is candidly criticised. It is the best-informed series of articles that has been published, and discloses behind-the-scenes details that are seldom, if ever, made known to the public.

2. THE PRESENT POSITION OF THE ADMINISTRATION.

IN the first article of this series it was explained that lack of unanimity between Sir John Reith and the Board of Governors was leading to a crisis. Various expedients were suggested for relieving the strain, and it was hoped that a solution would be found which, while implementing the constitution of the B.B.C., would make it possible for Sir John Reith to continue as Chief Executive indefinitely. Incidentally, it was deplored that such a large proportion of the time and energy of the heads of the B.B.C. was being diverted from broadcasting to the difficulties of reconciling administrative "opinions." I now turn to an examination of the actual administrative machine.

[Mr. R. H. Eckersley, who is chairman of the Programme Board.

Pioneering.

When I explained the administrative scheme of the B.B.C. two years ago I was able to describe it as in many respects a model organisation. The new Board of Governors had not yet attempted to do more than their predecessors; in other words they had accepted and carried forward the old B.B.C. Sir John Reith was in every sense dictator of everything connected with Broadcasting. He had at his right hand Admiral Carpendale, who earned a terrific reputation as a disciplinarian in the Royal Navy, and lived up to his reputation.

Unquestioning obedience to high authority, total absorption in the work, and a general attitude of intensity—these were outstanding characteristics of a product of the old administrative system of the B.B.C. There were, of course, disadvantages—lack of resilience, an attitude of aloofness, and almost Calvinistic austerity and gloom.

But good programmes were produced. There was still the first flash of enthusiasm—something of the feeling of pioneers—and this goes a long way to overcome obstacles, disappointments, and stupidity. On the whole, the spirit of the staff in the twenty-one stations was good.

After Two Years.

Two years have passed, the old system of distribution by numerous stations of low power is now in process of being superseded, with the advent of the Regional Scheme. What is the form and the effect of the present administrative machinery? Nominally of course, the Board of Governors are the Trustees of the Public, and as such are responsible for all the deeds and misdeeds of the B.B.C.

As explained in the first article the intention of Parliament in granting the Charter was that the Governors should constitute a "working" Board and not a "dummy" Board, and it was for this reason that generous stipends were sanctioned. But the Board of Governors has still a lot to do. Sir John Reith remains Chief Executor. He is still Dictator whenever a point of real importance has to be dealt with. For a time, he experimented with a mild variety of devolution.

He thought of reposing an increasing degree of responsibility on what he called the Control Board—that is, an informal committee of the heads of executive departments. This experiment was soon abandoned, although the formality was perpetuated. All real authority is centred in Sir John Reith. What little devolution has taken place is designed to prepare the way for Admiral Carpendale to succeed Sir John Reith when the latter decides to leave the B.B.C.

Too Much Organisation.

When I discussed this subject two years ago, I detected an incipient tendency to create and to extend an artificial distinction between broadcasting and something separate but superimposed, some great mysterious thing called "expert organisation." This tendency has not abated in the interval. Savoy Hill and its chiefs think far too little about broadcasting and far too much about organisation.

Just as in theory the Control Board controls the important policy, so, in theory, the Programme Board takes programme decisions. The Programme Board consists of the heads of the various departments

Mr. E. R. Appleton, Director of the Cardiff Station, giving a running commentary of an important event.

(*Continued on next page.*)

A SURVEY OF THE B.B.C.

(Continued from previous page.)

of the Programme branch, namely, the officials responsible for music, drama, education, religion, balance, talks, outside broadcasts, and finance.

But, in practice, the real decisions are taken by the chairman, Mr. R. H. Eckersley, acting in consultation with Mr. Grossmith and Mr. Filson Young, who assist him in interpreting the wishes of the Director-General and the Controller. And that is the present administrative machine of the B.B.C. What of its products and results? First of all, then, the average standard of programmes has improved considerably in the past two years. Music is better, although still in need of more positive direction; radio drama is immeasurably better; talks have improved; education has developed; religion is about the same.

There is almost a disagreeable absence of mistakes. The elegant polish of the anonymous announcers is organised to a pitch of irritation. There is no doubt at all that the pioneering period of the B.B.C. has given way to something not unlike the robotism of current literature. The "high spots" are not there now; nor do they appear to be sought. The programmes reveal the supremely tidy mind of the perfect organiser. Even their rate of progress and improvement seems to be controlled and organised.

This state of affairs has undeniable advantages; it is foolproof; it provides a steady average output and performance; by keeping just "good enough" it avoids stimulating demand. On the other hand it enshrines mediocrity; it discourages genius as distinct from talent; it makes this machine age rather more than less the machine; and, what is even of more practical importance, it cannot maintain its momentum; it inevitably slows down in the absence of genius or enthusiasm.

The Present Position.

The present position of broadcasting administration in Britain needs attention. The original pioneering enthusiasm has waned. The executive chiefs are so interested in the abstract problems of organisation that broadcasting suffers. There is a distinct and increasing deficiency in humanity. Anonymity has been applied to an extreme extent.

The staff of the B.B.C. is disciplined out of individuality. The habit of unquestioning obedience is so implanted that it influences the attitude of ex-employees long after they have resigned. There is far too much of the successful factory and far too little of the inspiring spiritual dynamo.

So much for broadcasting administration at headquarters.

What of the Provinces? It was there that we found most hopeful ground two years ago; more humanity, more understanding of the psychology of the listening millions. To-day, alas, the B.B.C. outside London is sadly reduced. The best of it is at Manchester and Birmingham. Mr. E. G. D. Liveing and Mr. Percy Edgar look after the North and the Midlands with conspicuous understanding and success. Mr. Liveing's grasp of the human problems of the North has served the B.B.C. in good stead. Mr. Edgar has overcome the greatest difficulties in founding a new Midland Region for the B.B.C.

There is real personality in the work of both Manchester and Birmingham. The Northern Wireless Orchestra for Mr. Liveing and the 5 G B Orchestra for Mr. Edgar have been wonderful recruiters both of licences and goodwill for the B.B.C. Until recently the headquarters of the B.B.C. had the good sense to leave the main provincial centres with a reasonable amount of autonomy and local initiative. But the tendency now is to restrict this.

In the Provinces.

Again the fetish of organisation! I have already mentioned Manchester and Birmingham. In Scotland, Mr. Cleghorn Thomson has done wonders. Scottish programmes are now of real artistic merit; rather too good, indeed, for regular admission to S.B.! Mr. Thomson has gone one better than his colleagues at Manchester and Birmingham. Anticipating the new "organisation ramp," he took the initiative in reducing his staff, retaining only a nucleus of first-class material. He has now reorganised this, retaining his freedom of action and the characteristics of his work across the Tweed.

Then down in the West there is Mr. Appleton hard at work making the new Region that will comprise Wales as well as the West Country. Here, again, the mainspring of organisation is humanity and sympathy, with ever-improving results.

So once again it is in the Provinces that broadcasting organisation is best. And, of course, this is because in the Provinces the B.B.C. officials think about broadcasting and not about the abstraction of organisation. But, alas, if present intentions materialise, there will be no successes of the kind to record in a year or two, for the simple reason that there will be no B.B.C. officials in the Provinces. Savoy Hill goes on steadily reducing the Provinces and expanding the already unwieldy mass in London.

Mr. Percy Edgar, the Birmingham Station Director, hard at work dealing with criticisms and appreciations from his army of listeners.

Centralisation.

The argument is that it is cheaper and more efficient to do most programmes in London now, and that when the Regional stations are finished, all programmes will originate in London. This is the objective which Mr. R. H. Eckersley is seeking with all the determination and inflexibility for which he is noted. This is the objective which Sir John Reith has accepted and recommends to his Board of Governors.

A completely centralised organisation for the B.B.C. is certainly commended on grounds of mathematics, and probably on all the grounds familiar to the expert "organiser." But this alone does not make it either right or expedient. There are factors of vastly greater importance. Is the B.B.C. to kill what is left of the imagination, humanity, and initiative of its provincial workers?

How much better it would be to envisage the new problems presented by the Regional Scheme in the way that Captain Eckersley would do. Let the Regional Scheme go on to technical fulfilment; but allow programmes to be originated with the full character and traditions of each Region; let contrast be in point of view as well as in artistic variety and standard.

The B.B.C. is in danger of being organised out of existence. I suggest to those whose responsibility it is to take stock afresh, and not to rest until they hear the approval of the "still small voice" of humanity.

CONCERNING ACCUMULATORS.

An accumulator is a very robust piece of apparatus, provided it is looked after carefully.

* * *

The voltage of an accumulator should never be allowed to drop below 1·8 in the case of a 2-volter; 3·6 in the case of the 4-volt battery; or 5·4 for a 6-volt accumulator.

THE HYDROMETER TEST.

One of the best ways of testing the condition of a low-tension accumulator is by means of a hydrometer (instructions for use are supplied with this).

* * *

The liquid in an H.T. accumulator should never be spilt upon the case.

* * *

It is useless to expect really good quality unless you have ample H.T. voltage and current available for the various valves.

* * *

Any leakage, however small, across the insulation of an H.T. accumulator constitutes a continuous discharge, so that great attention should be paid to maintaining the insulation as perfectly as possible.

* * *

To restore the level of the electrolyte of an H.T. accumulator after loss by evaporation, use only distilled water (obtainable from any chemist).

CLEANLINESS ESSENTIAL.

Keep the terminals of your accumulators clean and bright, using sandpaper or a file if necessary, and maintain a coat of petroleum jelly on all enclosed metal parts to protect them.

* * *

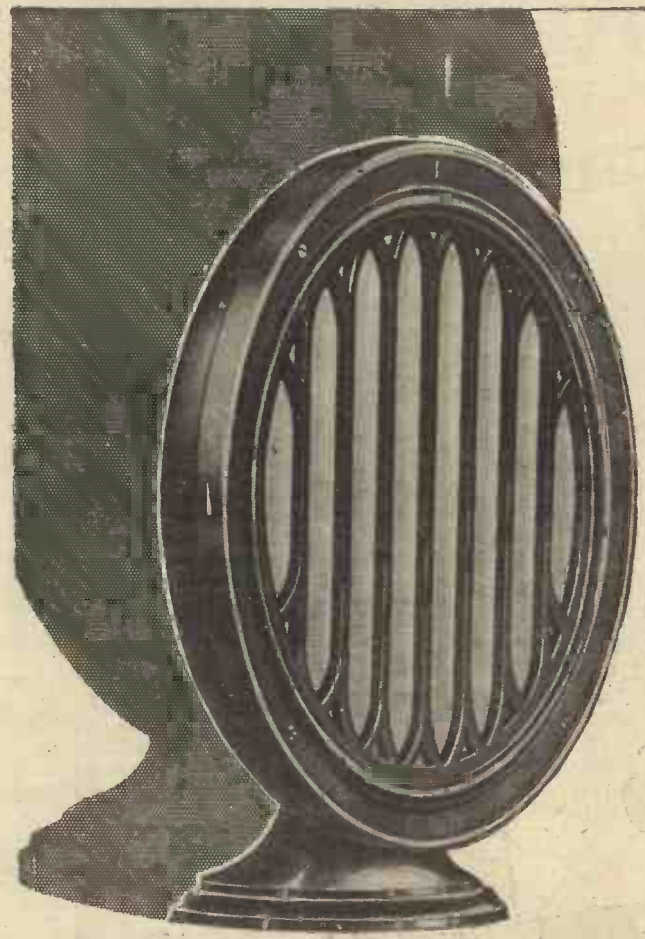
The short strip of a flashlamp battery is the positive terminal and the long strip is the negative.

* * *

Complaints of oscillation produced by neighbours' sets or by electric motors, etc., should be addressed to the Chief Engineer, B.B.C., 2, Savoy Hill, W.C.2.

BEAUTY · TONE AND HARMONY · · THAT'S

B T-H



The most critical listener with the most sensitive ear—these speakers were designed to please him.

Nor was appearance an afterthought. Both these speakers are finished a rich brown colour and have decorative grilles backed with gold gauze.

Whichever you choose—the speaker to suit your pocket—you will know that you have an instrument which will satisfy you.

The B.T.H. Cone Speaker.
PRICE £3

B T-H

The B.T.H. C.2 Loud Speaker.
PRICE 45/-

LOUDSPEAKERS
EDISWAN RADIO PRODUCTS

ADVT. OF
The EDISON SWAN ELECTRIC CO., LTD.,
HEAD OFFICE & WEST END SHOWROOMS, EDISWAN RADIO DIVISION:
1a, NEWMAN STREET, OXFORD STREET, W.1. (Museum 9801).
SHOWROOMS IN ALL THE PRINCIPAL TOWNS.

W.18.

They *must* be good — 3,000,000 Valveholders already sold!

CLEARER-TONE VALVEHOLDER

The original Clearer-Tone Valveholder, in face of considerable low price competition, has more than held its own and will be continued at

2/-

VIBROLDER

The Benjamin Vibrolder was last season's most successful accessory, the self-aligning feature ensuring positive contact with all types of English 4-pin valves.

1/6

5-PIN VALVEHOLDER

Designed for use with the new 5-pin valve with centre leg. The Benjamin anti-microphonic feature is incorporated, and also patented contact, which ensures perfect contact when using either solid or split pin valves.

1/9

Seen the new Switch?

Some people say "Turn off the wireless"—and that's just what you do with this rotary switch. It's an attractive alternative to the usual pull and push type. All insulated, with indicating "On" or "Off" dial, pointer knob, terminals, and double contact. Suitable for use with panels up to ⅛-inch thickness. Quick make and break action . . . **1/9**

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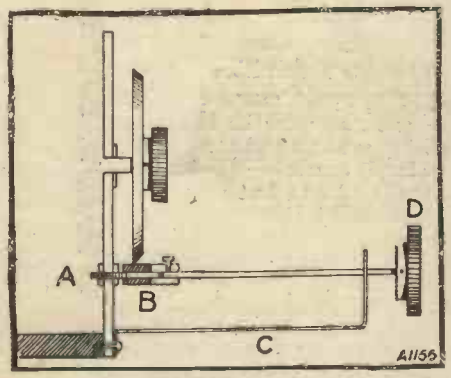
CAPT. ECKERSLEY'S QUERY CORNER

Under the above title, week by week, Capt. P. P. Eckersley, M.I.E.E., late Chief Engineer of the B.B.C., and now our Chief Radio Consultant, will comment upon radio queries submitted by "P.W." readers. But don't address your queries to Capt. Eckersley—a selection of those coming to the Query Department in the ordinary way will be dealt with by him.

Overcoming Hand-Capacity.

E. McN. (Edinburgh).—Is there any effective way of overcoming hand-capacity in a short-wave receiver? I have tried a copper screen behind the panel, but this does not seem to make things very much better."



This method of avoiding hand-capacity was suggested by a reader of "P.W." A is a piece of Meccano rod, 1 in. long and tapped for half its length, held to panel by one nut each side. B is a Meccano coupling link which revolves on A and carries a 4-in. spindle fitted with a knob, D. C is a Meccano strip which acts as a support for the spindle. With a piece of bicycle inner tube fastened round B, this apparatus will be found to give a very smooth control and will be free from hand-capacity.

Enclose the whole of your H.F. circuits *completely*, take the aerial well away from near your hand, and you will have no trouble. Lots of people, to save expense, extend their handles right out away from the set and get over their troubles this way.

* * *

Using a Frame Aerial.

G. O. L. (Sevenoaks).—"I have a portable set incorporating a frame aerial. I have always understood that one had to rotate the set in order to obtain the correct direction for a particular station.

"In my case the frame brings in a number of stations without my having to rotate the set, in fact, it does not seem to possess any marked directional properties. Why is this? Is it because I am using the set in the house?"

The point is that the set ought to have to be rotated only on the rare occasions when the direction of the station to be received is at right angles to the length of the box (or parallel to any line going front and back at the least distance—i.e. parallel to its depth). Nearly every portable has a frame aerial, and this will receive nothing if it points at right angles to a station's direction.

It receives well in any other position, hence, of course, you bring in a number of stations without rotating the set. But choose one and slowly turn the set. Is there a defined position where it disappears? If so, you are getting a true direction effect.

Sometimes, when there is a lot of steel-frame building about, this effect is not noticed. Try the set outside, away from buildings. Sometimes the frame is series earthed; in this case it has no directional properties.

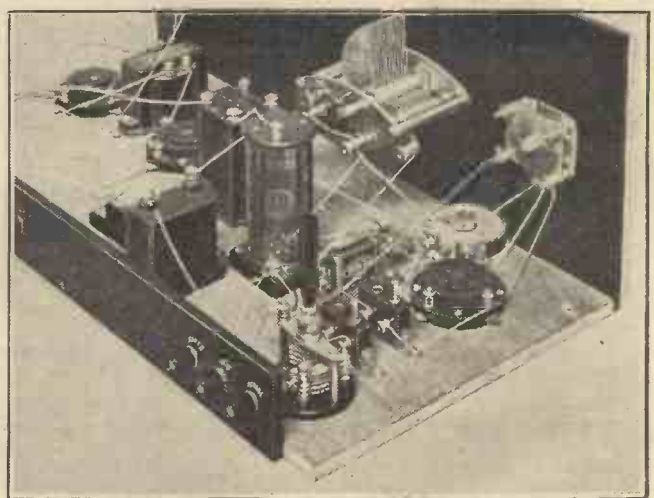
Short-Wave Reception.

C. W. R. (Southall).—"Although I am only about thirty or forty miles from 5 S W, I am unable to hear this station as satisfactorily as some of the American short-wave stations, which in some cases use less power. Why should this be?"

Short waves have this property, that the direct or ground wave, i.e. the wave which we use in broadcasting for local reception, dies out very quickly, say in 10 to 20 miles from 5 S W.

But the upward radiations go on up to the Heaviside Layer, where they are turned down again and impinge on the earth a few hundreds of miles from their point of origin. They "come down" at what we call a "skip distance," and you are within that distance, and 5 S W's radiations are passing over your head in an arch of radiation.

Not so America; you are getting their radiations as they come down from above, but someone twenty or thirty miles from 2 X A D, etc., would hear nothing.



The "Magic" Three is specially designed for use on the short-waves, as well as on ordinary broadcast wave-lengths.

Olympia's Masterpiece!

—and its price is only

£8·15s.

Price includes the three Cossor Valves of the latest type, the handsome one-piece cabinet and all the parts necessary for its rapid assembly.

Also for A.C. Mains operation—works direct from the electric light mains. Supplied complete with three of the latest type Cossor Mains Valves, factory-built and tested A.C. Mains Unit, handsome one-piece cabinet and all parts . . . . . Price **£15.0.0**

One dial Control

The 1930 Cossor Melody Maker is simplicity itself—anyone can use it—no "tricky" tuning—turn only one knob to hear the programme you want.

No coils to change

Coil changing is ended with the 1930 Cossor Melody Maker. When you want to hear Daventry, Paris or any other long-wave station—merely twist a knob.

Only 10 components— only 20 wires

In spite of its wonderful power—its ability to bring you over thirty programmes any evening—even while your local station is working—the Cossor Melody Maker is amazingly simple—only 10 components to mount—only 20 wires to connect—that's all.

NEVER before has any Receiver created such a sensation as did the 1930 Cossor Melody Maker at the Olympia Radio Exhibition. From morning till night huge crowds surged round this wonderful Receiver—eager to view its handsome one-piece cabinet richly lacquered in two-tone blue—eager to examine its three simple controls—one knob for tuning—one knob for volume and one knob for wave-lengths. And then they looked inside and saw the amazing simplicity of its assembly—the Synchronised Control Unit, factory-built and factory-tested—the 9 other components and the 20 connecting wires. In an hour or so anyone—without previous Radio knowledge—can assemble it and obtain results equal to a costly factory-built Receiver. And the same Receiver can be converted to all-electric operation by the simple addition of the factory-built Cossor A.C. Power Unit and three Cossor Mains Valves. Go and see this amazing Receiver at your Dealer's—he'll be glad to tell you all about it or—use the coupon.

Use this Coupon NOW

To Messrs. A. C. Cossor Ltd.,
Highbury Grove, London, N.5

Please send me free of charge a Constructor Envelope giving full details of 1930 Cossor Melody Maker (a) A.C. Mains Model (b) Battery Model.

(Please strike out one, you do not require)

Name .....

Address .....

P .....

If you are interested in the A.C. Mains Model please give voltage and cycles of your house supply. .....

A. C. Cossor Ltd., Highbury Grove, London N.5.

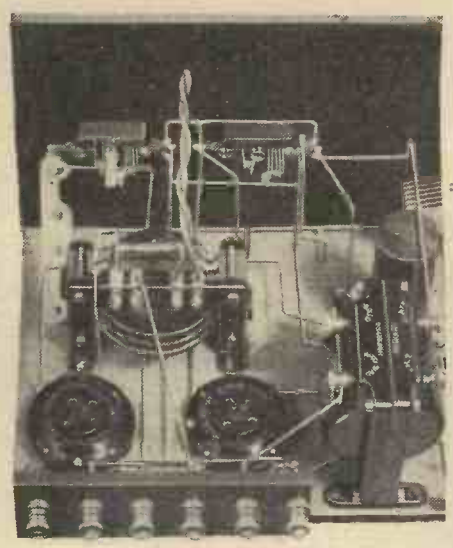
The 1930

Cossor

"Melody Maker"

Britain's Greatest Radio Achievement!

955 CA



CURING - - INSTABILITY

Does your set suffer from self-oscillation or other forms of instability? If so this article will help you to cure the trouble. Many useful hints for the successful construction and operation of valve receivers are given

By L. ROBINS

A CORRESPONDENT writes to say that he is unable to use any reaction on his set, it being too fierce, the set bursting into oscillation at the slightest provocation, although good components are used throughout. Our correspondent ends up by asking how he can obtain smooth reaction.

Uncontrollable Reaction.

The set in question is an ordinary four-valver with a screened-grid valve, a detector worked on the leaky-grid principle, followed by a resistance-coupled stage and a transformer stage of L.F. amplification. The reaction is carried out in the usual way by means of capacity control from the plate of the detector to a coil wound in series with the grid coil of the detector valve.

Just a plain Reinartz reaction system, and from the correspondent's remarks it is not possible to lay one's finger right on the trouble. You see there may be only one fault or there may be two or three causes which, when added together, give the result indicated—that reaction is so fierce that it is of no use attempting to employ it.

Apparently the set is on the verge of oscillation all the time, so that the slightest touch of the reaction condenser throws the set into oscillation immediately.

H.F Feed-Back.

The screened-grid valve may have something to do with the trouble. It may not be operating at its best owing to inadequate screening—there may be feed-back between aerial coil and the detector coil, that is the coil in the grid circuit of the detector valve—or there may be reaction between the grid coil of the screened-grid valve and its own tuned anode, if the tuned-anode system is employed. I would advise our reader to take care that no feed-back between the H.F. circuits is occurring, for if this is the case the set will always be on the verge of oscillation.

The next thing to look at is the reaction condenser itself and the winding of the reaction coil. Fewer turns on the reaction coil might cure the trouble, but if this is a standard coil, then a ·0001 mfd. in series with the reaction condenser may give some slight assistance. This will bring the total maximum capacity from the plate of the detector circuit to the grid circuit down to ·00005 mfd., instead of ·0001 mfd., assuming that the present reaction condenser is only ·0001 mfd., and also reduce the minimum capacity somewhat. If this condenser is of a higher value, then it would be advisable to substitute one of a lower maximum capacity. Our reader might try using a ·0001-mfd. variable condenser between the plate of the valve and the filament negative lead.

The H.F. choke also may be at fault, having peaks on certain wave-lengths.

No information is given as to the type of detector valve in use, or as to the H.T. voltages employed. It is possible, of course, that a lively type of valve is the cause, or too much H.T. may be used, while it is also possible that there is a fault of some description in the grid-leak circuit, so that the grid of the valve is "floating," and thus causing the instability.

Careful Screening Essential.

Another value of grid leak may materially assist, a value of say 1-megohm being employed, the constructor being careful to see that it goes to the L.T. positive lead, and that it really makes good connection.

If the set is completely unstable, however, I should be very inclined to suspect the screened-grid H.F. valve. This valve may be on the verge of oscillation always, owing to feed-back, especially if an ordinary vertical screen is employed and one of the latest upright types of screened-grid valve, and the coils on either side of the screen are not too carefully placed.

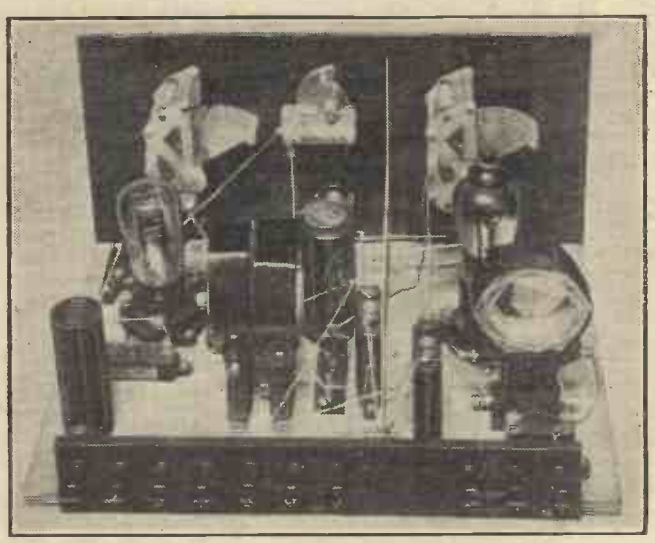
Six-pin coils placed vertically are prone to interact, so experiments in the screening of this stage by means of completely covering the coils with metal screens should be carried out to ensure that the screened-grid valve is not causing the trouble.

Incidentally, while dealing with this end of the set it might be worth while to find out the exact condition of the earth plate. If this is not up to scratch then instability may occur and the constructor will do well to make himself conversant with this point, as well as on the point regarding the screening.

Battery Coupling Effects.

We are concluding, of course, for the purpose of this article, that the H.T. battery or eliminator is above reproach, and that no resistance-coupling effects between circuits are occurring here. Resistance-coupling effects between the detector and the other circuits might quite reasonably cause instability, the set tending to burst into oscillation upon the slightest provocation.

In order to make absolutely sure the set shall be stable, it should be well screened where necessary, and bypass condensers should be placed between earth and places such as the following: The screening grid of the screened-grid valve; such places as the H.T. side of the tuned-anode coil; an anti-motor boating device from the H.T. lead of the detector valve may also be of assistance.



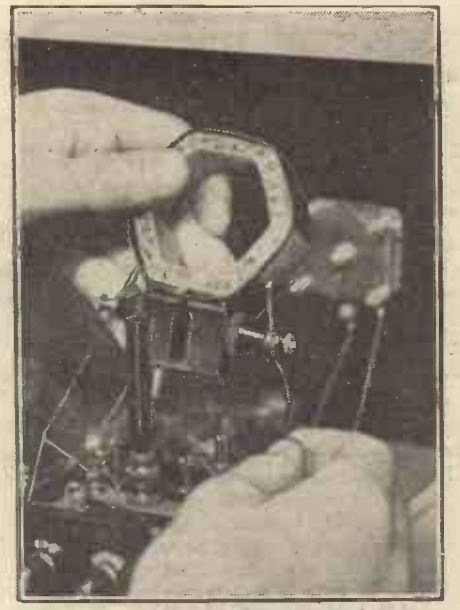
The careful screening of the S.G. valve and the aerial coil from the rest of the set is essential if stability is to be obtained.

The Output.

Finally it must not be forgotten that if the loud-speaker wires are taken close to the H.F. end, this may cause sufficient feed-back for instability to occur and upset the handling and reproduction of the set.

It is always advisable to have a filter-output circuit or an output transformer to isolate the loud speaker from the set and to keep the speaker well away from the H.F. end of the receiver.

If an output transformer is used it will not act as a decoupling device as will the output-filter circuit, so it is preferable to employ the latter in a set that is prone to instability.



Where the flex tapping lead goes on a Lissen "X" coil.

OUR original idea was to devote the greater part of this article to instructions for operating and getting the best from the "Magic" Three, but the set has turned out to be so simple to work that we could not possibly occupy three pages in telling you how to do it!

We will give you all the details you are likely to need, but we shall not by any means fill our space in that way, and so shall have a welcome opportunity of discussing a number of other quite interesting little points for which we could not find room last week.

Why It Is So Stable.

First we should like to explain a few points about the stability of the L.F. side of the "Magic" Three. We took a great deal of pains over this part of the set, and the margin of safety of any good copy of the original design should be very considerable. Since, however, some constructors may want to make little modifications of their own, in the way of using up components which they may have on hand and so on, it may be as well to explain briefly what makes the L.F. side so stable, so that they may be sure of similar good behaviour in their own models.

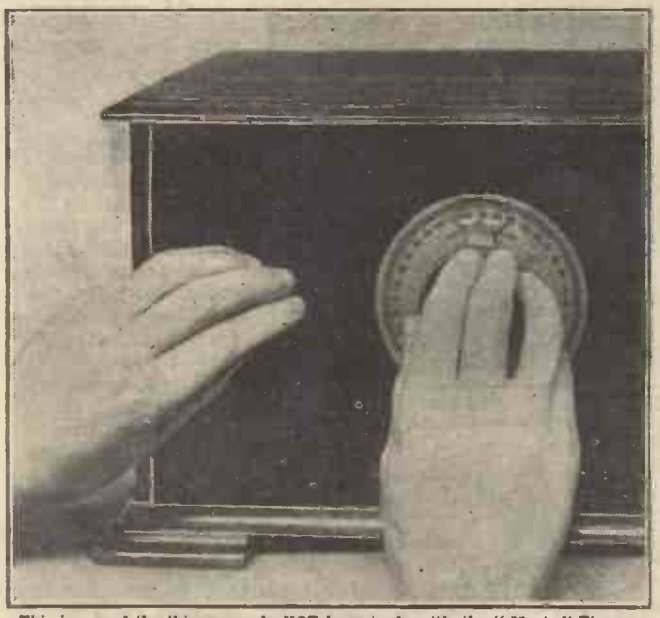
First of all there is what is called an anti-motor-boating filter in the H.T. lead to the detector valve. This takes the form of the usual series resistance, which was of 25,000 ohms in the original set, with a large reservoir condenser shunted down to the L.T. circuit from the junction point of this resistance and the primary of the first L.F. transformer. The value of this resistance is not at all critical, and anything from 25,000 to about 60,000 ohms is quite suitable. The lower value, as a rule, gives a slightly smoother reaction control.

A Point for Mains Users.

The reservoir condenser has a capacity of 2 mfd., and this is quite large enough for all general purposes. The arrangement as it stands is a very good preventive of trouble from battery-coupling effects, but it is interesting to note that where a very old and high-resistance battery may be causing a little trouble, a slightly better decoupling effect can be obtained by increasing the capacity of the condenser C_5 to 4 mfd. by placing another 2 mfd. in parallel therewith. This point is chiefly of importance to those who use mains units of a type which may be a little prone to motor-boating.

The careful layout of the L.F. side has a good deal to do with the stability obtained, and here all we can say is that you should make a rather careful copy. It is not as a rule desirable, by the way, to use exactly the same type of transformer in both stages, and you will note that in the original set we used specimens of two different makes. This is rather a good plan, and the reader is advised to do likewise, unless he is sure that the particular pair he intends to use are stable when used in conjunction with one another. There are certain makes in which two exactly similar specimens can be used in cascade with entire safety, of course.

Another important little point in connection with the L.F. transformers is this. Some makes are provided with a means of earthing the metal core of the transformer, and where this is present it should certainly be used on at least one of the two transformers. In the original set we found it quite sufficient to earth the core of the second transformer, which is of a type which has a little soldering lug projecting near one of the feet for the purpose. This connection you will see on the blue print and also in the circuit diagram. In the case of some other makes you will find that the manufacturers tell you how to make this connection by soldering a wire to one of the screws with which the transformer is fastened down to the baseboard.



This is one of the things you do NOT have to do with the "Magic" Three: constant checking and re-checking of tuning and reaction adjustments.

It may be of assistance to explain just which wire does the earthing of the second transformer which we have mentioned, and this is how you can spot the lead in question. It is shown in the blue print, and you will notice that the two filament terminals of the valve sockets V2 and V3 towards the back of the set are wired almost directly together, but the wire diverges slightly from the straight line and is soldered in passing to the earthing tag of the transformer.

Before we leave this L.F. stability question, here is a hint for the benefit of those who may happen to try out an odd pair of transformers they chance to have and find them tending to give a low-frequency howl. Such a tendency is very rare in this design and can only result from the use of a rather unusual combination of transformers, but an almost certain cure is to be found in the connection of a resistance of about 250,000 ohms (for example, a quarter-megohm grid leak) across the secondary terminals of the second L.F. transformer.

That Space on the Panel.

Next, there is a detail about the panel layout we should like to explain. You may have wondered why we crowded the parts upon the panel up towards the two ends, leaving a blank space in the middle of the set. Well, this was done deliberately in order to leave room for the later addition of certain little refinements which we shall be telling you about in a future issue. We realised at the beginning that it was not possible to produce a single design which would please everybody, and so we have adopted the scheme of giving you first of all a quite simple version of the set, and we intend later to go on and show you how to add a number of little refinements such as a volume control, a built-in output filter, and so on, so that you can if you like turn it into quite a de luxe affair fitted with all the little refinements so dear to the heart of the more advanced constructor.

We have already worked out these details, and we shall be showing you later how to add them with the very minimum of alteration and without any scrapping.

Some further deta
hints concerning
three-valver desc

By THE "P.W.
DEPART

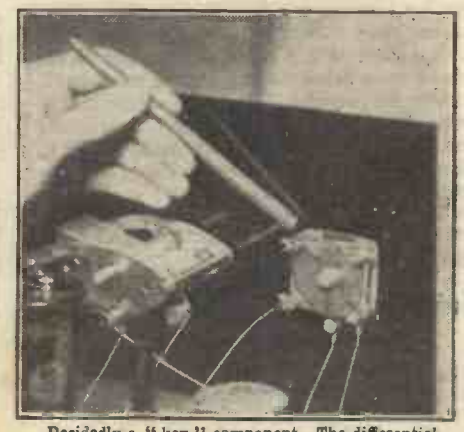
SHORT WAVES, LONG WA

rout C" E

s and operating the remarkable bed last week. RESEARCH MENT.

The choice of valves for use in the "Magic" Three is quite a simple matter; 2-, 4-, and 6-volters all work excellently in this receiver, and the decision here rests entirely with yourself. The 2-volters are much the more economical, but, of course, the 6-volt types possess slightly better characteristics, and so you will decide simply in the usual way between economy with good results or the super results to be obtained with the 6-volt class.

As a matter of fact, however, this set is not one of those which show up the difference between 2-volters and 6-volters very



Decidedly a "key" component. The differential reaction condenser.

clearly, and you need not be afraid that if you use the economical 2-volters it will give you results short of those we have claimed.

The Valves to Use.

For the detector you want a valve of the H.F. type, which usually has an impedance of from 20,000 to 30,000 ohms or thereabouts. There is nothing critical here, and any good make such as Cossor, Ediswan, Marconi or Osram, Dario, Mullard, etc., will give you the desired results. In the second socket, that is to say in the first L.F. stage, you want either a valve of the same type as before or one of the "L.F." or "G.P." type; these latter usually have an impedance of from 10,000 to 18,000 ohms. The choice here is to be made as follows. The H.F. type of valve when used for V2 gives slightly more amplification and so is rather desirable where distant listening is regarded as being of the greater importance. The other type generally gives slightly better quality on really powerful signals such as those of the local station, 5 G B and 5 X X, and enables you to handle slightly more volume without overloading. For all general purposes, however, we recommend the H.F. type, since there is little risk of overloading this stage unless you are trying to get tremendous volume with a very large super-power valve in the output stage.

For the last valve, namely, V3, you want as large a power valve as you think your H.T. battery is capable of supplying in an economical manner. The set is capable of giving you very powerful signals indeed on the local station, 5 G B, and 5 X X, and so you can make really good use of a super-power type. However, these valves require a considerable anode current, and so this type should only be used by those who are employing a mains H.T. unit or very large capacity dry batteries, or of course, H.T. accumulators.

For the smaller type of H.T. battery, such as the single and double capacity, we advise you to use an ordinary power valve here, and so get a reasonably long life from your battery. Such a valve will enable you to get quite a good output, but of course you must not expect to fill a large hall with it and must avoid overloading by keeping down the volume to reasonable limits by de-tuning, etc.

The Battery Voltages.

Grid-bias voltages should be arranged in this way: if you are using an ordinary power valve in the last stage a 9-volt unit should serve quite well. Insert the G.B.+ plug in the positive socket and the G.B.−1 in a socket 1½- or 3-volts negative. The G.B.−2 plug will usually go into the 6- or 7½-volt socket, but this will depend upon the amount of H.T. you are using. You must therefore look up the makers' recommendations on the information slip supplied with the valve and proceed accordingly.

Super-power valves require considerably more grid bias, and since they vary considerably in their characteristics as between different makes you should refer to the slip you will receive with the valve.

The H.T. voltages are very simply adjusted on this set. Connect up the H.T.− terminal to the negative socket of the battery and take a lead from H.T.+1 to one of the intermediate sockets round about 60 volts. This supplies the detector valve, and a little adjustment here in conjunction with a suitable setting of the potentiometer will soon find you a voltage which gives you beautifully smooth reaction.

Mention of the potentiometer reminds us that we had better give you some instructions about the use of this valuable device. If you try the arm in various positions you will probably find that signals are strongest with it fairly well over to the positive end, that is to say round towards the grid leak. Right round at this end, however, reaction is usually not quite smooth, and so you should take it a little

A very important feature is the anti-battery-coupling filter.

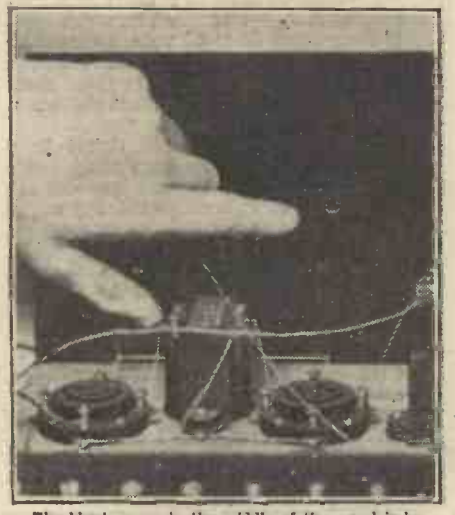
way towards the negative until you find that reaction becomes quite smooth.

Be careful not to go too far, however, since once you have passed the smooth reaction point signals usually begin to get a little weaker, although you will probably only notice the difference on very distant stations. A suitable adjustment of the voltage on H.T.+1 usually helps you to find a setting for the potentiometer slider which is fairly well towards the positive end.

When You Want Power.

The other H.T. terminal (H.T.+2) supplies the two L.F. valves, and here you really want about 120 volts, although less will serve at a pinch. The best results from the point of view of enabling you to handle full volume are naturally obtained with plenty of voltage here, and if you have it available you should go right up to the maximum rating permitted by the makers of your valves, which is usually about 140 or 150 volts.

(*Continued on next page.*)



The blank space in the middle of the panel is intended to allow a volume control to be fitted later.

CS, POWER AND PURITY

MORE ABOUT THE "MAGIC" THREE.

(Continued from previous page.)

There are only two coils in use at any one time in the "Magic" Three, and so the question of sizes is quickly settled. For L_1 you require a No. 60 "X" coil for the ordinary broadcast waves and a No. 250 "X" for the long waves. For L_2, which is the reaction coil, you will require about a No. 35 or 50 for the lower wave-band and a No. 100 for the upper range.

The exact size of reaction coil for the very best results should really be determined by trial, since it depends to some extent upon the particular detector valve you are using. It is a very simple matter to find one which gives you a good control of reaction over the whole tuning range, and this will not take you long.

Selectivity Adjustment.

Two degrees of selectivity can be obtained with the set on each wave-band, by means of the flex lead which is marked on the wiring diagram as going to the tap on L_1. The "X" coil, as you probably know, is provided with two tapping points, and by connection to one or other of these you can get either normal selectivity and full volume, or else very high selectivity and slightly less volume.

It is therefore best to find out by test which suits different conditions. In very extreme cases where you are very close to a local station and must have an abnormal degree of selectivity, it is worth noting that you can sharpen up tuning still further by connecting a fixed condenser of ·0002 mfd., or thereabouts, in series with the aerial lead to the set, but we do not expect that many people will need to adopt this expedient. The set is actually a very selective specimen of its class, and in all normal use we do not think you will experience any difficulty on this score. Of course, in the very difficult areas close to a local station the usual wave-trap can be used, but this should very rarely be necessary.

Operating instructions for such a delightfully simple set are scarcely necessary. All that you have to do is to learn the knack of adjusting the reaction to keep the set just below oscillation point, and then very slowly turn the dial of the tuning condenser, a trick you will learn in a few moments, whereupon you can proceed to astonish yourself with the number of stations which will roll in every few degrees on the dial so long as your aerial is reasonably efficient.

Now about short waves. The set as it stands will give an excellent account of itself on the short waves, and it is far easier to handle here than any normal short-waver. It is so much easier that the quite average broadcast listener will soon get the hang of it. Just a little patience in learning the extra delicacy of touch needed on the tuning condensers and the reaction control, and you should be able to bring in trans-atlantic stations at good volume whenever conditions are at all passable. You will find if you look up a list that there are any number of short-wave broadcasting stations working nowadays, and the "Magic" Three will open up quite a new world of broadcasting to you, and you will get a new range of stations to listen to.

Getting Easier Tuning.

As the set stands it has a full ·0005-mfd. tuning condenser, and although this is a little large for short-wave work, it is still quite workable with the aid of a really good slow-motion dial. Just a little delicacy of touch on the tuning control is needed, but even this will be unnecessary when you add a very simple little device which we shall be describing in our article next week.

For the short waves you want a set of the special short-wave plug-in coils now sold by a number of manufacturers (Atlas, Igranic, etc.), and for the L_1 socket you require a No. 4 for the interesting band of waves from about 20 to 40 metres. For L_2 a No. 6 is usually suitable. A little experimenting with this coil (the reaction) is needed, just as on the broadcast band.

For the next interesting wave-band, namely the range from about 40 to 60 metres, you will require a No. 6 coil for L_1 and a No. 9 for L_2, and with these two pairs you will be able to cover practically the whole of the short-wave broadcasting stations. On this second pair you will also be able to pick up the amateur stations on 45 metres, and quite an interesting time you will have listening to them.

The aerial coupling arrangement is slightly different on short waves, and you will find that in general the most convenient operation will be with the aerial connected to No. 1 terminal. This brings the series condenser C_3 into circuit, and it will usually suffice to keep this at maximum. If you have any difficulty in getting reaction at some particular place on the tuning dial, however, try altering the capacity of C_3. On small aerials, by the way, you may not need to use C_3 at all and can keep the aerial on terminal No. 2 permanently.

Aerial Coupling on Short Waves.

The tapping lead to the coil L_1 should be provided with a crocodile clip for use on the short waves (quite convenient for the "X" coils also), and this clip should be connected to a suitable turn on the coil. If you use the bare wire coils it is quite a simple matter to make the connection, bending the turns apart slightly if necessary, to make sure that the clip does not touch more than one turn at a time. You will not injure the coil in any way by doing this. The best position for the clip is usually at 1, 2 or 3 turns from the earthed end of the winding, but when the aerial lead is on terminal No. 1 you can take it as a general rule that the clip should be somewhere about the centre of the coil, and no particular adjustment will be needed.

By the way, you may wonder how you are to find out which is the earthed end of the winding. This is how you can do it. Notice which end of the wire composing the coil winding goes to the socket of the plug. That is the earthed end.

We shall have a little more to say about short-wave work in our article next week when we discuss the little modification mentioned which makes tuning less critical on short waves, but until then we must leave you. You now have before you complete details for getting the best from the set, and we think there is not much doubt about what your verdict will be when you have given it a try-out.

WORKING DATA IN BRIEF.

1.—H.T. VOLTAGES: Detector is supplied by H.T. + 1 terminal, for which plug-in from about 40 to 60 volts, adjusted for smooth reaction. Terminal H.T. + 2 feeds the L.F. stages and should be given about 120 volts for best results on loud stations.

* * *

2.—COILS: Tuning coil should be a No. 60 X for ordinary wave range and a No. 250 X for long waves. Reaction coil should be a No. 35 or 50 for ordinary waves, and a No. 75 or 100 for long waves. For short waves, use a No. 4 for tuning and a No. 6 for reaction for 20- to 40-metre band and a No. 6 and No. 9 for 40 to 60 metres.

* * *

3.—VALVES: 2-, 4- and 6-volt types all work well in this receiver. Suitable types are: detector, H.F. type of about 20,000 ohms. First L.F., similar valve or one of L.F. or G.P. type of from 10,000 to 18,000 ohms impedance. Third valve, power or super power.

4.—SELECTIVITY CONTROL: Two different degrees of selectivity can be obtained by placing the flex lead on one or other of the tapping points on the "X" coil. The one giving the best selectivity usually gives slightly less volume.

* * *

5.—REACTION CONTROL: To get perfectly smooth reaction adjust H.T. on detector suitably, and set potentiometer arm carefully. Try to keep it as far round towards positive end (nearest grid leak) as possible without making reaction ploppy.

If there are "flat spots" on the reaction on short waves transfer aerial lead to A_1, so bringing small series condenser into circuit. Keep this at maximum if possible, but try other settings if necessary.

* * *

6.—LOUD-SPEAKER CONNECTIONS: With ordinary power valve loud speaker can be connected to L.S. terminals of set in its original form (see Blue Print). With a super-power valve it is better to use an output filter, either as a separate unit or built into the set in the manner described in one of the later articles.

* * *

7.—KEY TO CONTROLS: Left-hand knob is reaction, which INCREASES by turning to right (clockwise). Use this sparingly and keep at minimum (turned to the left) for local station. Middle knob (large dial) is the tuning control. Lowest waves of each range by turning to the left (anti-clockwise) and higher waves by turning to the right (clockwise). Small knob at right-hand end of panel is the on-off switch.

NOTE.—On the "de luxe" version incorporating refinements described in later issues there is another small knob near the middle of the panel. This is the volume control.

NEVER ALLOW THE SET TO OSCILLATE.

BUILD The MAGIC 3

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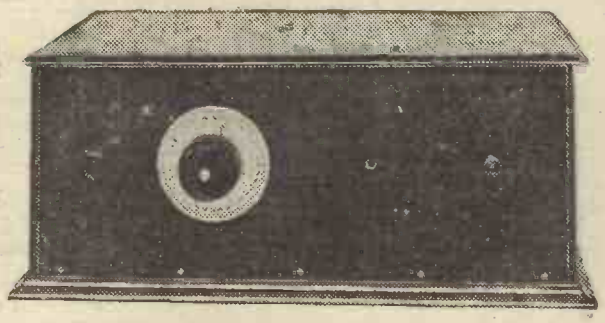

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1 Vernier dial (Jackson)		5	6
1 differential reaction condenser		5	0
1 L.T. on-off switch		1	3
3 Sprung valve holders		3	9
2 Single-coil sockets (Lotus)		1	4
1 400-ohm baseboard mounting potentiometer (Igranic)		2	6
1 Baseboard-mounting neutrodyne type condenser (Magnum)		5	6
1 H.F. choke (Varley)		9	6
1 L.F. transformer (R.I. "Hypermu")	1	1	0
1 L.F. transformer (Igranic J.)		17	6
1 ·0003 mfd. fixed condenser (Igranic)		1	3
1 2-mfd. Mansbridge type condenser (Lissen)		3	6
1 2-megohm grid leak and holder (Ediswan)		2	0
1 2,000-ohm resistance and holder (Cosmos)		2	5
2 Terminal strip, 18 in. × 2 in. (drilled)		2	0
10 Terminals (Belling & Lee)		2	6
1 Set of valves as specified (Cossor or Mullard, as desired)	1	13	6
1 Lewcos No. 60 X coil		4	9
1 " No. 40 coil		3	6
1 " No. 250 X coil		6	6
1 " No. 100 coil		4	6
2 Set of short-wave coils (2 : 4 : 6 : 9)		10	6
2 Set of MAGIC insulated connecting links		2	0
Screws, nuts, etc.			3
TOTAL (INCLUDING VALVES)	£9	16	6

Any of the above components can be supplied separately if desired.

KIT A	less valves and cabinet	£6 : 13 : 0
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FROM THE TECHNICAL EDITOR'S NOTE BOOK

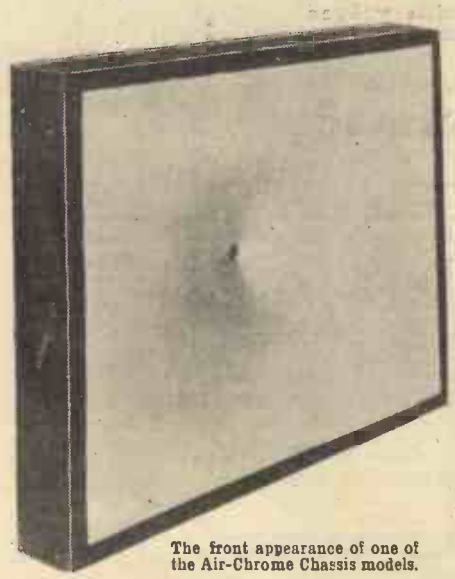
Tested and Found—?

ULTRA "AIR CHROME" LOUD SPEAKERS.

One of the most interesting radio accessories we have come across for some time is the Ultra "Air Chrome" Loud Speaker. We have recently had two of the chassis models on test, and can say right away that we consider the results impressive. The design of the "Air Chrome" is a complete break away from the conventional.

It has two diaphragms, and these are made of specially treated linen. One diaphragm is large and this is intended to deal with the low frequencies and, of course, the small diaphragm deals with the upper register. The diaphragms are driven by a balanced-armature movement.

The diaphragms are stiff and do not appear capable of free movement, although there is no suspicion of drumminess. Indeed, the response is distinctly clean cut,



The front appearance of one of the Air-Chrome Chassis models.

although, it must be mentioned, there is ample continuance. In fact, in this regard the "Air Chrome" has qualities that have hitherto been almost peculiar to the moving-coil class. Bass notes come through excellently, while the harmonic range is so well embraced that high notes retain their individuality. Speech is crisp and natural.

Altogether, the "Air Chrome" is a fine proposition, especially as the prices are of a very attractive nature. There are chassis models available for portable sets or for large cabinet models and radio-gramophones.

ANOTHER "EKCO" MAINS UNIT.

The "Ekco" H.T. mains unit 2 A.10 comes in the 10-milliamp range, and is suitable for one- to three-valve sets not needing more anode current than that. Its two output voltages are 60 and 120. A Westinghouse metal rectifier is used. The price of the 2 A.10 is £3 10s., and at this it is as good value for money as anything in radio we have come across.

The "Ekco" people say that they use in their units a liberal quantity of best quality transformer steel laminations, oversize coils, enamelled wire of ample gauge, and safe insulation between each layer, etc. This is evident by a close examination of the interior of any one of their productions, and that remarkably skilful design and construction is bestowed on them is proved by the consistently high standard of performance they give.

Although they are compact and completely free from complexities, they are wonderfully silent in operation. This we have mentioned several times before in connection with "Ekco" mains units, and it is a point well worth emphasising and one that is very much to the credit of the manufacturers.

The model 2 A.10 is no exception, and is as sturdy and satisfactory a device as any other bearing the same name. It is said that over 70 per cent of the total sales of radio mains devices in the British Isles to-day are "Ekco," and this in itself is an excellent commentary on the satisfactory service they give.

THREE INTERESTING PUBLICATIONS.

From the General Electric Co., Ltd., we have received copies of the "Osram Wireless Guide," "Gecophone Radio Receivers," and "Stork Loud Speakers." The Osram Wireless Guide is full of valuable information concerning valves. In this book there is also a list of broadcasting stations.

TWO WEARITE COMPONENTS.

One of the neatest and most useful components I have seen for some time is the new Wearite C.A.T. switch. This device has the appearance of an ordinary push-pull panel switch. There is a small plunger knob, the usual screwed bush for one-hole panel mounting, and a circular insulating plate on which are mounted two small nickel terminals.

But the circular plate is divided, and sandwiched in it is a small fixed condenser. The one terminal goes straight to the aerial, and the other terminal to the aerial point in the circuit of the set. When the switch is in the off position the small condenser comes into operation and it is shorted out of circuit when the switch is closed. Therefore, you can operate your C.A.T. adjustment without, as is usually the case, having to change the aerial lead from one terminal to another. A further attractive point in regard to this latest Wright & Weaire production is its price which is only 2s. 3d. The article is really well made, too, and the switching movement is perfect. There should be a great sale for this component during the coming season.

Another new Wearite line is an iron-cored centre-tapped choke, known as the H.F.O. which has been specially designed for gramophone scratch filters. The price of this well-made and efficient device is 6s. 6d.

S.R.S. SHORT-WAVE COILS.

We have now been able to test a pair of S.R.S. short-wave coils for the Mullard S.G.P.3 receiver, which has been sent us by the Stonehouse Radio Supplies, of Union Street, Plymouth. The coils are wound on ribbed ebonite formers, mounted on the necessary 6-pin bases. Some time ago we published a report on short-wave coils due to the same firm, and readers may remember

Traders and manufacturers are invited to submit radio sets, components, and accessories to the "P.W." Technical Department for test. All tests are carried out with strict impartiality under the personal supervision of the Technical Editor, and readers are asked to note that this weekly feature is intended as a reliable and unbiased guide as to what to buy and what to avoid.

the "Keep me clean, Tune me right, I'll Bring you in, The World each night" that was mentioned as having appeared on the box.

The same catchy and appropriate rhyme is in evidence on this occasion. The Mullard S.G.P.3 is a particularly suitable design for short-wave work, and with the S.R.S. coils the S.G. H.F. stage undoubtedly gives considerable amplification. Short-wave conditions were not good when we made the tests, but there was no difficulty in bringing

Here you see the reverse side of the Air-Chrome instrument.

in a number of the Americans at excellent strength. Tuning was sharp and the results were appreciably superior to those given by a set not employing H.F. amplification.

THE VARLEY ANTI-MOBO

PRICE 9/6

PRICE 9/6

The Varley Anti-Mobo is one of the components specified in the Mullard "Orgola" Senior Receiver. This alone affords convincing proof of its quality, for only proved products are used in this efficient receiver.

It has been selected for its effectiveness in eliminating "motor-boating." For this reason, too, it is indispensable in any set which tends towards this form of oscillation.

Like all Varley products, its manufacture is the result of careful design and painstaking workmanship. It is finished in bakelite moulding with terminals and soldering tags ready for connection.

Write for Sections B and C of the Varley Catalogue.

Outside view of portion of Works.

A corner of the Coil Winding Shop, where over 300 girls are employed.

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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.

QUESTIONS AND ANSWERS.

CONNECTIONS FOR A SELECTIVE DET.-L.F.

D. D. T. (Beckenham, Kent).—"Can you give me the wiring in words of a good Det.-L.F. receiver—employing three plug-in coils (separate aerial coil for selectivity) and an L.F. transformer—preferably one with throttle control of reaction?"

You will require the usual tuning and reaction condensers, an H.F. choke, grid condenser and leak, valve holders, on-off switch and terminals, etc. The connections are: aerial terminal to aerial coil. Remaining side of aerial coil to earth, to the grid coil, to tuning condenser, to one filament tag on each valve holder, moving vanes of reaction condenser, to grid-bias positive, H.T.— and L.T.—.

The L.T. positive terminal goes to on-off switch, and the remaining side of this switch to remaining filament terminals on valve holders and to one end of the grid leak. The remaining side of the grid leak to grid terminal on the detector valve holder and to one side of the grid condenser. The other side of the grid condenser is joined to the vacant terminal on the grid coil holder and to the variable tuning condenser (fixed vanes).

Plate terminal on the detector valve holder is joined to one side of the reaction coil, and to one end of the H.F. choke. The remaining side of the reaction coil goes to a ·001-mfd. fixed condenser. The fixed vanes of the reaction condenser are connected to the remaining side of this ·001-mfd. condenser.

The vacant side of this H.F. choke is then joined to the A terminal on the L.F. transformer, H.T. positive terminal on which goes to H.T. positive about 60 volts.

The G terminal on the transformer is joined to the grid of the second valve holder and G.B.—terminal is fitted with a flexible lead with black plug for putting into the correct grid-bias voltage on this battery. The plate terminal of the last valve holder is joined to the L.S.— terminal (or to the choke-output if this is employed), the final connection being from the other loud-speaker or choke-output terminal to maximum H.T. positive. (See "P.W." No. 377, page 751.)

RESISTANCE FOR VOLUME CONTROL.

L. J. T. (Hatfield).—"When Brookman's Park gets going my H.F. stages are going to be hopelessly overloaded (on both of his wave-lengths), and I am contemplating a one-turn aerial coil or something of that kind. Seriously though, do you think it will be sufficient to have a many-tapped aerial coil, and alter this to a very low value when in the neighbourhood of Brookman's wave-length, or is there some easy way of experimenting with a volume control in the H.F. stage which will not entail much alteration to the receiver?"

One of the most interesting methods is to try to use a high-resistance potentiometer to govern the input to the aerial coil. A non-inductive potentiometer having a value of say anything between 20,000 to 60,000 ohms would be suitable, and this should be joined between the aerial and earth terminals of the receiver.

The end of the aerial coil should not be taken to the aerial terminal, but should be joined to the slider of this potentiometer, and the input of the set will obviously be governed by the position of this slider, being at a maximum when the slider is at the aerial end of the coil and at the minimum (short-circuited position) when the slider is taken to the earth end of the potentiometer.

IMPROVING REINARTZ REACTION.

L. B. F. (Manchester).—"It is the Reinartz reaction set built from Blue Print No. 42, and

(*Continued on page* 340.)

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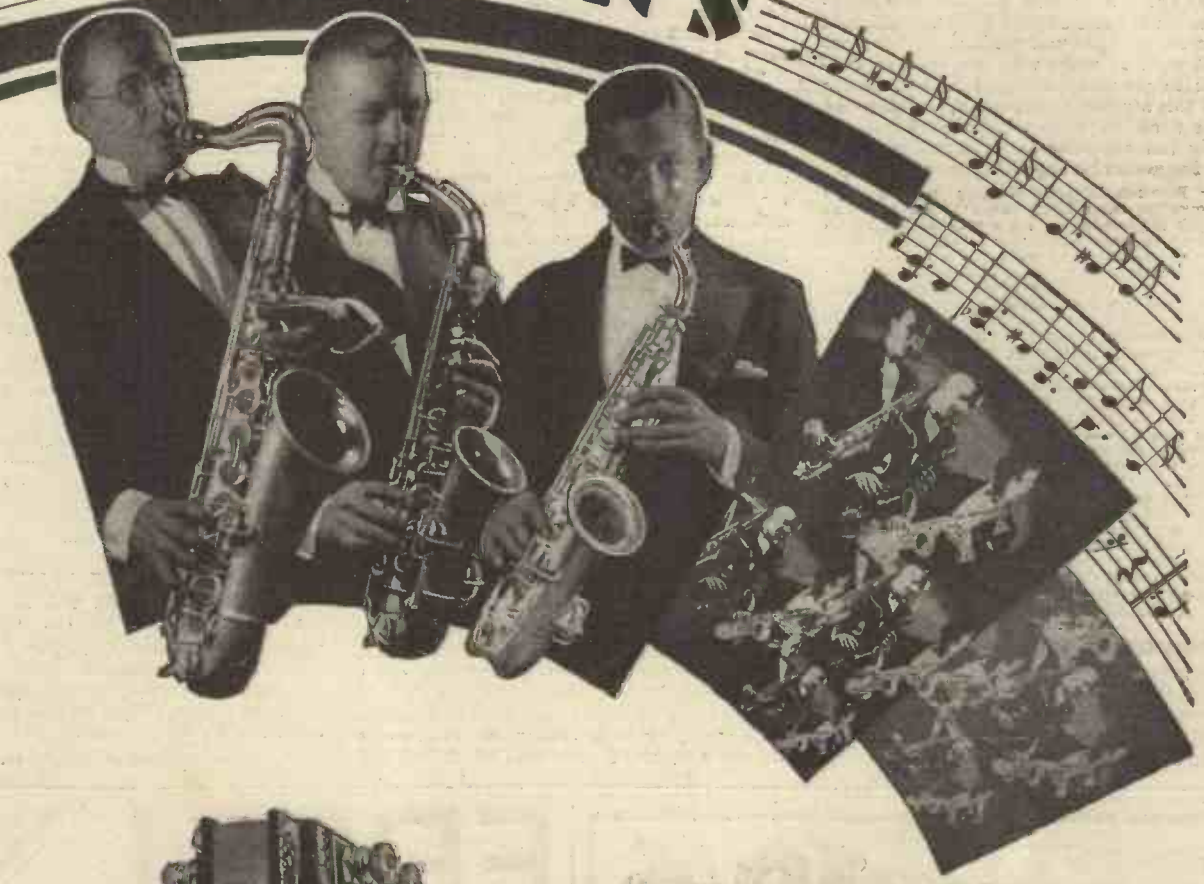

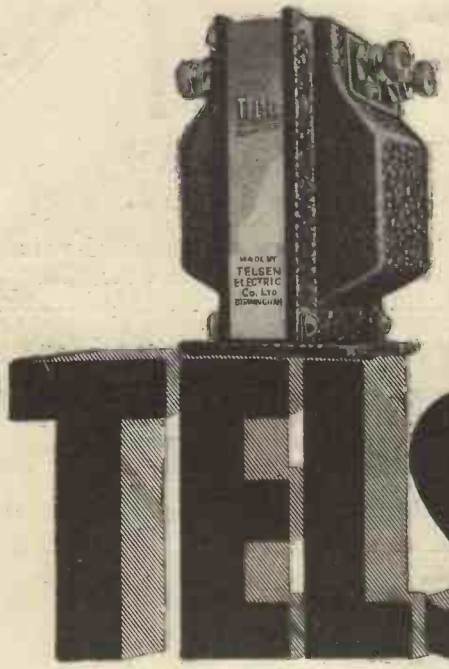

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RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page* 338.)

although it is delightfully smooth to handle and so on, I sometimes feel this condenser-control is not quite as good on distant stations as the old swinging-coil method. I have put a ·001 mfd. in series with the reaction condenser to prevent shorting, etc., and I have found this a great improvement, for it stopped a little scratching noise which the set had previously been subjected to. Can you make any other suggestion for improving reception ?"

The Research Department have recently been recommending extra bypassing, for they find that when this is provided there is a very decided rise in sensitivity in many cases, which brings the circuit very much more nearly up to the level of the equivalent swinging-coil type of receiver, without any sacrifice of the ease of handling for which the Reinartz and similar types are justly famed.

The alteration is very easily made, and all that you require in the way of extra components is a Formodenser, or one of the Pre-set Igranics, or a similar type, having a maximum capacity of about ·0001 or ·00015 mfd. Screw this condenser down on the baseboard in a convenient position quite close to the plate socket of the detector valve holder.

Then wire up one of the terminals on this extra condenser to the anode terminal of this valve socket and the other terminal of the condenser to the negative filament. To adjust, start with the condenser fully unscrewed, that is to say at the minimum capacity, and gradually screw it down until you find you can only just obtain reaction effects over the whole tuning range when the reaction condenser is full in.

After this you can leave the added condenser alone and tune on the set as usual and you will find that there is a very definite improvement in sensitivity, particularly on the long waves.

WHEN A CHEAP TRANSFORMER IS BEST.

"PUZZLED" (Leigh-on-Sea).—"Finding that this short-wave work gets more and more interesting, I determined this year to build a special two-valver for it, keeping my other set for use of the family.

"At first I was very disappointed, for I struck a threshold howl which I could not cure, and was regretting the time and trouble taken. However, I happened to mention this to a friend who suggested that my L.F. transformer was too good, and, at his suggestion, and without much hope of success, I changed over the transformer I had for an old one which I have had standing by ever since I dismantled my first set.

"The remarkable thing was that it completely cured the trouble, as he said, and though I have tried putting the best transformer back again, it always results in the return of the howl; so I have come to the conclusion that the old one deserves the job. Why is it that the more expensive type fails to function satisfactorily ?"

So much depends upon the exact circuit, and there are so many other factors that affect threshold howl that it is impossible to say off hand why one transformer works better than the other. However, it is quite a common experience to find that, where there is a tendency to threshold howl, an old-fashioned and rather high-capacity L.F. transformer is better than a more modern transformer, which generally has a much lower self-capacity and a much greater efficiency in an ordinary broadcast-wave-length set.

Sometimes it is possible to use the more modern transformer if a high-resistance is shunted across the primary of this; whilst, in other cases, a cure is effected if the output of the receiver is wired for choke coupling instead of direct output. We do not think, however, that your results will necessarily be better if you persuaded the high-quality transformer to work instead of the older one; so, in the circumstances, we should be inclined to leave well alone unless, like many short-wave enthusiasts, you are fascinated by the problem and would like to work out for yourself what are the factors affecting the short-wave set's efficiency.

STARTING SHORT-WAVE WORK.

G. M. (Guildford).—"I have always been tempted by the short waves, and although I have now built two receivers for this class of work I never manage to get them to oscillate.

"For ordinary broadcasting I must have built at least a dozen sets and as I never had any trouble with these at all I am quite at a loss to understand why I cannot oscillate on low waves, even when sets, batteries, and everything appear to be O.K. How do you account for this ?"

We should suspect that you have been up against the old fault of coupling the aerial too tightly.

For successful short-wave work it is essential that the coupling between the aerial and the grid circuit should be really loose, and we do not doubt that if you remember this in your next short-waver, you will have no difficulty in getting oscillation on very low wave-lengths. If your set has to employ a separate aerial coil, remember that if you place a coil of too many turns in this coil holder you will be coupling the aerial too tightly to the grid coil, and this is quite sufficient to prevent reaction effects. Consequently you must use a *few*-turn (say two-turn) coil in the aerial and do not put up with unsatisfactory reaction effects without trying alterations in the size of the coil, or a much shorter aerial.

If the set has an aerial lead terminating in a clip for putting on to one of the turns of the grid coil remember that loose coupling is obtained if this clip is adjusted near to the earth end, and not to the grid end, of the coil. By varying the position of the clip, you will soon learn to obtain just the right degree of coupling to give satisfactory reaction effects over the whole tuning range.

Finally, if this set should be used with a small variable condenser between the aerial lead and the aerial terminal to vary the coupling, this condenser must be set towards its minimum in order to give loose-coupling effects, as if a fairly long aerial is employed and the aerial coupling condenser is set "all in" the set may refuse to oscillate even though everything else is in perfect order.

Remember also that the H.T. applied to the detector valve has an important effect upon the oscillation control, which is to some extent also dependent upon the value of the grid leak.

SWITCHING THE "P.W." FOUR FOR LONG AND SHORT WAVES.

L. S. (Bolton).—"In the 'P.W.' Four, where does the short-wave X coil go—in the holder near the reaction condenser, or near the anode tuning condenser ? And which side does the corresponding switch move to, for short and for long waves ?"

(*Continued on page* 342.)

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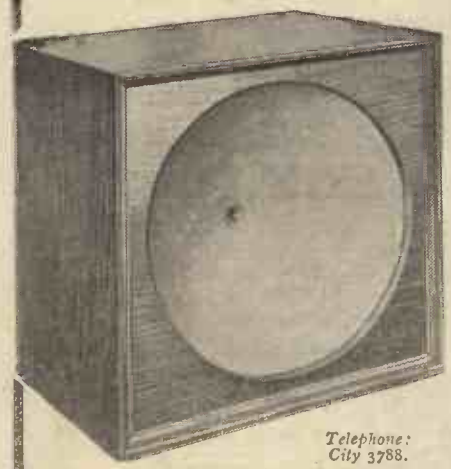
POST 9d.

For a limited time, to introduce our P.R. Speaker we have arranged to supply the complete KIT to make up this wonderfully powerful Speaker for 19/6.



The KIT consists of our Balanced-armature P.R. Speaker Unit, the Special P.R. Fabric Cone, 3-ply oak-front Baffle, 4 heavy, natural oak, cabinet-finished sides cut ready for assembly, 4 pieces oak front moulding, 4 rubber feet, 3-ply unit cradle, screws, etc.

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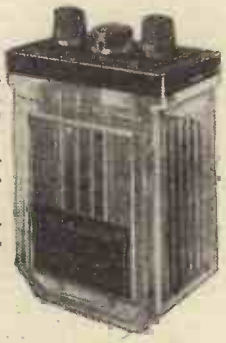

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Further advantages of the P.G.F. are these. Plates are sturdy. Paste is held in by interlocking grids Terminals cannot be reversed and have acid-proof glands. The lid is made of Dagenite and is hermetically sealed to the box. And the price is low—only **11/9** for a 2 volt 20 **a.h.** (true capacity) or 9/- without the indicating feature.

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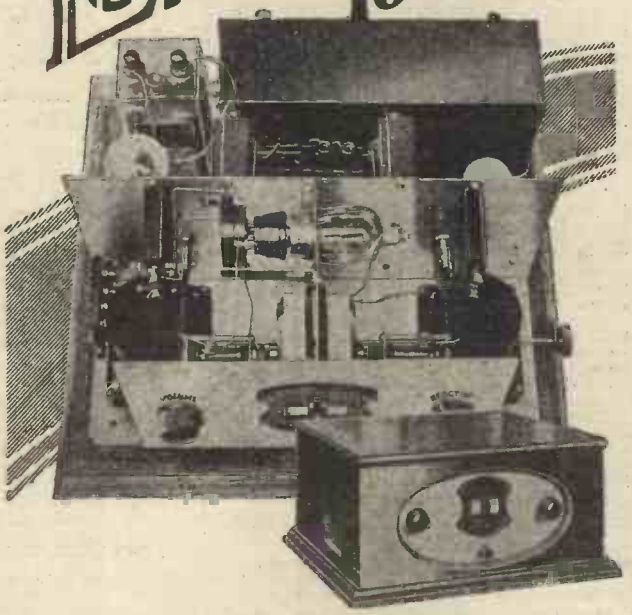

Set builders—build and own the very latest radio development, the new 3-valve Lotus S.G.P. set. You can buy the kit for it complete, assemble it in a few hours and demonstrate to your friends the greatest range, power and selectivity of any set of the season.

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P.W. 19/10/29

Causton

RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page* 340.)

It does not matter in the least whether you put the short-wave X coil in the holder near the reaction condenser and screen, or in the other holder, near the L.F. transformer.

In either case, one coil is disconnected when the other is used, so we suggest you put the short-wave X coil in the holder near the screen, and the 250 coil in the holder behind the anode tuning condenser.

If you set the knob of the second wave-change switch so that its pointer is upright when in the central (off) position, the turning of the knob to the left will switch over to short waves. And, when the knob is tuned to point towards the *right*-hand (big) coil, the switch will join up the long-wave coil instead.

HOW TO TUNE THE "P.W." FOUR.

J. M. (Falkirk).—"What size 'X' coils should be used in the 'P.W.' Four, and what is the best way to handle this set to bring in distant stations?"

The long-wave coil for the "P.W." Four should be an X No. 250, and for the short waves either a 60 or a 75 X coil may be employed.

The operation of the set is really quite simple if a little trouble is taken to learn the correct use of reaction. This is only necessary if you wish to go in for real long-distance work; for, as a matter of fact, the "P.W." Four is so sensitive that the reaction condenser can be set almost at zero and left alone if desired, the correct operation of the two tuning dials being all that is necessary to bring in alternative programmes; but with the reaction the range of the set is enormously increased, *provided that the reaction is handled properly.*

Looking at the set from the front, there will be seen the first wave-change switch towards the left of the panel, the other controls being the aerial tuning condenser, potentiometer, reaction, second wave-change switch, H.F. tuning, and on-off switch in the order named. To run the set for ordinary reception you pull out the on-off switch, set the reaction at zero position, place both wave-change switches to cover either long or short waves, as desired, and then adjust either of the tuning dials so that not very strong signals are received.

Now adjust the potentiometer for maximum signal strength, the idea being to tune-in to a fairly weak signal and, leaving all the controls alone except the potentiometer, bring it up to maximum strength with that. The potentiometer having been adjusted to the most sensitive position, it can be left alone and attention turned to the tuning.

The only point to watch with these dials is to see that they are both "in step"; for, unless both circuits are tuned to the same wave-length, there will be a large drop in signal strength, and many stations will be missed. The ideal condition, of course, would be for the wave-length always to be in step if the tuning dials were in step; that is to say, that if the aerial tuning condenser is adjusted to 5 degrees, the anode condenser should be adjusted to 5 degrees also, and any station on that wave-length would automatically be received. If the aerial dial is then turned to 50 the anode dial would be turned to 50 also, when stations on *that* wave-length should automatically come in.

"P.W." TECHNICAL QUERY DEPARTMENT

Is Your Set "Going Good"?

Perhaps some mysterious noise has appeared and is spoiling your radio reception?—Or one of the batteries seems to run down much faster than formerly?—Or you want a Blue Print?

Whatever your radio problem may be, remember that the Technical Query Department is thoroughly equipped to assist our readers, and offers an *unrivalled* service.

Full details, including scale of charges, can be obtained direct from the Technical Query Dept., POPULAR WIRELESS, The Fleetway House, Farringdon Street, London, E.C.4.

A postcard will do: On receipt of this an Application Form will be sent to you free and post free immediately. This application will place you under no obligation whatever, but having the form you will know exactly what information we require to have before us in order to solve your problems.

LONDON READERS PLEASE NOTE: Applications should NOT be made in person at Fleetway House or Tallis House.

Unfortunately, owing to small differences in coils, etc., the matching of the dial readings does *not* usually mean that the circuits are necessarily in tune; although, of course, the dial readings will correspond, more or less, with the tuning.

Probably the easiest way for a novice to tune a set of this kind is to set both condensers at "0," and if there is no programme there, to first of all tune the anode condenser to 5 degrees, leaving it in that position for a moment. Slowly turn the aerial condenser between 0 and 10 or 12 degrees, and if any weak transmissions are brought in on the aerial condenser, leave this set for maximum strength and turn the attention to the *anode* condenser, when a slight alteration will be bound to improve or weaken the transmission being heard.

If it is still too weak to be enjoyable, then gently increase the reaction a very little way, readjusting slightly the aerial, and then the other condenser, to make sure that maximum strength is being obtained. When you have had enough of this station, slacken off the reaction again and set the anode condenser first at 10 degrees, then at 15 degrees, then at 20, and so on, pausing each time it is reset to search round with the aerial dial for 5 or 10 degrees around the corresponding number.

For instance, if the anode condenser is set at 20, the aerial condenser may need to be rotated slowly between about 10 and 30. When a weak signal is heard do not swing both dials, but do as formerly—i.e. first of all tune the aerial, until the signals are at maximum. Then, leaving that alone, turn attention to the anode condenser till the station is tuned in satisfactorily on that also, and then finally bring up the reaction a little until the required strength is obtained or until the station is found to be too weak to be worth listening to.

The point to watch in tuning a set of this kind is that first one dial should be set to wave-length and then left alone, whilst the other dial is rotated until the best signal strength has been found. If you keep a log of the station positions you will soon be able to tune in lots of stations, for it will be found that neither of the tuning dials "varies," but they always have to be set at exactly the same positions for the same wave-length; though, of course, very delicate adjustments may be necessary to get absolutely the last ounce from a very distant station.

ADDING AN EXTRA L.F. VALVE

P. N. G. (Glamorgan).—"What I had in mind was a resistance stage added to a two valver, and I have on hand a .01 fixed

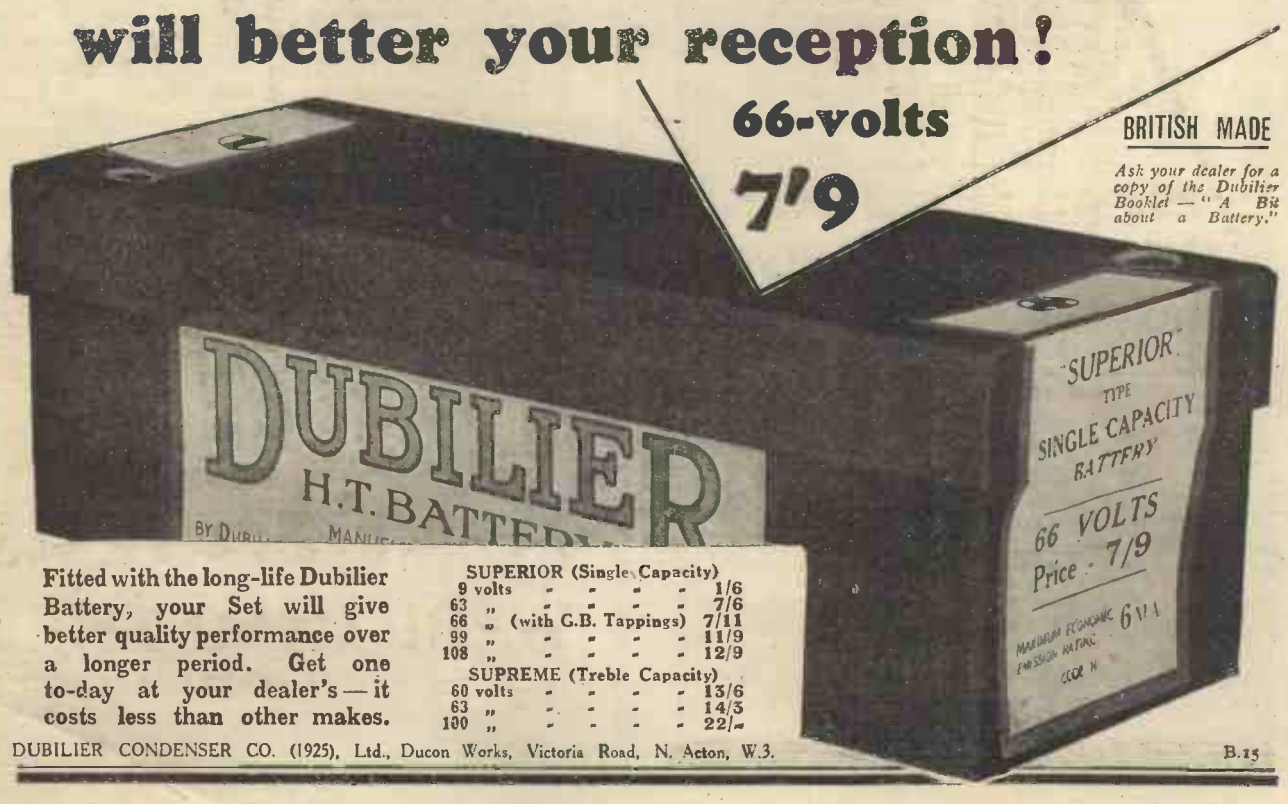
(*Continued on page* 344.)

This long-life Battery will better your reception!

66-volts 7'9

BRITISH MADE

Ask your dealer for a copy of the Dubilier Booklet — "A Bit about a Battery."



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SUPERIOR (Single Capacity)		
9 volts	- - - -	1/6
63 "	- - - -	7/6
66 "	(with G.B. Tappings)	7/11
99 "	- - - -	11/9
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60 volts	- - - -	13/6
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Specially made to improve YOUR Set!

FOR ALL REQUIREMENTS AND BETTER RECEPTION

TYPE	VOLTS	AMPS.	USE IN SET	PRICE
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Same Types in 4 volts, also Pentode, and Screened Grid				

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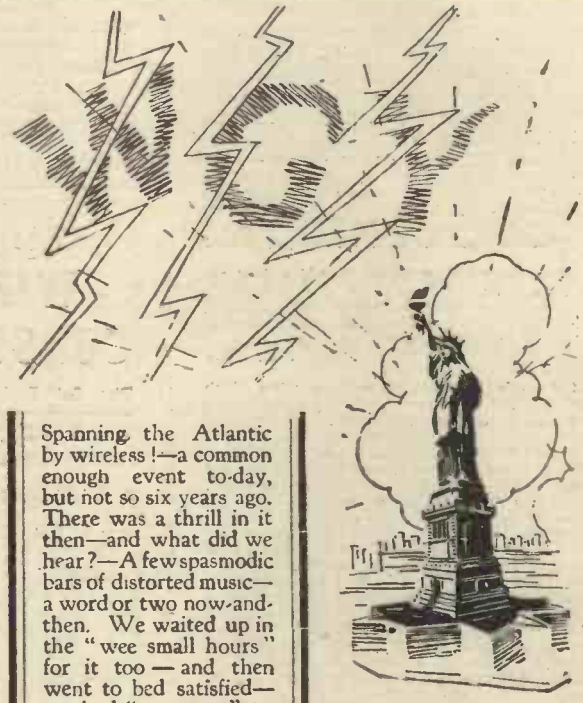
DO YOU REMEMBER?



Spanning the Atlantic by wireless!—a common enough event to-day, but not so six years ago. There was a thrill in it then—and what did we hear?—A few spasmodic bars of distorted music—a word or two now-and-then. We waited up in the "wee small hours" for it too—and then went to bed satisfied—we had "got over."

We marvel to-day that we managed to do anything at all with such elementary gear—it *was* a good performance for those days, however commonplace it may be now. Many things have changed since then but T.C.C. Condensers were used—as a standard—then, and are still the standard to-day. Be guided by the veterans of radio and use a T.C.C. wherever a condenser is specified.

Here is a .0003 mfd. Mica Condenser Price 1s. 3d. each, other capacities from .0001 to .01 mfd. Prices 1s. 3d. to 2s. 6d.

T.C.C. CONDENSERS

WERE USED THEN

Advt. Telegraph Condenser Co., Ltd., Wales Farm Rd., N. Acton, London, W.3

CA 1029

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from page 342.)

condenser, mica, an anode resistance, grid leak' valve holder, etc. So, if you can give me the necessary wiring in words, I think I can make a good job of it. As the set is good and strong at present, I have got a power valve in the last stage, and I suppose I shall have to increase my grid-bias battery ? "

Yes, you will need higher grid bias when you get the power valve going, and we advise you to use as much high tension as you can manage. If you look at the valve-maker's curve for the power valve, you will see the number of grid volts that are necessary for use with the H.T. voltage you intend to employ.

Having purchased a suitable grid-bias battery, you can connect up as follows : First of all, mount the valve holder in a suitable position on the baseboard, arranging the holder for the anode resistance near to this. Close to the grid of the valve holder mount the '01-mica condenser and the grid leak. You will require an extra H.T.+ terminal.

Join the anode resistance across those wires which now go the loud-speaker positive and negative terminals. The loud speaker, of course, is disconnected from these, and two other loud-speaker terminals are provided near to the near H.T. positive terminal.

Having inserted the anode resistance across the points which previously went to the loud speaker, connect that end of the resistance which is now joined to the plate of V2 to one side of the new coupling condenser ('01 mfd.). The other side of this condenser is joined to the grid socket of the new valve holder and also to one end of the grid leak.

To the other end of the grid leak is connected a flexible lead terminating in a black plug which is inserted in the grid-bias battery at the required negative voltage. One of the filament terminals on the new valve holder can be taken to the lead on the old set which at present joins the grid-bias positive and the two-valve filament sockets together, and which also goes to earth, etc.

The other filament socket on the new valve holder is joined to the lead which connects L.T. positive to the remaining two filament sockets on the valve holders, etc. Finally, join up the plate socket of the new valve holder to one of the new loud-speaker terminals (negative), and then join the positive L.S. terminal to the new H.T. positive. This completes the wiring. (See also "P.W.," September 28th issue.)

GRID-BIAS CONNECTIONS.

W. N. (Peterboro').—" Blue-print connections show an R.C. coupling unit with one of its terminals marked H.T.+, one marked P, one marked G, and one marked G.B.—. My own resistance-capacity unit, which is an old one, has no G.B.— terminal, but is marked as follows : H.T.+, P, G, and L.T. Is it correct to take L.T. to grid-bias negative ? If so, how many volts ? "

DON'T FORGET YOUR COPY

of

The November

WIRELESS CONSTRUCTOR

The Set Builders' Finest Magazine

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Obtainable Everywhere.

Yes, it is quite correct to take the L.T. terminal as though it were marked G.B., and provide it with a flexible lead terminating in a black plug for negative grid bias. The amount of grid bias necessary will depend upon the valve you are using and upon the H.T. you are applying to this.

HAND-CAPACITY ON SHORT-WAVER.

"CURIOUS" (Manchester).—" Why is it that hand-capacity effects are so noticeable on short waves whilst with the same set, working on long waves with different coils, there is no trouble in this respect at all ? "

All short-wave work is more "finnicky" and touchy than work on the longer wave-lengths, owing to the fact that the frequencies being dealt with are enormously greater and the high-frequency current has many peculiarities which are not noticeable on lower frequencies.

The amazing thing is not that hand-capacity effects occasionally show themselves, but that wave-lengths representing a frequency of millions per second can be dealt with at all with quite simple receiving apparatus and without the long extension handles or ultra care that were thought to be necessary a year or so ago.

PROTECTING THE VALVE.

H. P. (Sittingbourne).—" Being informed that an ordinary flashlamp bulb of the low-consumption type will act as a fuse to protect the valve from being accidentally burnt out, if fitted in the H.T.— lead, I inserted a flash-lamp bulb of this type in my own flexible lead, and found that results were just as good as formerly, although the lamp does not light up. Is it a fact that this affords a good protection against short-circuit or similar troubles, and, if so, can I make a permanent job of the fuse inside the set instead of having it dangling about in the flexible lead, as at present ? "

A flashlamp of the low-consumption type makes quite a good fuse to protect the H.T. circuits, saving the H.T. battery and the filament of the valves in case of a short. But as the current passing through the lamp in such circumstances is very small it will *not* light. (This will only happen if excessive current flows, when it acts as a warning signal that something is wrong.)

You can easily insert the fuse in the permanent wiring of the set instead of bothering with it in the flexible lead. Disconnect all batteries, etc., and examine the wiring on the inside of the H.T. negative terminal.

Probably this is connected to the L.T. negative terminal by a short, straight wire (most sets are arranged in this way as the two points are nearly always connected directly together), and if it is so in this instance all you have to do is to break the wire and insert the flashlamp bulb in series with it. If, however, this lead goes to a switch, or to some other point on the circuit, insert the flashlamp bulb holder between the main H.T.— terminal and the switch, when the effect will be the same.

The SQUIRE UNIVERSAL No. 97 b.

THE new Universal (No. 97 b) and the new Power Model (No. 98) fitted with 9¼" and 12" cones respectively will take every unit at present on the market including the new Amplion BA2. They will take yours. In each case the cradle is of aluminium, cone of the latest Vellume type and the beautifully polished octagonal front gives the speaker a really finished appearance. This is entirely in keeping with the magnificent reproduction afforded.
See them at the Manchester Radio Exhibition, Stand 116 (Gallery), or drop us a postcard for a fully descriptive leaflet.

97b *Aluminium Cradle, Enamelled and Polished, fitted with Vellume cone and octagonal front, back leg and bracket also included* 15/-

98 *Similar in every respect to the above, Universal Fitting, etc., with 12" Vellume Cone and Octagonal Front, back legs and bracket included* 18/6

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24, Leswin Road, Stoke Newington, N.16.

P & T

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ONLY 19/6

GRAMOPHONE PICK-UP

TRACK-ARM. Specially designed for use with the Bowyer-Lowe Pick-up .. 10/-

UNIVERSAL LOG CONDENSER

For panel mounting with dial control, or for drum control. Very easily ganged. Single hole fixing.

List No. 366.
·0003 without dial 5/9
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A NEW TRANSFORMER

ANOTHER LEAD BY FERRANTI

Recent developments in Radio have created a demand for a new transformer of the same quality and reliability as the AF5, but capable of greater L.F. amplification. In their class of medium ratio, the Ferranti AF3, AF4 and AF5 are still supreme; but changed conditions — notably the advent of the Screened Grid Valve — have rendered this a necessary addition to the standard range.

THE AF5 RATIO 1/7

Designed to ensure the maximum volume where only ONE L.F. stage is employed with Grid Leak rectification. It is particularly suitable for sets of the S.G.3 type, where greater amplification is desired than is usually obtained from one L.F. stage. The curve is better than that of the AF3, and the amplification is twice as great. This new transformer is not intended for use in receivers employing more than ONE stage of L.F.

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THE NEW LOUDSPEAKER

ALL THE REFINEMENTS OF THE MOVING COIL

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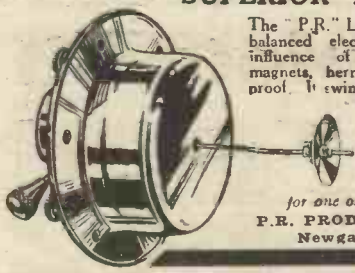
The "P.R." Unit will reproduce every note as clear as a bell—the full depth of the big drum to the harmonics of the violin—the reality of the performance will surprise you. Try one—give your set a chance to show what it can do.

SUPERIOR IN TONE VOLUME



The "P.R." Loudspeaker Unit is driven by a fully-balanced electro-magnetic armature under the influence of powerful cobalt steel permanent magnets, hermetically sealed and absolutely fool-proof. It swings to the weakest impulse bringing out the treble notes and the rich double bass of the organ. Fitted with a simple tonal adjustment that stays put. Most powerful Unit giving full strength from a 2-valve set. No extra H.T. *Ask your dealer for one or send your remittance direct to—*

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TWIN EASYFIX FLEX

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THE CAPACITY REDUCING FLEX FOR LOUDSPEAKER EXTENSIONS

Ask your Dealer for a 12 yard sample packet with Fixing Pins. Price 3/-

Or send direct to :—

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QUEENSWAY, PONDERS END, MIDDLESEX

The type H.T.3

WESTINGHOUSE

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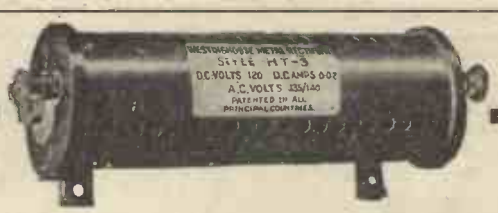

suitable for incorporation in high-tension eliminators requiring up to 20 milliamps at 120 volts.

Costs only 21/-

There are a number of other types also, from which any type of eliminator or charger can be constructed. Full details are given in "The All-Metal Way 1930," our new 32-page book which shows you how to run your set entirely from your A.C. mains. Send 2d. stamp with your name and address to :—

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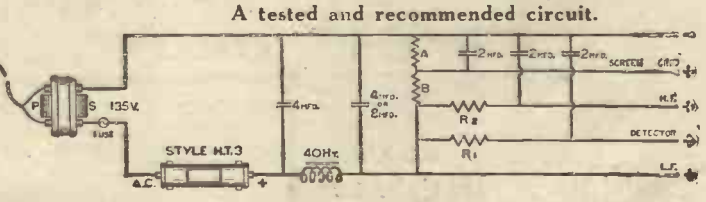
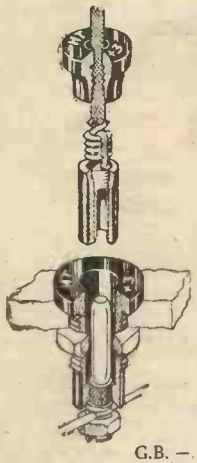


The Westinghouse Brake & Saxby Signal Co., Ltd., 82, York Road, London, N.1.

YOU CANNOT GO WRONG



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is the only Panel Terminal entirely insulated when connected or disconnected, and entirely supersedes the old type of panel terminal. Every plug is engraved for its particular use; also H.T. + and G.B. — plug-in sections vary in size and safeguard your valves.

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PRICE **8D.** Complete

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LECTRO LINX LTD.
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MODERN CRYSTAL SETS

Although the crystal receiver is being rather badly neglected by the world's radio laboratories, its uses and its possibilities should not be forgotten. In this article some cheery information for crystal enthusiasts is given.

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

THE first set described in "P.W." was a crystal set, and, for a long time, this type of receiver was by far the most widely used. Then, by degrees, there filtered through rumours of the building up of an enormous percentage of valve sets. Eventually, I now speak of to-day, and, judging by authentic figures, crystal receivers form a small minority.

Maybe, the declining popularity of the crystal set is only a comparative one. It is possible that there are to-day just as many crystal-set users as ever, but that more new-comers have been attracted by valve sets than by the battery-less, power-less type of outfit.

Question of Quality.

This is as may be; but, undoubtedly, the crystal set has lost its erstwhile position as the provider of the best quality of reproduction. In the early days of broadcasting there were many who were driven from the valve to the crystal in order to obtain something that the critical ear could stand. Nowadays the crystal set does not provide the purest quality.

To start with, all crystal detectors distort, while the response curve of the average pair of telephone receivers compares unfavourably with that of the average cone loud speaker. In passing, I must say that it is a pity that more research has not been carried out in regard to the design of "'phones." I once started to take the response curve of a pair of headphones I have by me at home, but was so alarmed by its undulations that I desisted.

Ideal for Some Purposes.

Yet, while the quality of a crystal set of to-day, or yesterday for that matter—for the crystal set has made but little material advance—is barely equal to that of an average valve set, the small volume and freedom from extraneous noises makes the listening very pleasurable. There is no local power to generate harsh resonances and to amplify other distortion effects.

Also, a crystal set still has its applications and must not be neglected. It is ideal for a listener fairly close to a broadcasting station who does not wish to be bothered by batteries or mains connections. Again, it must be remembered that you can build a crystal set for two or three shillings; the cost of a whole installation, including the licence and a pair of telephone receivers can be kept within the thirty-

(*Continued on page* 348.)

Begin building the NEW COSSOR Melody Maker!

Don't delay another day! Begin building the wonderful new COSSOR Melody Maker! Enjoy the advantages of this amazing three-valve screened grid Receiver! You can build it in under an hour. WARNER'S—Britain's Biggest Radio Stockists can supply you with the complete COSSOR Kit including valves for a first payment of 14/2 only. There are 12 further payments of 14/2 to complete purchase. But remember: you need pay only 14/2 to begin building this super set! Payments are as simple as construction under the WARNER system. Fill in the coupon below NOW!

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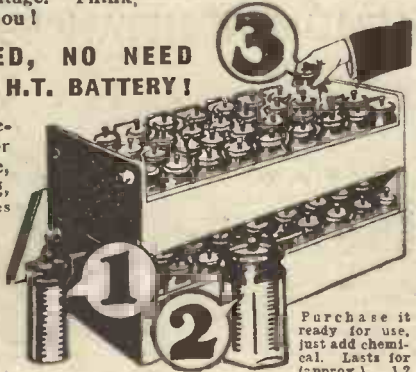
ONCE INSTALLED, NO NEED TO BUY ANOTHER H.T. BATTERY!

and all worry of replacements is gone for good. Proved reliable, efficient non-creeping, neat and compact. Eliminates 'background.' Improves reception. In every way to be recommended as sound H.T. Before you buy another dry battery seriously consider the STANDARD Permanent Wet H.T. first.



Purchase it ready for use, just add chemical. Lasts for (approx.) 12 months. Recharge at home.

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"A" Series:	
30 Henries	170 m.A.
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Comply with I.E.E. Regulations in every respect. Blue print of suggested circuit supplied with each transformer.

AMT/50—Primary tapped for all A.C. voltages. Secondary 200 + 200 volts. Full wave. 45 milliamps output. Filament-heating 2 volts + 2 volts — 4 amps. output 2·5 volts + 2·5 volts 2 amps. output. Price 65/-.

AMT/100 — Primary tapped for all A.C. voltages. Secondary 400+400 volts full wave. 100 milliamps. output. 200+200 45 Ma. For G.B. or intermediate or both. Filament heating 4 + 4 volts — 3 amps. output, 2 + 2 volts — 3 amps. output, 2·5 + 2·5 volts—2 amps. output, 2·5 + 2·5 volts — 2 amps. output. Price 105/-.

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BROWNIE are now producing 2,000 Dominion Vernier Dials a day. That is why it is possible to offer this high-grade dial at the wonderful price of 2/6.

The mechanism is a special non-backlash design with a reduction ratio which makes fine tuning easy without becoming tedious.

Finished in plain black or beautifully grained mahogany Bakelite.

BROWNIE WIRELESS

Nelson Street Works, London, N.W.1.

MODERN CRYSTAL SETS.

(*Continued from page* 346.)

shilling mark, and this is the price of but a very cheap loud speaker indeed.

A crystal set, again, makes a very good standby for a valve set. It requires no maintenance whatever, and can be stored away in a cupboard, and will be available for use any time it is required. I have always had a crystal set and it has certainly proved very useful. Complete breakdowns in my valve installation have been few, but the crystal set has filled some awkward gaps caused by these rare occurrences. During the general strike, for instance, I was able to listen to train bulletins despite the fact that I had not a charged accumulator in the house.

The progress of the crystal receiver was slow and sure up to the time of the introduction of the "oscillating" crystal circuits. These were thought in some quarters to be precursors of a new era in radio reception; but, unfortunately, they did not prove practical propositions, and in due course fizzled out.

blem of Selectivity.

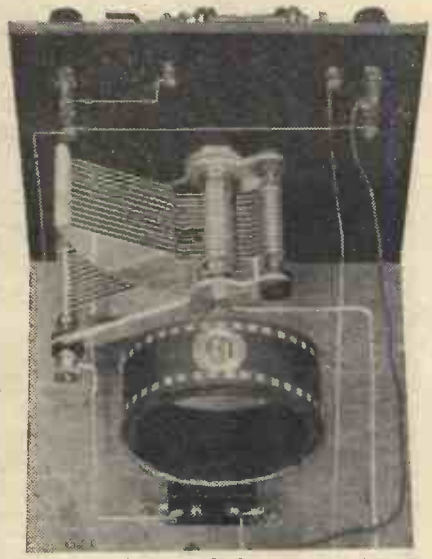
Since then, there has been very little doing in the way of crystal-set innovations. There has been one step forward in the evolution of the "100 %" design on the part of Mr. G. P Kendall and his staff. This circuit gives a better combination of selectivity and sensitivity than any other arrangement.

The question of selectivity has been the main problem confronting the designer of crystal sets. In this instrument you have no local power on which to draw to supplement any losses that may occur. Until the inception of the 100 % crystal set selectivity was only to be achieved by sacrifice of power, and compromises between the two qualities had to be made.

There are, of course, some other very good circuits, and from time to time no doubt fresh ones will be placed before you, but, at present, there is no indication that there will be any material advance in this rather minor stage of radio.

For one thing, the big radio concerns no

(*Continued on page* 350.)



A coil, condenser and detector comprises a crystal set, the simplest of all radio receivers.

One of the outstanding successes of Olympia

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Ask for

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EDISWAN GLASS-ENCLOSED VACUUM RESISTANCES.

(Grid Leak or Anode)

Ediswan are the only British made resistances of this type on the market. All resistances are thoroughly tested before leaving the works, and are absolutely accurate and noiseless in operation. Obtainable in values from 5,000 ohms to 5 megohms. Overall length, 45 mm.

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These condensers are ideal for the man who likes to experiment. In a second, you can pull one out of the clips and put in another of a different value. They are made in values from .0001 mfd. to .001 mfd. Overall length, 45 mm.

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For best results

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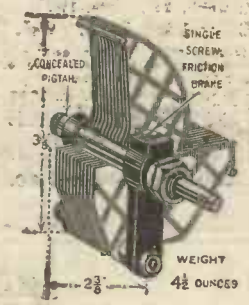
All British

COMPONENTS.

The SMALLEST, LIGHTEST, and most EFFICIENT obtainable

"1930" LOG CONDENSER



In four Capacities :

·0005
·00035
·00025
·00015

4/6

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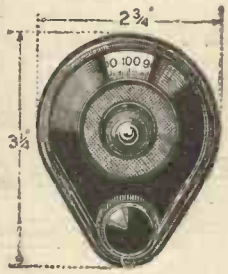
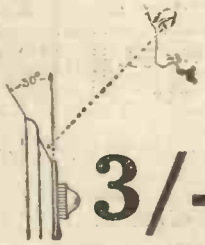
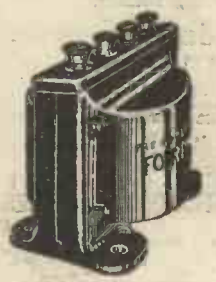




3/-

Shrouded L.F. TRANSFORMER



Ratios :
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8/6 each.

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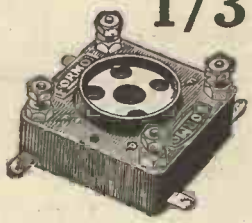
1/3



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AND THAT MEANS YOU NEED A

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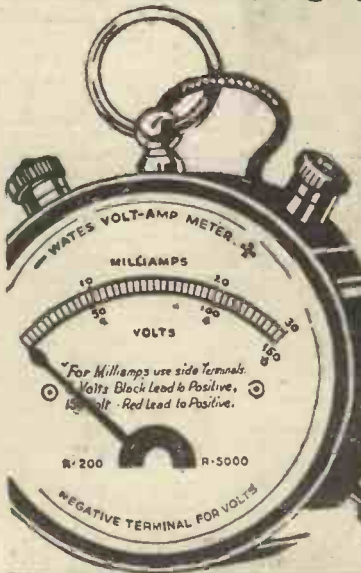

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0–150 VOLTS
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0–30 MILLIAMPS

Res.: 5,000 Ohms.

The "Wates" Range

Standard Model Price 8/6. Case 2/6 extra. Panel-Mounting Three-in-One Model 13/9. Panel-Mounting Milliammeters with jewel bearings, 0-50 or 0-25 M.A., 9/6.

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Prices - 5/6 to 10/-

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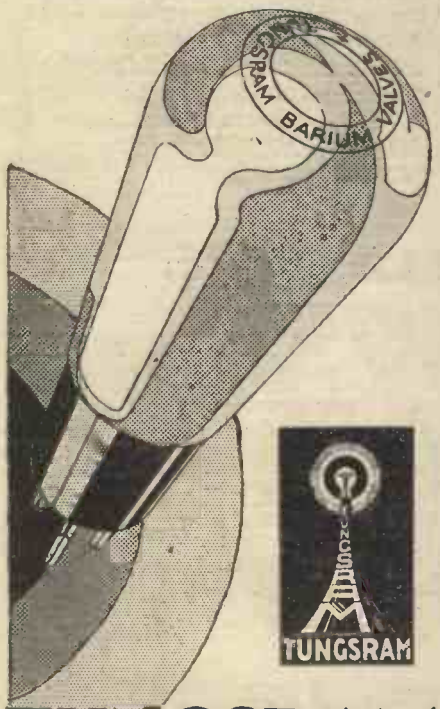

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If you have difficulty in obtaining write direct to:—

Tungsram Electric Lamp Works (Great Britain) Ltd.,
RADIO DEPT.,
72, Oxford Street, London, W.1
Branches: Belfast, Birmingham, Bristol, Cardiff, Leeds, Manchester, Newcastle, Nottingham and Glasgow.

MODERN CRYSTAL SETS.

(*Continued from page 348.*)

longer entertain crystal-receivers in their laboratories. I doubt if there is one commercial radio laboratory in the world that is spending any real time on the development of the crystal. On the other hand there are thousands of scientists concentrating on the valve.

The "P.W." Research Department.

We must look to the remaining amateur enthusiasts for any further crystal-set progress and, I must not forget to add, the "P.W." Research Department. This will not fail to devote time to crystal-set research while there is still evidence that there are people who want to use these instruments.

I, personally, think there is still much that can be done and that round the corner of the future there is something waiting that will give the crystal set a real fillip. "P.W." readers will no doubt agree with me that if a simple crystal set could be designed which would, with, perhaps, the assistance of a flashlamp battery, give really good loud-speaker signals, if from only one station, its popularity would be enormous.

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WIRELESS CONSTRUCTOR

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NOW ON SALE

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FULL CONSTRUCTIONAL DETAILS

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PERTINENT PARAGRAPHS.

If you have not done much set building remember when making a set that you should occasionally insert the valves and the coils into their respective places, so as to make sure that none of the wires will foul them.

* * *

It often pays to insert a variable filament resistance for the short-wave detector valve when reaction control is not perfect, as slight adjustments of this will often overcome difficulties in the control of oscillation.

* * *

A pair of dividers makes an excellent instrument for marking out a panel.

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Specification: Garrard double spring motor with 12" Turntable, B.T.H. Pick-up, double balanced Armature Speaker, handsome Oak Cabinet, French polished antique finish. Height, 3'; width, 23"; depth, 17".

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and pull in all stations with the Te-Ka-De set. Complete kit of parts, including Te-Ka-De V.T. 126 2-electrode valve, cabinet and panel, drilled and engraved.

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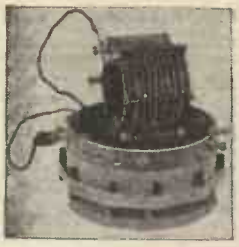

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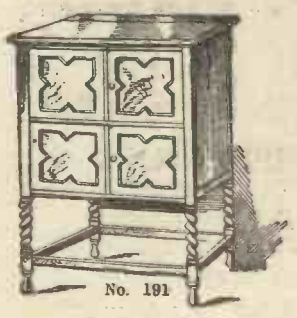

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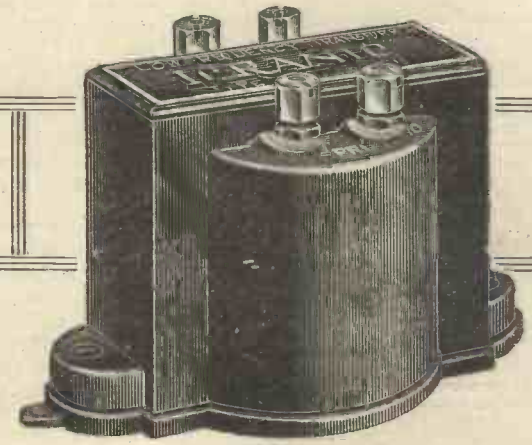

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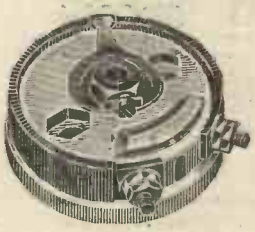

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	£	s.	d.
1 Drilled Aluminium Panel (18in. x 7 in.) (Colvern)		5	6
1 Set of screens		2	9
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2 5-pin valve holders (Junit)		3	6
1 Valve holder (Lotus)		1	3
1 "Permacore" Transformer (Mullard)	1	5	0
1 Mullard Combined grid leak and holder		6	0
1 ·0003 mfd. fixed condenser (Mullard)		1	9
1 ·25 mfd. Paper condenser, type BB (Dubilier)		2	5
1 Kit of condensers (Jackson Bros.)	1	9	6
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1 H.F. Choke (Climax)		7	6
1 Set of terminals (Belling-Lee)		3	0
1 Seven-way battery cord fitted with engraved wander plugs and spade tags (Belling-Lee)		5	9
1 Safety Anode Connector (Belling-Lee)			6
1 Pair of panel brackets		2	6
1 Set of Junit switches (Junit)		4	6
3 Junit indicating washers, 1d. each			3
3 Terminal Mounts (Junit) 8d. each		2	0
(Say) 8 oz. 18 gauge copper wire (approx.)		1	3
Length of sleeving, screws			6
Total	£6	11	5

Any of the above parts can be supplied separately if desired.

RECOMMENDED ACCESSORIES

	£	s.	d.
3 Mullard Valves, as specified	2	18	0
1 P.M. Loud Speaker (Model C) (Mullard)	2	10	0
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1 Grid Bias Battery, 16-v. type G.3 (Siemens)		3	6
1 Accumulator, 30 amp.-hr. capacity		11	6
1 Cabinet and baseboard	1	7	6

READY RADIO "ORGOLA" KITS IN SEALED CARTONS

KIT A (excluding Cabinet) - £6 : 11 : 5

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COUNTERPOISE EARTHS.

By C. RADFORD

THERE are two reasons why people use counterpoise earths. In some cases, the more conventional earths, such as buried plates and water-pipes, are not available, while there are instances where the only cure for serious interference is to employ the counterpoise variety. But before going any further, I must point out that counterpoise earths, buried aerials and all other such devices are useless for the elimination of atmospherics.

There are many ways of reducing the strength of static, but invariably, you also reduce the strength of the station you want to listen to. If a radio station can get its transmission through to your loud speaker, so can atmospherics arrive as well. Fortunately we do not in this country suffer from static to the same extent as they do in many other parts of the world.

Reducing Atmospherics.

Nevertheless, it can be troublesome at times, especially during the summer. The thing to remember is that the greater the ratio of signal to static that you can get, the less will be the effective interference. A great deal can be done by taking advantage of the threshold or relay action of most detector circuits.

If you can arrange conditions so that the static falls just below the "efficiency line" of the detector while the signals from your desired station remain above, the interference is going to be negligible. You can play on this point in complement with something else which is not generally realised. This is, that some proportion of static is tunable.

This means that atmospherics are less troublesome in the case of sharp tuning circuits than with inselective sets of equal sensitivity. If you have a high-frequency volume control, tune in the station as closely as possible, running the set all out, and then reduce volume with the appropriate control. A similar effect, although not so marked, can be obtained by close tuning followed by volume control in the L.F. stages.

Quite Efficient.

When atmospherics are very bad, such as when a local thunderstorm is raging, nothing can be done, and it is best to safeguard the house and set by earthing the aerial outside the house. The real purpose of this article, however, despite the diversions regarding static, is to discuss counterpoise earths, or counterpoise aerials as they are frequently termed.

I prefer to call them counterpoise earths, even although the term is somewhat paradoxical. Nevertheless, inasmuch as they replace ordinary earth connections, it must be misleading to amateurs to have them styled "aerials."

A properly arranged counterpoise is just as efficient as a buried plate in the ground; in fact, it is distinctly more effective. By avoiding a connection to the ground, you get away from earth currents

(*Continued on page 354.*)

A New Whiteley Boneham Loud Speaker

This is the new model which proved so popular at Olympia.

The Mellow Tone and Full Volume of this Speaker are things to marvel at. It brings out the low and the high notes to exceptional advantage without overloading. The case is beautifully made and finished in mottled bakelite. At 42/- this new Whiteley Boneham Speaker is one of the big things in present-day speaker value. **42/-**

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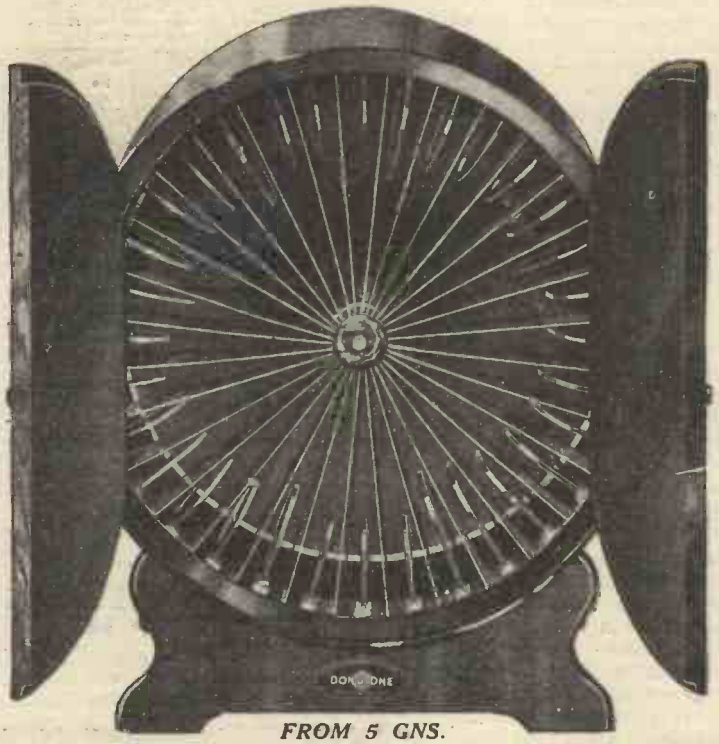

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PRICES: Coils of 50 ft. 9/-
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Extraordinarily efficient Full particulars on request. Prices from 3/-
Stocks held at LONDON DEPOT: 5 and 6 Eden St., HAMPSTEAD RD., N.W.1.

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Mr. T. B., c/o D. A. & Co., Ltd., Dukinfield, Manchester, writes:—
"**Considerably more volume was received.** It enabled me to reduce my length of aerial and obtain **more selectivity** with ample volume. Results obtained were worth extra cost."

Mr. W. W. R. Crook, Kendal, writes:—
"The results are marvellous. I never thought it possible to get such excellent results. **The volume is increased, and tone improved beyond words.**"

Mr. J. E. M., Pentre, nr. Wrexham, writes:—
"I think it is just wonderful—**the results are simply amazing.** It has improved my 3-valve set 100 per cent. All stations come in now so much purer, and certainly they are nearer to one."

Mr. S. H. H., Trowbridge, writes:—
"Really the result is **simply marvellous,** and all that have heard my set since putting the aerial up think it splendid."

Ward & Goldstone
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REDFERN'S
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RADIO PANELS
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FOR THE
MULLARD ORGOLA
AND ALL OTHER RECEIVERS
with Panels 18"×7" with 10" baseboard.

PRICE 18/- OAK

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For the SENIOR ORGOLA RECEIVER
Oak - 36-
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NOTHING LIKE IT SINCE THE MOVING COIL!

New Design – new principle–Low Price

Here is something you have never heard before! Nothing less than the fourth step forward in loud speaker design—the Puravox "1930"! The change in principle is revolutionary; yet so simple is the patent Spider diaphragm and piston motion drive that it has been possible to produce the Puravox "1930" in large numbers at a very low price.

FREE 7 DAYS TRIAL

Reproduction without a particle of distortion! Vivid-toned bass notes. Every instrument clearly heard in an orchestra from the tap of a drum to the tremolo of a violin. Hear it yourself, on your own set — FREE! Ask your dealer for a Puravox. Take it home and try it. If it pleases you, keep it. If not, take it back within the week and your money will be refunded in full!

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"1930"

CONE LOUD SPEAKER

(PATENT)

The model illustrated is 57/6 in Mahogany Cabinet. Other models from 32/6 to 85/-.

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Please send me complete list of Puravox Loud Speakers.

Name.....

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If contemplating a new Wireless Set, get particulars of the Efescaphone

COUNTERPOISE EARTH

(Continued from page 352.)

which are particularly troublesome in the close neighbourhood of some electric railways and power stations.

You can always test for this source of interference by disconnecting the earth-lead from your set and, if crackling or other noises which have been troubling you cease, it is clearly indicated that a counterpoise should be used and as carefully insulated from earth as is the aerial.

It can take the form of another wire or wires of the same length as the aerial, and run underneath it, but only a few feet from the ground. It is a distinct advantage to extend the counterpoise wires in the other direction for a few yards, if this can be arranged.

It should not be forgotten that if you earth your aerial to a counterpoise during a thunderstorm, complete protection is not afforded you against lightning. A direct earth should be available in the shape of a buried plate or such-like, for precautionary earthing purposes.

For Flat Dwellers.

I have said that there are people who are unable to make water-pipe connections or bury plates or metal in the ground in order to obtain conventional earths. For instance, a listener may be using an indoor aerial in an upper flat in an apartment building, a long way from a water-pipe. It is not often that one meets these conditions, but even where a water-pipe is handy from a domestic point of view there may be objections to running wires to it.

I can visualise polished floors or thick walls that would form obstacles. Although a gas-pipe makes a good earth connection, despite what has often been said to the contrary, it is not wise to tinker with these. Also the pipes through which electric wires trail around the house are always very efficiently earthed, but I do not think that electric-light supply companies regard with favour radio connections to their apparatus (by the way, it is always as well to get the company's permission to use mains devices).

But any fairly big expanse of metal will make a good earth. A lead-covered roof is admirable, while fireplaces, fireguards, iron bedsteads and other such objects have very successfully been employed by many listeners. Failing these, wire netting can be laid down underneath carpets.

Area is Wanted.

Something fairly expansive is needed. You should remember that you want area rather than bulk. Such things as I have been referring to are frequently styled capacity earths. With an instable frame aerial set, it is frequently a gain to bring in an earth connection, and you generally find that it considerably adds to the efficiency of the receiver.

It should be noted that quite a number of frame-aerial sets, particularly portable types, have their otherwise efficient circuits highly damped in order to attain the stability which more invariably accompanies a conventional earth.

Where the mains are used either for H.T. or for supplying all the local power needed, these, the mains, can be automatically brought in to operate as an earth, inasmuch as the filament circuits of the set via H.T. minus are connected to them.

HAVE YOU BUILT YOUR NEW SET?

—NOW IS THE TIME TO BEGIN—

The long evenings are here—You have time on your hands—USE IT PROFITABLY.

Why not make a Wireless Set or bring your present Receiver up-to-date?

GET PERFECT REPRODUCTION OF THE WORLD'S MUSIC.

We will advise you of a Receiver which best suits your conditions and requirements.

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COSSOR 1930 KIT. CASH £8.15.0. Send only 16/-, bal. by monthly payments of 16/-.

NEW OSRAM MUSIC MAGNET. CASH £9.0.0. Send only 16/6, bal. by 11 monthly payments of 16/6.

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EKCO MODEL 3 F.20 (A.C.). CASH £3.19.6. Send only 7/3, bal. by 11 monthly payments of 7/3.

CELESTION C.12 (Oak). CASH £5.12.6. Send only 10/4, bal. by 11 monthly payments of 10/4.

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AN INTERESTING FILM.

THE action of electric currents in actual circuits is not easy to understand, because current flow, unfortunately, is not visible to the eye. Text-book explanations and diagrams are apt to leave the student with a confused impression of what really happens.

We were recently privileged to attend a demonstration at which a novel and interesting film was shown. This film is entitled "Rectification," and has been produced by the technical department of the Westinghouse Brake & Saxby Signal Co. to show the action of the Westinghouse Metal Rectifier.

The film explains the difference between alternating, direct, half-wave and full-wave rectified currents. The effects of transformation, and the use of a reservoir condenser are made clear with the aid of moving diagrams.

The film is both highly interesting and instructive, and we were informed that it is likely to be included in the series of lectures which will be given by the Westinghouse Co. to a selected number of radio societies.

FOR YOUR NOTEBOOK.

Careful maintenance and cleanliness are just as important to good results when running a set as when running a motor-car or bicycle.

* * *

Many an obscure fault has been traced to a faulty flex connection.

* * *

If your earth consists of a clip around the water-pipe, improved contact can often be obtained by giving this clip a sharp blow from a punch or nail so as to form little projecting teeth that will bite through any non-conductive film on the water-pipe into the metal beneath.

* * *

Enthusiastic gardeners should remember that wire stays from the aerial mast should not be run through the foliage of valuable fruit trees, as charges due to nearby lightning might easily damage the trees.

* * *

FOR PORTABLE SETS

If you are building a portable set remember that the modern anti-microphonic valve holder allows of considerable movement of the valves, and that to protect these sponge rubber, or some similar shock-absorbing material, will be necessary.

* * *

Owing to the possibility of short circuits, positive H.T. leads carried very near to screening boxes should be guarded with extra insulation besides that provided by the insulation covering the wire itself.

* * *

WET H.T. BATTERIES

If the zinc for wet batteries is amalgamated at home it should be remembered that it must not be allowed to come into contact with wounds or broken skins, or the results may be serious, for the solution is very poisonous.

* * *

Generally speaking, better results are obtainable with a small reaction coil closely coupled to the grid circuit than with a larger reaction coil placed at a great distance.

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In addition to their own extensive range PETO SCOTT offer YOU every known Radio Receiver or Component. The list given below merely illustrates our terms for a few well-known lines and we ask you to fill in the coupon or send us a list of your requirements for which we shall be pleased to quote for cash or on our famous system of

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THE NEW "TITAN" SETS. Complete kits, including the very best components, drilled panels, and polished cabinets
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"TITAN" FOUR. Send only 13/2, balance in 1 monthly instalments of 13/2.
THE "P.W." FOUR (as described in issue of Sept. 21st). Complete kit, including polished mahogany cabinet, panel, and all specified components. Send only 17/8, balance in 11 monthly instalments of 17/8.
THE BROOKMAN'S THREE (described in "Modern Wireless," September issue). Complete kit, less valves. Send only 17/5, balance in 11 monthly instalments of 17/5.
NEW OSRAM MUSIC MAGNET. Send only 16/6, balance in 11 monthly instalments of 16/6. Valves included.
McMICHAEL SCREENED GRID THREE. Complete kit of components, excluding cabinet, valves, etc. Send only 16/3, balance in 11 monthly instalments of 16/3.
FERRANTI ELIMINATOR KIT for home construction, using Westinghouse Metal Rectifier. Output 200 volts, 100 m/a for A.C. Mains. Send only 40/-, balance in 11 monthly instalments of 22/8.
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REGENTONE W.1.B. S.G. (A.C. Mains). For S.G. and Pentode Sets. Send only 9/2, balance in 11 monthly instalments of 9/2.
EKCO 3 F.20 (A.C. Mains). Also for S.G. and Pentode Sets. Send only 7/4, balance in 11 monthly instalments of 7/4.
ALL LEADING MAKES OF ELIMINATORS from 4/7 first payment.
CELESTION C.10 LOUD SPEAKER in Oak. Send only 6/11, balance in 11 monthly instalments of 6/11. In Mahogany, 7/1.
CELESTION C.12 LOUD SPEAKER in Oak. Send only 10/4, balance in 11 monthly instalments of 10/4; in Mahogany, 10/9.
CELESTION Z.20 LOUD SPEAKER in Oak. Send only 14/3, balance in 11 monthly instalments of 14/3; in Mahogany, 15/2.

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THE "MAGIC" THREE. *Build the wonderful set described in this and last week's issues. Complete kit of components as specified for 15/- down, balance in easy instalments.*

1930 MULLARD "ORGOLA," including cabinet and valves. Send only 20/-, balance in 11 monthly instalments of 20/-.
COSSOR 1930 THREE-VALVE KIT. Send only 16/-, balance in 11 monthly instalments of 16/-.
COSSOR 1930 THREE-VALVE A.C. MAINS KIT. Send only 27/6, balance in 11 monthly instalments of 27/6.
COSSOR 1930 TWO-VALVE A.C. MAINS SET. Send only 19/3, balance in 11 monthly instalments of 19/3.
S.G. BROWN, MODEL B. Three-valve screened grid set. Complete kit and cabinet. Send only 18/-, balance in 10 monthly instalments of 18/-.
BOWYER-LOWE UNIVERSAL SHORT-WAVE KIT, including coils for 10 to 5,000 metres, and valves. Send only 46/4, balance in 11 monthly instalments of 25/6.
MAINS COMPONENTS AND VALVES of every description are available on easy terms. Full details in our Catalogue. For example: **WESTINGHOUSE METAL RECTIFIER,** Type H.T.1, with Regentone Power Transformer, Type W.R.1. Send only 9/2, balance in 11 monthly instalments of 9/2.
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BLUE SPOT 66 K UNIT, with **SQUIRE MODEL 101 CONE KIT.** Send only 5/11, balance in 11 monthly instalments of 5/11.
EXIDE 120-volt H.T. Accumulator, Type W.J., in crates. Send only 6/11, balance in 11 monthly instalments of 6/11.
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TECHNICAL NOTES.

(*Continued from page 316.*)

between different coils but it has the drawback that a good deal of the energy may be lost owing to the setting up of "eddy-currents" in the shields themselves. Like so many other remedies, therefore, it is not a complete remedy but brings with it disadvantages peculiar to itself.

Basket Coils.

It is hardly necessary to touch on the coils of the basket type, as I suppose most of you have actually made basket coils yourselves for various purposes. A basket coil, of course, is formed on an arrangement consisting of a centre piece with a number of spokes, after the fashion of a car-wheel without the rim, the centre and spokes being arranged so that they can subsequently be removed, leaving the coil without any "former" at all.

In order that it shall keep its shape when the support has been removed, it is necessary to fix the various turns by means of some form of "dope," which may be shellac varnish, celluloid varnish or something else of the kind. The main drawback to the basket coil is that its high-frequency resistance is generally rather on the high side whilst the need for a coating of, say, celluloid varnish means that the self-capacity of the coil is increased, notwithstanding the fact that the formation of the coil itself is designed to diminish self-capacity. Nevertheless the basket coil has much to be said in its favour, as it is very easy and cheap to make and, being of flat formation, occupies very little space.

The honeycomb coil is in a sense a variant of the basket coil. Honeycomb coils are still considerably used and can be made quite small and still be efficient, although again the high-frequency resistance and self-capacity are both apt to be rather higher than one could wish.

Special Forms.

Coming back to the solenoid type of coil, this has been very considerably improved since the days when it was simply a plain cylindrical coil wound upon a tube. In order to reduce the self-capacity, the type of the former has been changed and solenoids are sometimes wound upon a hexagonal prism, so that the wire touches at only six points per turn.

Various other shapes of "former" may be used and again the coil may be fixed by means of the dope whilst it is on the "former," the latter being then removed, leaving the coil entirely self-supporting.

Fieldless Coils.

There are one or two other points I should just like to touch upon before leaving the question of coils. I mentioned above the importance of limiting the electromagnetic field of the coil and how this may be done with a solenoid by winding the two halves in opposite directions.

The same thing applies in a general way to any type of coil, but there are one or two types which have been designed so that the limitation of field is secured in another way. For instance, there is the so-called "binocular" coil, which consists really of a solenoid coil divided into two halves, the two halves being placed side by side, after

(*Continued on next page.*)

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See Advertisement on Page 343

TECHNICAL NOTES.

(Continued from previous page.)

the fashion of the two telescopes forming a pair of binoculars—hence its name. The electro-magnetic field in this way tends to follow an unbroken circuit through the two coils and the stray field is thereby very much limited.

Toroids.

Carrying this idea to the extreme limit we have the so-called "toroid" coil, which is really a solenoid coil bent round into a circle, the two ends being brought together—not unlike a balloon tyre of a motor-car. The field inside a coil is popularly supposed to be entirely contained within the windings, but a little consideration will show you that this is impossible and, in fact, there is a certain amount of stray field even with a toroidal coil, although the stray field is distributed in a way which causes much less trouble than with a straight solenoid.

Inductive Values.

I think the foregoing remarks, although perhaps very elementary to those of you who are accustomed to make your own coils, will help to clear up any little points as to terminology for the sake of those of my readers who are comparatively new to radio. I find that newcomers sometimes get completely mixed up between basket coils and lattice coils.

There is very little difference in principle between these types and, of course, any coil, no matter what its form, depends upon the principle of magnetic induction. Broadly speaking, the considerations which govern the design of coils are questions of self-capacity, high-frequency resistance, inductive value and stray field or interaction between the coil and other coils or other components in the set.

Bearing these facts in mind, I think you will have no difficulty in seeing why coils are made in special shapes or forms or of special sizes (upon the inductance value, of course, depends the wave-length), and why some constructors prefer one form and some another.

H.F. Amplifiers.

I have more than once touched on the question of the importance of using correct grid bias with any type of valve, more particularly with valves used as low-frequency amplifiers. The proper bias not only has the effect of working the valve at the proper part of its curve, but incidentally of economising anode current and thereby prolonging the life of the H.T. batteries. In other words with the proper grid bias you get better reproduction, less distortion and longer high-tension-battery life.

Now I want to say a word about the matter from the other end, as it were, that is, not the importance of using a sufficient value of grid bias but the importance of not using too much.

I refer more particularly to the case where a valve with a somewhat high magnification factor is used as an H.F. amplifier. A sufficient value of grid bias must be used to counteract the tendency for grid current to flow, as in this way the impedance of the valve is reduced to a minimum and, of course, the amplification obtained with the valve is kept to a maximum.

(Continued on next page.)

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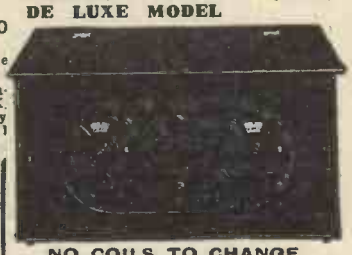

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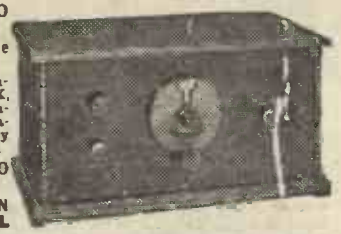

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TECHNICAL NOTES.

(Continued from previous page.)

G.B. and H.T. Volts.

When dealing with high-frequency amplification the problem is in many ways quite distinct from that of low-frequency amplification, mainly owing to the small signal voltages which are dealt with. In consequence of the fact that the signal voltage in the case we are considering may be extremely small we shall often find that the correct grid-bias voltage is only a fraction of a volt.

Alternatively, if the grid-bias voltage used is too large, it means that we have to employ a correspondingly higher value of H.T. in order to obtain the same result—the increase in H.T. volts being, of course, enormously greater than the increase in grid-bias volts. There are two or three simple ways in which a fraction of a volt may be applied to the grid of the H.F. amplifier. One is to use a simple potentiometer which need not be adjustable but can be "set" once for all (consisting, in fact, simply of a tapped resistance).

Valve Developments.

It is interesting to notice that in the development of receiving valves during the past four or five years, there have been continual reductions in the voltage and current ratings of the filament, until now we have the many excellent examples of receiving valves working from 2 volts and consuming only one-tenth of an ampere. The old bright-emitter valve generally consumed over ½ ampere at 4 volts at least, so that you see the wattage consumed by the modern 2-volt dull-emitter filament is only a small fraction of that consumed by the old 4-volt or 6-volt bright-emitter.

The anode current at the same time has, however, been increased, not only by the greater emissivity of the filament under given conditions, but also by the design of circuits adapted to enable much higher values of H.T. voltage to be used. The net result is that enormously larger anode currents are used to-day than in the receivers of four or five years ago, with consequent increase in output power.

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See Advertisement on Page 343

A RAPID GUIDE TO RADIO

A JUMPING-OFF SERIES FOR THE NEW AMATEUR

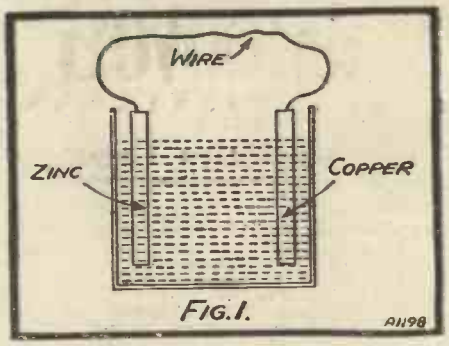
By "Pentode"

WITH a fair idea of the nature of the electron it is possible to dive into more practical matters. We have seen that a movement of electrons is, in effect, a demonstration of electrical activity. While the electrons confine themselves to their own individual atoms nothing particular happens. It is when they start jostling from atom to atom that noticeable incidents take place.

There are quite a number of ways of causing such to happen. When your local power station started to cause tramcars to crash and rattle about and electric lamps to glow it did this by creating terrific electron activity by means of huge dynamos and communicating this electron activity to distant points via wires.

On a smaller scale a radio battery does the same kind of thing only in a different manner. We will not be touching the subject of dynamos just yet, although when the time comes to make close reference to them you will see how closely linked are all the basic laws and facts of electrical and radio science.

A battery is a mighty interesting thing, for it is an object that transforms chemical



action into electrical action. You put certain metals into a chemical solution, and the magical result is that electricity for ringing door-bells, lighting small lamps, or driving a radio outfit is immediately available.

That is in the case of the primary cell. The primary cell in radio is represented by the H.T. battery.

How Accumulators Work.

The secondary cell, or accumulator as it is more commonly known, works a little differently. Here you have to apply electricity in the first place in order to form a certain chemical condition. And with the reversion of this condition to its original nature electrical activity is caused.

But this is what you have got to learn early and always remember; there can be no flow of electricity without there is a complete circuit. Let me explain this in detail, for it is remarkably important.

The simplest kind of primary cell consists of a piece of copper and a piece of zinc immersed in a solution of sulphuric acid. And in brief the action is that the chemical activity causes a very large number of electrons to collect on the piece of copper, while the piece of zinc is correspondingly robbed of electrons. These pieces of metal are now out of balance; it is as though there were two water tanks, one having in it a lot of water, and the other having but a small quantity (Fig. 2).

Restoring Balance.

Nature hates anything to be out of balance, and if you gave this primitive electrical cell the chance it would endeavour to restore its equilibrium. You can do it by joining the two pieces of metal together with a length of wire just as you could help

It is a common belief that the theory of wireless is dry-as-dust sort of stuff that concerns only the engineer and scientist. This is quite wrong, for, told in the right way it makes fascinating reading. Further, even a superficial knowledge of the subject will prove invaluable to either listener or constructor and make the tasks of set-building and maintenance easier and more interesting. But it should be noted that this series is not confined to theory alone. Skilfully welded into the articles will be a vast amount of information directly relative to the assembling and operation of radio receivers. Hints and tips concerning all phases of "household wireless" will be given, and it is our firm belief that every reader of "P.W." will find something in the series of individual interest.

2 CONCERNING BATTERIES.

the two water tanks to achieve a level height of water by joining them together by a water pipe (Fig 3). And in the case of the cell the excess of electrons on the copper jostle the electrons forward in the piece of wire so as to make way for them until eventually they are jostled through to the zinc.

The wire is already full of electrons, all revolving around in their atoms, and this pushing forward does not upset the electron arrangements of the atoms. This you must carefully note.

Supposing this wire were a drainpipe completely filled with peas. If you pushed a hundred more in one end, a hundred would roll out of the other. The electrons are not packed tightly in so that they are all cheek by jowl as it were, but they are electrically packed very tightly, for you cannot push an extra electron in an atom's anatomy without very special methods.

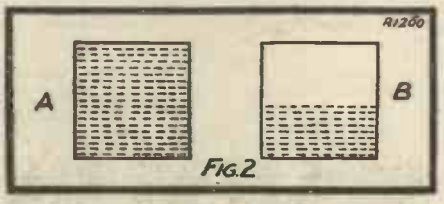
This is a hard point to grasp, and cannot easily be explained, but you must conceive of an electron needing a certain amount of elbow-room.

To get back to our cell. In order to sustain a flow of electrons through the wire the chemical action must continue to cause a lack of electron equilibrium, and the more sustained it is the greater the efficiency of the device as a producer of electricity.

A cell based on the simple zinc and copper scheme would not be much good for practical work. A satisfactory cell is rather more complicated in construction.

The "dry" cell used in radio is a good example. By the way, this is not really dry, because it has a chemical paste in it which does not operate at all when it dries up.

Besides this paste are zinc and carbon,



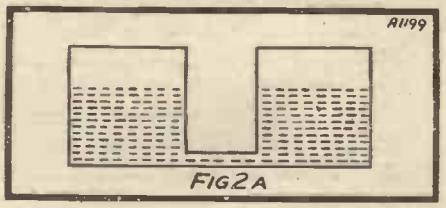
which form the two "electron tanks," and another ingredient, the purpose of which is to put a stop to a chemical activity which would otherwise impede the action of the cell.

The accumulator cell has lead plates and here sulphuric acid solution is used. The "charging" of the accumulator (or secondary cell) is the application of electricity in order to make the cell take up a chemical form suitable for the causing of electron movement. In a way, the cell is brought to the condition in which a primary cell starts by this means.

Unhappily a primary cell cannot be restored by the application of a charging current of electricity.

Conductors and Insulators.

But we are jumping ahead a little too far. Let us go back to Fig. 1. This illustrates a complete electrical circuit. While the chemical activity continues in the jar containing the metals and acid solution the electron balance continues to be upset, and a compensating flow of electrons passes through the wire.

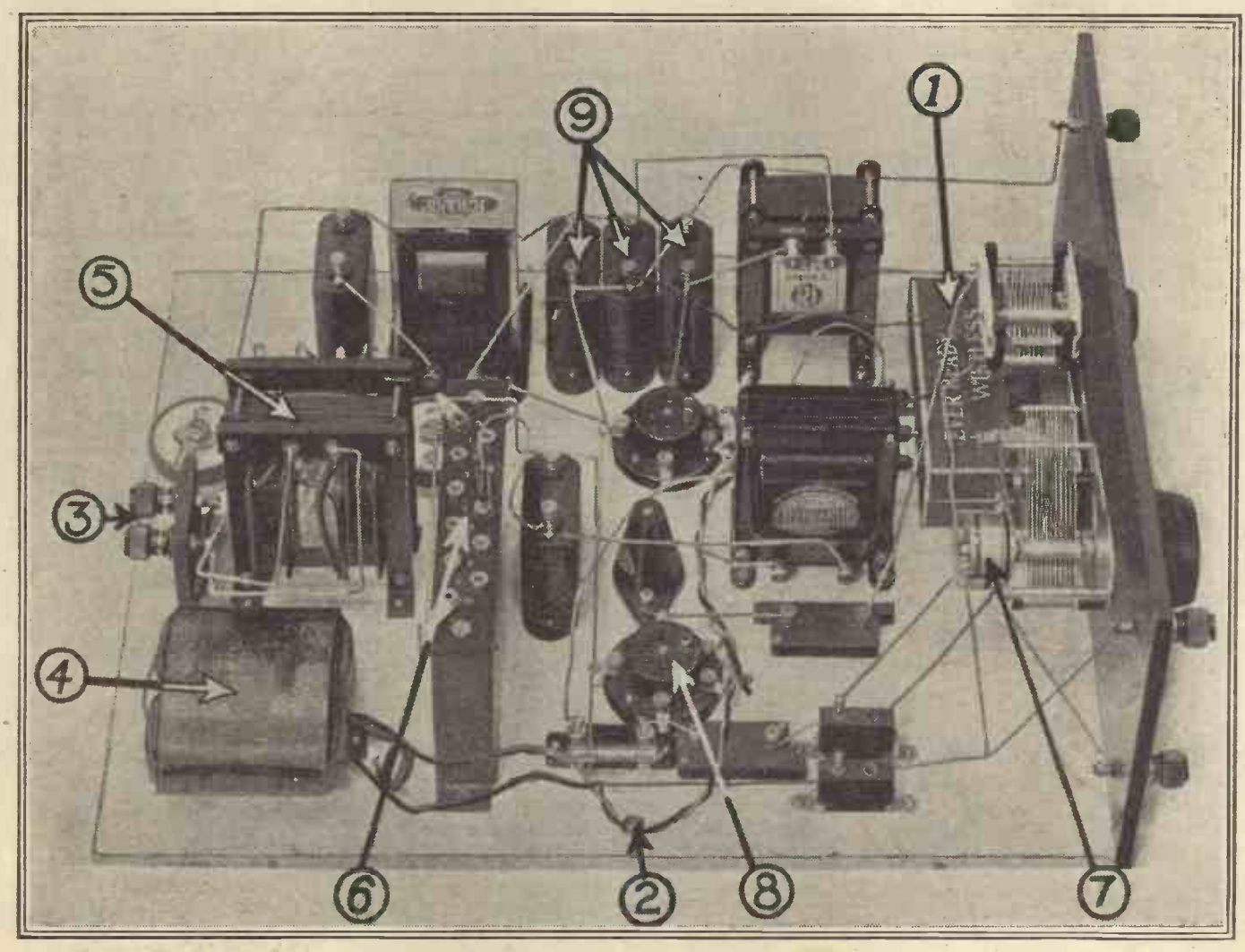


It is, of course, a metal wire. A piece of string would not serve the purpose, for string is not a conductor of electricity. True, it is composed of atoms comprising little solar systems of electrons, but its electrons are so grouped that they strongly resist any kind of jostling forward.

All metals are conductors, while such substances as paper, wool, mica, wood, glass, rubber, jute, ebonite, and so on, are non-conductors or insulators.

CLOSE-UPS FOR CONSTRUCTORS.

THE SECOND OF A NEW PICTORIAL SERIES.



THIS week we are jumping ahead a little and dealing with a set which, although only a two-valver, is slightly involved in design, as it derives its H.T. and L.T. from the mains. Newcomers to radio who know little or nothing about the "innards" of sets will, in due course, have the opportunity of examining "analysed hook-ups" of simpler characters. In the meantime they must acquire a little knowledge about electrons and so on by reading the article overleaf.

Indirectly-heated A.C. valves are arranged for in the above set. There are several interesting things to note in this particular design, some of which are points applicable to many other types of home-constructed receivers.

Points Concerning the Wiring.

At (1) you see how the grid-bias battery is tucked away on the baseboard. It is lying on its side under the variable condensers.

With mains sets great care must be taken with the wiring, and (2) indicates how the well-insulated flexible wire, which takes the A.C. along to the valve holders, is held to the baseboard to keep it clear of the components.

The terminals indicated at (3) are the mains input terminals and as such should be of the insulated variety, (4) is the L.T. step-down transformer which reduces the mains voltage to the lower value needed for the A.C. valves, and (5) is the H.T. transformer. (6) is the "potential divider" that enables various values of H.T. to be selected.

Notes on the Variables.

A slow-motion or geared type of variable condenser is used for tuning in this set and (7) indicates the gearing of this particular component. You will notice that the other variable is a smaller one and that, apparently, it has no gearing. A geared movement in this variable is not really needed as it is the reaction condenser.

The new A.C. valves have five pins, four of which are arranged similarly to those on ordinary valves, the extra pin being centrally disposed. As you will see at (8) the old type holders figure in this set. The two raised sockets are for the heater connections.

At (9) you see how the large fixed condensers used for smoothing purposes are neatly grouped to facilitate wiring and make the baseboard layout neat.

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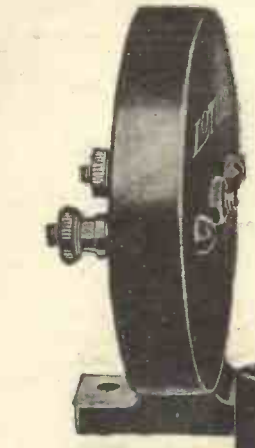

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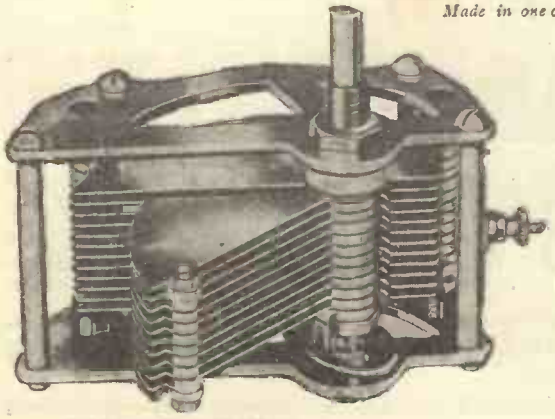

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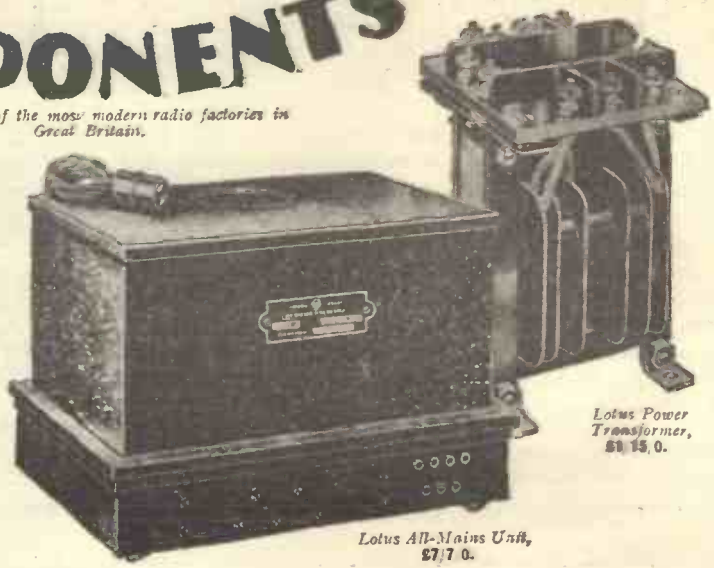

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Presented Free with Popular Wireless, October 19th, 1929.

THE "POPULAR WIRELESS"

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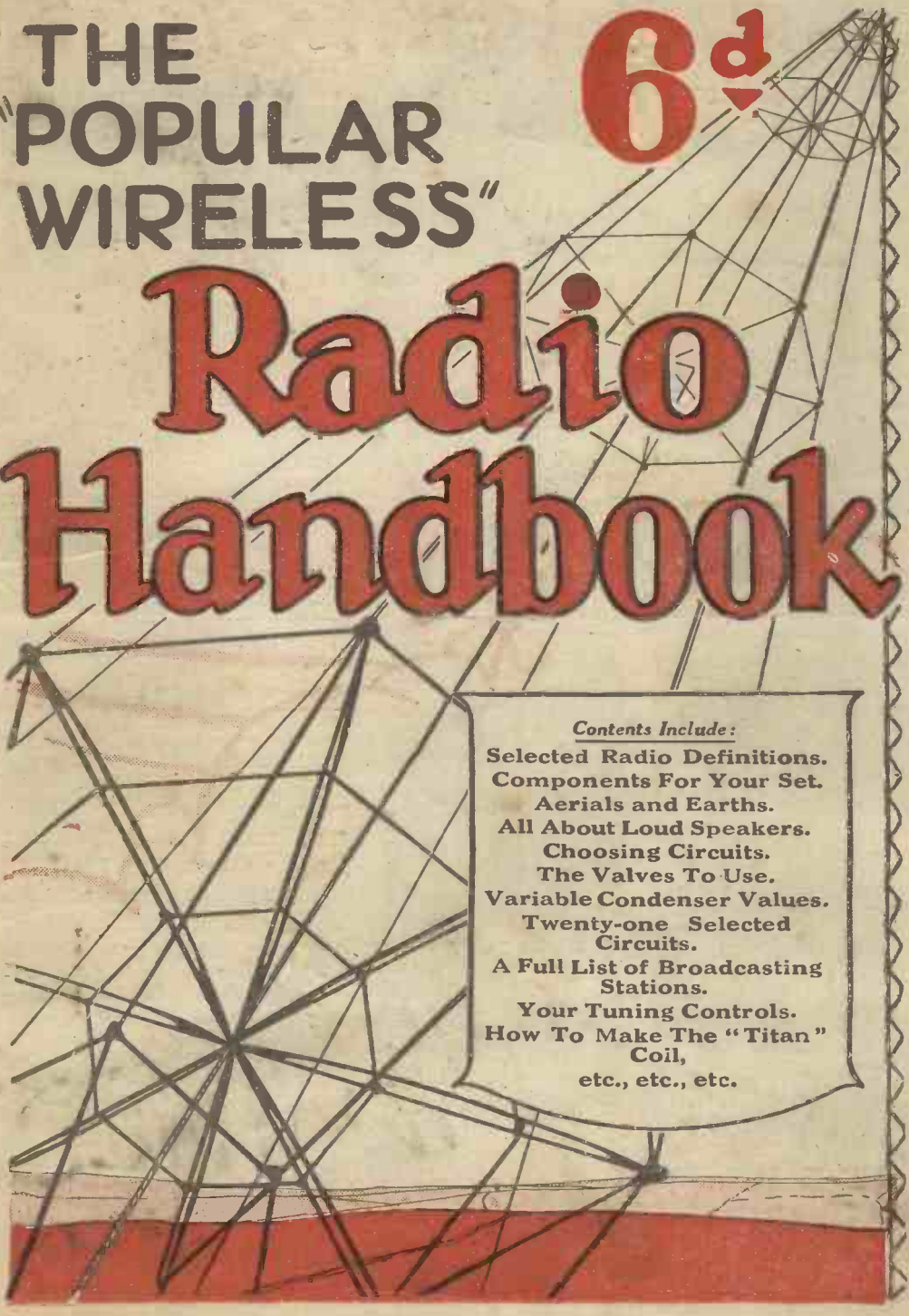
Radio Handbook



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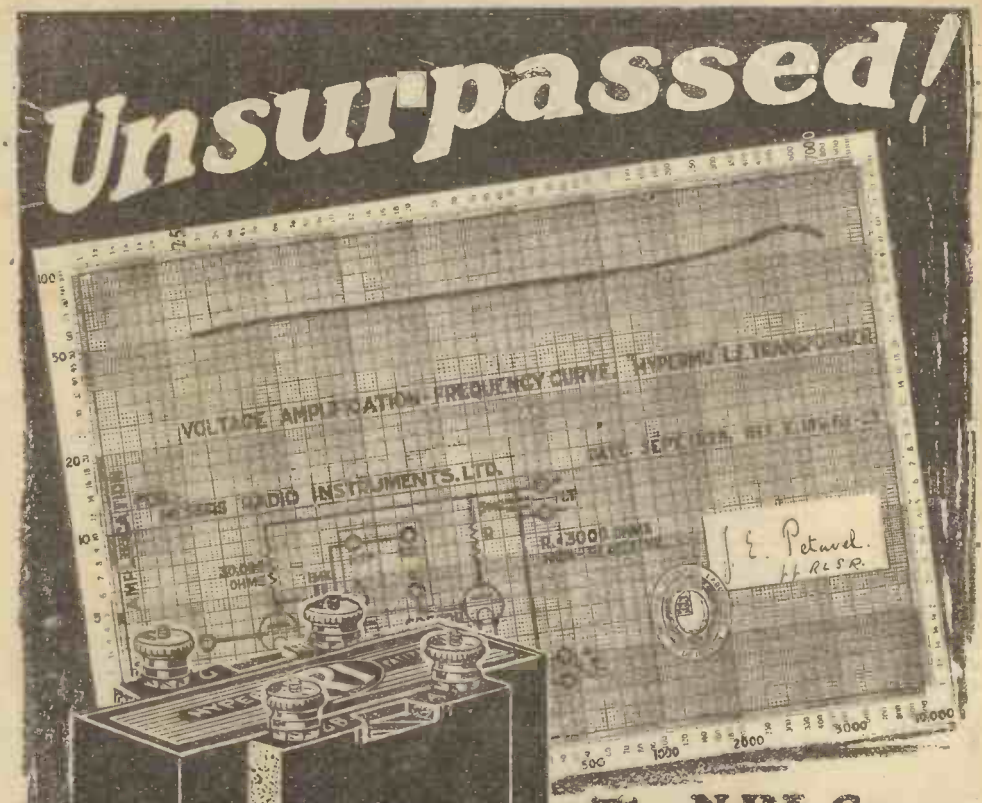

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THE "P.W." RADIO HANDBOOK

A Complete Guide for Listeners and Amateurs specially compiled by the Technical Staff of "P.W." and presented free with "Popular Wireless," week ending October 19th, 1929.

CONTENTS

AN EVENTFUL RADIO YEAR

A brief summary of some recent outstanding wireless happenings at home and abroad.

The Baird Co. gave demonstrations to a Special Committee and the P.M.G. recommended that the B.B.C. should offer facilities for experimental television transmissions. There was a failure to reach agreement between the B.B.C. and the Baird people regarding the times of transmissions. The B.B.C. were unable to offer more than three quarter-of-an hour periods per week out of programme hours. Eventually, experimental transmissions were arranged on the basis of five periods of half-an-hour each per week.

* *

The new high-power broadcaster at Brookman's Park, which is to be London's Regional Station, started experimental transmissions.

* * *

Work was commenced on Broadcasting House, the new headquarters of the B.B.C.

* * *

The Prague Plan of wave-lengths allocation was brought into operation.

* * *

B.B.C. RESIGNATIONS.

Capt. P. P. Eckersley, Mr. R. E. Jeffrey, Capt. West, Mr. K. A. Wright, Mr. Eric Dunstan, and other well known B.B.C. officials resigned. Capt. Eckersley joined the staffs of "Popular Wireless," "Modern Wireless" and the "Wireless Constructor."

* * *

It was calculated that in 1922 there were 30,000 radio receiving sets in use, and that the trade turnover was about £500,000. At the end of 1928 the turnover for the year was reckoned to be £25,000,000, and the sets in use 3,000,000.

* * *

Professor E. V. Appleton, Professor of Physics, King's College, London, disclosed details early in the year of his Heaviside Layer experiments. He was able to penetrate this with very short waves and located another similar layer many miles above it.

* * *

MARCONI ROYALTIES.

The Marconi Royalty question was thrashed out in Courts of Law and, after several interesting phases, an agreement was reached between the Marconi Co. and the R.M.A. on a 5s. per valve royalty basis. Contracts are to be for 5 years, the trade benefiting by getting the use of a very large number of existing patents and of any future patents eventuating in this period.

* * *

Broadcasting played a leading part in the General Election. There were pre-Dissolution speeches by all parties and the results were broadcast far into the early hours of the day following polling day.

* * *

Better valves than ever became available for listeners and constructors, notable newcomers being the remarkable Cossor New Process Valves.

* * *

PORTABLE SETS.

Portable sets attained a remarkable popularity which at the time of writing shows no signs of waning.

* * *

The combination of electric gramophone and radio set in the one instrument has created great interest, and manufacturers selling them report heavy demands.

Attention was at last turned by the listening public to the electric-supply mains as sources of radio power. The result has been exceptionally good trade in all kinds of mains devices.

* * *

A long-standing difference between the important cable companies (Compagnie Française des Cables Téléphoniques and La Compagnie Radio France, Cables P Q) has been removed by what is described as a "co-ordination of technical means."

* * *

RAILROAD RADIO.

The Federal Radio Commission of U.S.A. allotted five short-wave channels especially for use in connection with railway trains.

* * *

The Brazilian Government has made it compulsory for every vessel leaving a Brazilian port to be equipped with a radio set in proper working order. Unless this condition is complied with the clearing of the vessel will be refused.

* * *

Radio developments started taking place very actively in Russia. A party of Soviet engineers went over to New York to engage in Technical Conference with the engineers of the Radio Corporation of America.

* * *

It was announced that five new Russian stations are in the course of construction.

* * *

NEW BROADCASTING STATIONS.

New broadcasting stations were being built in practically every country.

* * *

The Czecho-Slovakian Government placed orders with the International Standard Electric Corporation of Prague for a broadcasting station which it is expected will be the largest in the world. The new station will have a power of 120 kilowatts.

* * *

A German wireless company secured a contract from the National Government of Nanking for the erection of high-power radio stations in Canton, Tientsin, Shanghai and Hankow.

* * *

Mr. Aylesworth, President of the National Broadcasting Company of America, paid visits to England, France, Germany and other European countries. His object was to endeavour to arrange an ambitious scheme of programme exchanges on an international basis. It is calculated that the N.B.C. chain of broadcasting stations serves 50,000,000 American listeners.

* * *

A RADIO MUSEUM.

What was claimed to be the very first museum devoted entirely to radio was opened in America.

* * *

Great strides in the development of broadcasting were stated to have been made in Sweden, it being reckoned that there are now 66 sets per 1,000 inhabitants.

* * *

Radio-Paris and Radio Toulouse were voted by French listeners as the two most popular stations in France. Bordeaux Sud Ouest, Limoges, Nimes and Toulouse P.T.T. were found to be of little interest.

CHOOSING CIRCUITS

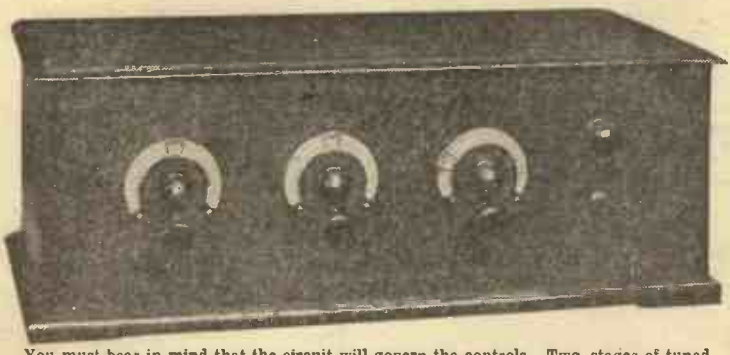
There are literally scores of different circuit arrangements, all with attractive features, and to choose any particular type is a perplexing problem. Here is some really practical advice on the subject.

There are three standard detector circuit arrangements, three very well-known forms of L.F. coupling, and about eight more or less completely different H.F. circuit arrangements. You will see from this that an H.F.-Det.-L.F. set lends itself to some sixty different variations. How many different versions of a five-stage arrangement it would be possible to tabulate would need some working out. Anyhow, it would be a very great number Therefore, we can extend our sympathies to the constructor who, having dug down into the theory of radio more or less superficially, scratches his head in puzzlement and says: "Which will be my ideal arrangement?"

HAPHAZARD SET SELECTION.

And we can picture him wandering among a maze of split-primaries, split-secondaries, tuned grids, and so on and so forth, with the horizon getting farther and farther away from him. Of course, a very great number of constructors pay little or no attention to the circuit of a set. They note that the designer or designers of the "Standard" Three, or whatever it is, say that the hook-up has these or those qualities and can accomplish certain things under certain conditions, and, if the story as a whole appeals to them, then they make their choice by this means.

But a study of the circuit, however superficial it may be, will be worth while, for it will enable the constructor more easily to make his mind up for himself and not to rely completely upon the directions of others. You see, designers of sets are notoriously optimistic people, at least the majority are. A notable few are remarkably modest in regard to their productions.



You must bear in mind that the circuit will govern the controls. Two stages of tuned H.F. coupling will mean three variable condensers or elaborate "ganging."

We must add in parenthesis that every receiver described in POPULAR WIRELESS is independently tested by the "P.W." Research and Construction Department. We have always recognised the necessity for some such department, but it was only about two years ago that it was constituted, under the able control of Mr. G. P. Kendall, B.Sc. Every set forming the basis of a prospective constructional article for POPULAR WIRELESS is very carefully tested and all its claims verified, whoever may be the designer. And it is worth noting that very, very few sets indeed pass through without suggested modifications being made.

However, to get back to this circuit business.

First of all, let us take rectification. In these days the crystal detector should be confined to the simple crystal set. If any valves at all are to be used, then it is just as well to eliminate crystal detection. Even the best crystal detectors are liable to pack up in the middle of a concert. Remember that providing the batteries are O.K. nothing short of the house falling down is likely to stop a first-class valve set operating.

GRID LEAK v. ANODE BEND.

There are two well-known methods of valve rectification. The one is known as the leaky-grid method (grid leak and condenser) and the other is anode-bend. Undoubtedly the anode-bend method enables a greater purity of reproduction to be obtained, but, despite anything which you may hear or read to the contrary, you can take it from us that a fairly careful choice of valves and a moderately skilful adjustment of conditions are needed in order to obtain this superior quality.

None of these complications occurs in leaky-grid rectification, and this is the scheme we would recommend to the average constructor, for unless he uses a moving-coil loud speaker and first-class gear throughout, he is not going to benefit very much in point of quality by adopting the anode-bend method, and, on the other hand, it is probable that he would lose considerably in point of sensitivity.

Very few people can afford to ignore the sensitivity obtained through the use of reaction, although the careful operator uses only the minimum degree.

Regarding L.F. amplification the issue is less clear, but nevertheless it is really quite straightforward. Here we have choke capacity, resistance capacity and transformer coupling. These are the three best-known arrangements, but, additionally, there is the push-pull scheme and what is known as dual impedance coupling.

L.F. AMPLIFICATION.

The choice of the average constructor will range between the first three mentioned methods and combinations of these. We think it is a mistake to strive for very high amplification per valve on the low-frequency side. In our opinion, it is better to aim for more stages and lower amplification per valve. But, unfortunately, only the fortunate few could afford to carry this idea through thoroughly; the majority find it financially necessary to limit the number of valves.

For one stage of L.F. amplification it is safe to say that the transformer method of coupling has the most

points in its favour. Useful amplification and very passable quality can be obtained with but moderate high-tension voltage. But to get really loud-speaker signals, even from the local station two stages of amplification are needed. An arrangement which has much to commend it and is much used is a stage of resistance-capacity coupling followed by a transformer-coupled valve.

Somewhat superior results might be achieved by the employment of resistance-capacity coupling throughout, but you would need three valves instead of two unless you were to force the magnification up by using high values of coupling resistances and high-magnification valves, but in doing so you would endanger the quality of results.

With choke-capacity coupling one is not able to get the magnification possible by the transformer method, although an approach to the quality obtainable with resistance capacity is possible with lower H.T. But there seems to be a "settling down" towards resistance capacity and transformer methods and it is easy to summarise the most popular arrangements.

TRANSFORMER COUPLING.

For one valve, transformer coupling: for two stages of L.F., resistance capacity followed by transformer; for three stages, resistance capacity throughout with two valves in parallel in the output position.

The pentode is easily dealt with. This needs a high H.T. voltage, takes a moderately high H.T. current and, even so, cannot handle the input that is "money-for-jam" for an ordinary super-power valve. On the other hand, it gives the magnification of two ordinary L.F. valves. You save a valve and an L.F. transformer or R.C. coupler, but you must use a special output transformer (for good results), and you must pay a good bit for the one valve (25s.).

So you see the pentode v. ordinary L.F. issue is not as straightforward as it should be. Examined in the hard, cold light of dawn, as it were, the pentode stands to lose a little of its romance; but, whatever the anti-pentode school says, it still has the solid advantage of great magnification.

H.F. amplification seems to lend itself more readily to circuit variations. The screened-grid valve has been very prominent of late, and it is a fact that a screened-grid stage will provide the greatest possible amplification together with a remarkable stability and freedom from extraneous neutralising devices and all their complications.

On the H.F. side every extra valve generally means so much additional tendency to instability and difficulty in tuning. The S.G. valve gives you greater amplification, and is stable in operation by virtue of its capacity-eliminating construction and operation.

But although one S.G. valve may give you one and a half times the effective amplification of one ordinary valve (we think one and a half is nearer correct than the popular two), don't forget that you lose a valuable tuned circuit by replacing two ordinary valves for one S.G. You get the magnification without the selectivity to make the best use of it.

THE SCREENED-GRID VALVE.

Incidentally, you get a trifle more background, or mush, accompanying your music or speech.

Here again cost comes well to the fore, as the S.G. costs twice as much as an ordinary valve and consumes two or more times the H.T. current. Further, it necessitates a high H.T. voltage.

The S.G. comes definitely into its own where immense sensitivity is required. Two stages of S.G. H.F. give you "super-het." results with surprising stability. Of course, they are somewhat "noisy," but you expect noise with enormous magnification.

A point well worth bearing in mind is that the pleasant reception of distant stations depends upon the normal ratio of static or mush to the music. You might have heard a station on a three-valve set, not loudly but just sufficiently powerful to hear all his speech. On a five-valve set you might collect so much "mush" with that station that you would never care to listen to it.

Other types of H.F. circuits offer compromises between selectivity and sensitivity. Others, again, are more stable and less sensitive, and so on. In fact, there are so many considerations, or varying combinations of considerations, that it is impossible to lay down hard and fast rules. To add to the complexity we are always coming up against special schemes which individually appear to be extraordinarily attractive. These are generally modifications of better known arrangements, and we could do little better than to confine ourselves to a consideration of the more standard hook-ups.

R.C. H.F. COUPLING.

Resistance-capacity H.F. coupling can be dismissed in a few words. This appears to be of value only on the longer wave-lengths and, although it enables one to dispense with tuning, it will not meet the average constructor's needs.

The old-fashioned but very simple tuned-anode coupling can likewise be put aside as being more or less obsolescent. The simple tuned-grid circuit, however, has its points. An H.F. choke is placed in series with the plate circuit of the "H.F. valve," and the feed to the detector is via a fixed condenser. The detector has a straightforward tuned-grid circuit. We would only advise the use of this scheme for one stage of H.F. amplification. The input to the detector can be tapped down the grid coil in order to achieve quite a useful degree of selectivity. Not a remarkable degree of amplification can be effected, but at the same time, in this respect it does not fall very far short of the best of some of the best of other methods. Neutralisation can be introduced, when the arrangement becomes even more attractive and it certainly lends itself remarkably well to the design of wave-change sets.

Of the two forms of H.F. transformer coupling, i.e. split-primary and split-secondary, practically everybody these days is of the opinion that the split-primary is the better both in point of stability and magnification. Nevertheless, special split-secondaries have been invented which have very great advantages, but the future of H.F. amplification lies in the screened-grid valve. One day it will be as cheap as an ordinary valve now is, at least we hope so, but at present the subject of H.F. amplification is a very difficult one.

AMPLIFICATION PER VALVE.

On the L.F. side the only compromise that needs to be made is that between amplification per valve and quality of reproduction. Here one is not up against such problems as selectivity, operation and, in any way to the same degree, stability. Additionally to these we still have on the H.F. side amplification per valve and quality. You must not forget that quality of reproduction can be ruined before the detector just as easily as after it.

And with this rather unsatisfactory conclusion we are afraid we must leave you to use a great deal of your own judgment.

The almost perfect circuit would provide the highest possible amplification per valve plus great selectivity, complete stability, remarkable ease of operation, perfect quality of reproduction, and very low maintenance costs, but there is, of course, no almost perfect circuit and one has to choose the arrangement which appeals to one as being the nearest approach to it, all things considered.

THE "P.W." "TITAN" COIL

Constructional details of one of the most famous tuner units ever developed. It is the "key" component of the well-known "P.W." "Titan" Sets and it has figured and is being used in many other effective receiver designs.

This unit, the reader will remember, was produced by the "P.W." Research Department after lengthy experimental work and it has been used with great success in the "Titan" Three, the "Titan" Two, the "Titan" Tuner, etc.

The basis of the coil is a piece of insulating tube 4 in. in diameter and 2¾ in. long. This can be of any good insulating material, such as Pirtoid, Paxolin, ebonite, etc. Round the upper edge are arranged seven small terminals, and for the placing of these and their lettering you should refer to the wiring diagram of any of the "Titan" sets or units.

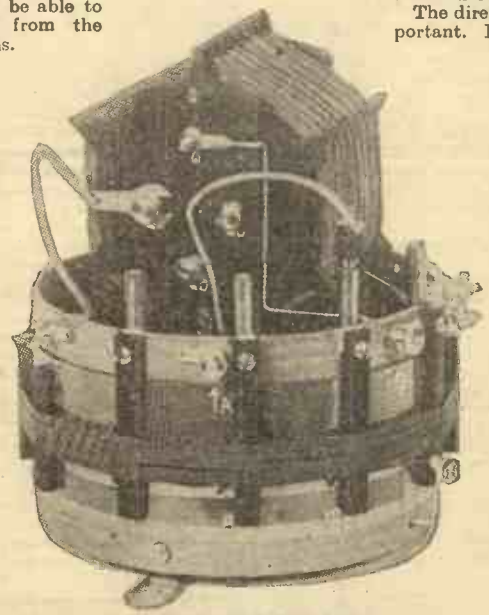
The placing of the terminals is not exactly critical, but you should just take a little care to get it roughly right, so that when you put the unit in a set you will be able to follow the wiring easily from the positions of the connections.

METHOD OF MOUNTING.

This main tube should be fixed down with its axis vertical on a piece of ¾-in. thick wood about 4½-in. square in a home-made model (a different method is used in commercial ones, but this is easier). Some little brackets cut from strip brass are an easy way of doing this.

Inside this main tube and raised up a little is fixed a "P.W." standard loading coil in an edgewise position. An easy way of mounting this is by means of a couple of brass brackets, as in the case of the main tube, the desired height being obtained with a block of wood.

Details of this sort, of course, are very much a matter of taste, the important point being the height of the loading coil. This is vital, for if the coil is too low efficiency is lost. In the correct position the centre of the loading coil is at least 1 in. above the upper edge of the main winding. (It can be higher if you like, but not lower.)



A SPECIMEN TITAN COIL.
In this picture, which is of an early model, the loading is mounted a little too deep inside the tube.

THE WINDINGS

Now for the windings. On the main tube there is first of all a secondary winding of 40 turns of No. 24 D.C.C. wire (or 38 turns of No. 24 D.S.C.). The upper end is connected to the G terminal and the lower to the S terminal nearest to R_1. The direction of this winding does not matter.

Continuing on below this winding is the reaction coil (L_3) which has 20 turns of No. 32 D.S.C. in the same direction as the previous winding, i.e. as though it were a continuation. There is a space of about ¼ in. between these two. The upper end of L_3 goes to R_1 and the lower to R_2.

Put on over the top of the lower part of L_2 (the secondary) there is a tapped primary (aerial) winding (L_1) of 16 turns of No. 24 D.C.C. or D.S.C. This is lifted up slightly above L_2 with a series (10 or 12) of little wooden or ebonite spacers, each about ¼ in. × ⅛ in. × 1 in.

IMPORTANCE OF DIRECTION.

This winding has tappings at 5, 8, and 12 turns, and the upper end (16th turn) is also left projecting to act as another tapping point. The lower end goes to the S terminal nearest to the A terminal.

The direction of this winding is important. It must be as though it were a continuation in a second layer of L_2 working upwards from the bottom. That is, you should imagine that you have started at the top, put on L_2 in a layer working down towards the bottom, and then returned upwards in another layer of 16 turns, revolving the "former" in the same direction the whole time. This forms L_1.

Now for the remainder of the connections, and our coil is done. From the A terminal there comes a short flex lead ending in a tapping clip, and this engages with the various points on L_1. From E comes another similar lead which works on the tappings on the loading coil (L_4). The "216" terminal of the loading coil is wired to the S terminal nearest to R_1, and the "O" terminal on the loading coil to the S terminal nearest to A.

AN EARLY MODEL.

It is rather a laborious job to wind, but after all it is only a matter of patience, which is called for in any coil-winding work.

Now for some miscellaneous points. First of all, about the unit you see in the photograph. This was a rough model made up in the early stages of the experimental work, and you should note that the loading coil is mounted a little too deep inside the tube. We chose this specimen to emphasise the fault in question.

Then about the spacers between L_1 and L_2. These should be placed on the coil so that the ¼ in. dimension is against the surface of L_2.

THE VALVES TO USE

It is most important that each valve in a set is capable of doing the work allotted to it. A valve that is specially designed for H.F. amplification cannot possibly cope with the work of handling the energy in the last L.F. stage of a set.

OPERATING CHARACTERISTICS.

There is no true "General Purpose" valve. There are valves that are quite suitable for any one of several tasks, but no valve yet designed can equally well perform any function. Upon the selection of the valves the whole effectiveness of a set depends.

Every valve made by a reputable manufacturer is sent out complete with a leaflet giving its characteristics. Generally, there is also ample information concerning the best way to place the accessory in operation.

The two most vital characteristics of a valve are its impedance and its magnification or amplification factor. This last is a direct guide as to the amplifying properties of the accessory. You can safely endeavour to obtain the greatest amplification factor, providing the impedance of the valve suits the circuit in which it is to work.

The impedance of a valve is always given in ohms. Impedance in itself is no particularly desirable factor, but, in conjunction with the "mag. factor," it indicates the suitability of a valve for a particular job, as the table below shows.

MAINS-OPERATED VALVES,

The figures given do not apply rigidly to mains-operated valves, for the characteristics of these are of a somewhat different nature from those ruling with battery-operated valves. Nevertheless, the table will guide you even in the selection of mains valves, as long as you apply the figures as a basis of comparison between equivalent types in both categories.

It is important that a valve should be able to handle any input it is likely to be given without overloading. The characteristic curve which is supplied with practically every valve sold shows this. There should be an ample area of the straight portion of the curve covering a grid-volts range of adequate dimensions.

Owing to various methods of nomenclature a complete list of manufacturers cannot be given.

Circuit Valve is Required for	Valve Impedance	Mag. Factor.
Grid leak det. (special det. valves are available) ..	7,000–30,000 Highest value if resistance coupled to next stage	13–30
Anode-bend det. (special det. valves are available)	7,000–30,000	15–30
H.F. split primary, neutralised	13,000–30,000	13–30
H.F. tuned anode, neutralised .. .. .. H.F. res.-coupled	20,000 upwards	17 upwards
H.F. un-neutralised	Special S.G. circuit for screened grid-valves should be used.	
L.F. res.-coupled to following valve (depends largely upon individual circumstances, such as position of stage in receiver)	With resistance of 250,000 ohms and upwards. 20,000 upwards	20 upwards
	Res. under 250,000 ohms 7,000–30,000	10–30
L.F. trans.-coupled to next valve..	7,000–30,000 dependent upon transformer and load	Use as high a mag. as is consistent with good reproduction. Too high a mag. will cause overloading in the next stage.
L.F. last stage	For small sets 6,000–10,000 Larger sets 2,400–6,000 Very large sets 1,600–3,000	6–15 3–8 1·5–6

A Pentode valve will often be suitable as an output valve if properly used. If the loud speaker is one with a tendency to over-emphasis of high notes a special Pentode transformer should be used; otherwise the ordinary filter output is suitable.

SELECTED RADIO DEFINITIONS

Here are practically all the wireless names and terms you are likely to meet in "P.W." together with concise and lucid definitions. This list was specially compiled for this book.

By THE "P.W." TECHNICAL STAFF.

AERIAL CIRCUIT.—The circuit containing the aerial, and all apparatus connected between it and the earth, usually comprising a variable condenser and tuning coil.

AERIAL TUNING INDUCTANCE (A.T.I.).—The variable inductance or tuning coil in the aerial circuit, by means of which the wave-length of the circuit can be adjusted. The greater the wave-length required, the greater must be the size or portion of the A.T.I. included in the circuit.

ALTERNATING CURRENT (A.C.).—A current which reverses its direction of flow a definite number of times per second.

AMPERE.—The unit of electric current, being the current that can be driven through a resistance of 1 ohm by a pressure of 1 volt.

AMPLITUDE.—The maximum value which an alternating current or voltage attains in either direction. The current rushes produced by spark signals have an amplitude which decreases towards the end of the wave train.

ANODE.—The terminal by which current enters electrical apparatus. Thus the Plate of the Valve is its anode according to standard electrical practice—not the electron theory.

ANODE-BEND RECTIFICATION.—Detection or Rectification using the bend in the anode current—grid volts characteristic of a valve.

ANODE CURRENT.—The current which is driven, by the high-tension battery round the anode circuit and through the valve.

AUTO-TRANSFORMERS.—A transformer in which the one winding is tapped off the other winding, the connections being exactly the same as those for a potentiometer. The difference lies in the fact that the magnetic effect in the auto-transformer ensures that the primary and secondary currents are in the inverse ratio of the voltages, which is not the case in the potentiometer.

BACK E.M.F.—A voltage acting in opposition to a normal flow of current.

BAFFLE or BAFFLE-BOARD.—A wooden or other screen used in conjunction with a loud speaker to prevent the interaction of the sound waves emanating from the front and back of the instrument.

BALANCED ARMATURE.—A type of movement figuring in loud-speaker units. A piece of soft iron acting as an armature is balanced between the poles of a permanent magnet. The balance of this is upset by the operating energy and a diaphragm or cone moved accordingly.

BLASTING.—The distortion which follows the overloading of microphones, valves, loud speakers, etc.

CAPACITY.—The property which enables apparatus to store a quantity of static electricity when electrical pressure is applied. Capacity is measured by the quantity of electricity that can be forced into the apparatus by a pressure of 1 volt. The unit of capacity is called a "Farad."

The capacity of an accumulator is measured in ampere hours. In this case the term is used in a somewhat different sense. Ignition capacity is double actual capacity. One ampere hour means capacity to deliver a current of one ampere for one hour.

CARRIER-WAVE.—The steady H.F. oscillations emitted by a wireless telephony transmitter. These oscillations are varied or modulated by the speech and music.

CATHODE.—The teminal by which current leaves any piece of electrical apparatus. In a thermionic valve the filament is the cathode. In a cell supplying electricity, the cathode is the negative terminal (according to standard electrical practice).

CHOKE.—A coil of wire which offers considerable opposition to varying and alternating currents, but which may have low direct-current resistance.

COUPLING.—The connection by means of which electrical energy is transferred from one circuit to another. The transference may be brought about by means of condensers (capacity coupling), by electro-magnetic induction, as in the transformer (inductance coupling), or by connections similar to those in an auto-transformer (direct coupling).

CURRENT.—An electric current is a movement of negative electrons, driven by an electro-motive force. A current cannot flow unless there is an electro-motive force to drive it, and a conducting path for it to flow along. The unit of electric current is the ampere.

CUT OFF.—The point in the frequency scale at which apparatus, such as a loud speaker, ceases to operate.

CYCLE.—A complete alternating current or voltage wave, extending from one maximum value to the next maximum value in the same direction.

DAMPING.—Loss caused by energy absorption in mechanical or electrical apparatus.

D.C.—Direct Current.

D.C.C.—Double Cotton Covered.

DIELECTRIC.—A substance which will allow practically no electric current to flow through it—i.e. a nearly perfect insulator. The term is usually applied to the insulating material in a condenser.

EDDY CURRENTS.—Currents induced in metal by adjacent varying magnetic fields.

ELECTRODE.—A part of a valve or of a battery.

ELECTROLYTE.—The solution or paste used in a battery.

ELECTRO-MOTIVE FORCE (E.M.F.).—The force which is necessary to produce an electric current, and upon the value of which depends the amount of current, measured in amperes, in any particular circuit. Electro-motive force is measured in volts.

ELECTRON.—The ultimate particle of matter, consisting of an indivisible negative electric charge. A stream of negative electrons constitutes an electric current.

EMISSION.—The stream of electrons thrown off by the heated filament of a valve.

ETHER.—The all-pervading medium through which radio waves are presumed to vibrate.

FARAD.—The unit of electrical capacity, being the capacity of a condenser which will store 1 coulomb of electricity at a pressure of 1 volt, or which will take 1 second to be charged to a pressure of 1 volt by a current of 1 ampere.

FILTER.—An arrangement of inductances and condensers which will pass, or prevent from passing, varying currents of certain frequencies.

FREQUENCY.—The number of times per second that an alternating current or voltage attains its maximum value in one direction; the number of complete wireless waves received per second.

FULL-WAVE RECTIFICATION.—The rectification of alternating current so that both half-cycles are used.

GRID BIAS.—A voltage applied to the grid of a valve in order to bring its operating characteristic to a certain desired condition.

GRID CIRCUIT.—The circuit which externally connects the filament and grid of a valve, and is completed internally by the electron stream between them.

HALF-WAVE RECTIFICATION.—The rectification of alternating current so that only one half-cycle is used.

HARMONICS.—Frequencies which are multiples of other frequencies.

HEAVISIDE LAYER.—An upper layer of atmosphere (60 to 200 miles above the earth) which is presumed to affect the transmission and reception of radio by acting as a reflecting or absorbing screen.

HENRY.—The unit of self-inductance, being that inductance which will so retard any change in the value of a current that it takes 1 second for 1 volt to raise the current in a circuit by 1 ampere.

HIGH FREQUENCY.—A term applied to alternations or waves which occur at frequencies too high for audibility; sometimes called "Radio Frequency." High frequency may be taken to include all frequencies above 20,000.

HIGH-FREQUENCY RESISTANCE.—The resistance which a conducting path offers to high-frequency currents. Skin effect renders this higher than the resistance that would be offered by the same path to a continuous or low-frequency current.

HYSTERESIS.—The lagging effect observed in the magnetising of iron.

IMPEDANCE.—The total opposition offered by a circuit, or a piece of apparatus, to a varying or alternating current, being made up of the combined effects of resistance and reactance.

INDUCTANCE.—The property of a circuit which operates and retards any change in the value of the current flowing. Inductance has the same effect upon an electric current as inertia or momentum has upon a moving body.

INDUCTION.—The production of an electromotive force in an electric circuit through the agency of another circuit, without any direct electrical connection between the two. Induction may be brought about by lines of electric force (electrostatic induction), or by lines of magnetic force (electro-magnetic induction). Upon the latter depends the working of the transformer and the loose coupler.

KILOCYCLE.—One thousand cycles.

KILOWATT (K.W.).—The unit used for measuring large amounts of electric power, being equal to 1,000 watts or 1½ horse power.

LAMINATIONS.—Layers or thin sheets. A laminated core in a transformer or choke is a core built up of thin sheets of iron.

LINES OF FORCE.—The paths along which acts the force due to a magnet or electrically-charged body.

LOOSE COUPLING.—The fairly weak magnetic or electric linkage between two coils or circuits.

LOW FREQUENCY.—Frequencies up to about 20,000 cycles.

MAGNETIC FIELD.—The space surrounding a magnet, extending as far as its magnetic influence is appreciable. Any space pervaded by lines of magnetic force is a magnetic field.

MANSBRIDGE CONDENSER.—A type of large capacity fixed condenser.

MEGOHM.—The unit used for measuring high resistance, being equal to 1,000,000 ohms.

METAL RECTIFIER.—A rectifier, consisting of two plates of metal in contact, used mostly in mains units.

MICROFARAD (MFD.).—The practical unit of capacity equal to one millionth of a farad.

MICROHENRY (MH.).—The practical unit of inductance equal to one millionth of a henry.

MILLIAMPERE.—Thousandth part of an ampere.

MOVING-COIL LOUD SPEAKER.—An instrument whose diaphragm is operated by a small coil of wire suspended in a strong magnetic field. The input energy is fed into this Moving Coil.

NATURAL FREQUENCY.—The frequency at which a circuit containing inductance and capacity will most readily oscillate.

NEGATIVE POLE.—A pole that is at a lower potential relatively to another, the positive pole.

NON-INDUCTIVE.—A wire resistance wound so that it has negligible inductance is so described.

OHM'S LAW.—The law which states the relations existing in any circuit between current, voltage, and resistance. These relations are as follow: Amperes = Volts ÷ Ohms. Volts = Amperes × Ohms, and Ohms = Volts ÷ Amperes. Thus, for example. 36 volts are required to send a current of 4 amperes through a resistance of 9 ohms.

OPEN CIRCUIT.—A broken circuit; a circuit through which current cannot flow.

OSCILLATORY CIRCUIT.—A circuit having inductance and capacity and comparatively low resistance.

PARALLEL.—Two or more conductors or pieces of apparatus are in parallel when they are so connected that the current in the circuit divides, and part goes through each of them. Cells are connected in parallel when the required current is equal to the sum of the currents which can be given by each individual cell, and the voltage required is that of a single cell.

PLATE CIRCUIT.—The circuit which externally connects the filament and plate of a valve and is completed internally by the electron stream between them.

PLATE OR ANODE IMPEDANCE.—The internal impedance of a valve.

PLATE OR ANODE VOLTAGE.—The potential difference (voltage) existing between the plate (anode) of a valve and its filament.

POSITIVE POLE.—A pole having a relatively higher potential than another pole, the negative.

POSITIVE AND NEGATIVE (+ and −).—Names given to distinguish the terminals of a source of electric supply. Current is assumed to flow round a circuit from positive to negative, although it actually consists of an electron stream flowing from negative to positive. Positive and negative terminals are often distinguished by the colours red and blue or black respectively.

POTENTIAL DIFFERENCE (P.D.).—The difference of potential or electrical pressure between two points is the electro-motive force trying to send current from one point to the other. (Voltage.)

POWER VALVE.—A valve designed to handle relatively large inputs. A power valve does not necessarily give greater amplification—frequently its amplifying properties are comparatively low.

PRIMARY CELL.—A cell which produces current by chemical activity and which cannot be recharged like an accumulator (secondary cell).

PRIMARY CIRCUIT.—A circuit which hands on applied energy to another (secondary) circuit.

REACTION.—A system of feeding-back the amplified energy from the anode circuit of a valve to its grid circuit for further amplification. Indiscriminately applied, this scheme may result in a receiving set radiating interfering energy.

RESISTANCE.—The opposition offered by an electrical path to the passage of current when no reaction is present. Except in the case of high-frequency currents, resistance depends purely upon the conducting path and is independent of changes in the value of the current. The resistance of any path depends upon the length and sectional area of the path, and upon the material of which it is composed.

RESONANCE.—A circuit is in resonance when its frequency corresponds to that of the applied energy. Resonance in a loud speaker indicates a tendency to vibrate more readily on certain notes.

SATURATION.—In a valve—where further increases in anode voltage produce no corresponding increases in anode current. The maximum amounts in such cases are known as saturation currents.

Magnetic saturation indicates a point when further increases in the magnetising force fail to cause increases in flux density. This condition is met with in L.F. chokes and transformers.

SCREENING.—The separation of components or circuits by metal partitions or boxes in order to prevent coupling effects.

SERIES.—Two or more conductors or pieces of apparatus are in series when the whole of the current in the circuit has to pass through them one after the other. In a simple receiving circuit, for instance, the telephones and crystal detector are connected in series. Cells are connected in series when the required voltage is equal to the sum of the voltages of the individual cells.

SHUNT.—When two portions of a circuit or pieces of apparatus are connected in parallel, one is said to shunt the other.

SIDE-BANDS.—A number of high-frequency waves above and below the frequency of the Carrier-Wave produced by Modulation.

SMOOTHING CIRCUIT.—An arrangement of chokes and condensers designed to suppress the irregularities in a current supply.

SOFT VALVE.—A valve in which a little gas remains. The anode current is carried partly by this gas as well as by the electron stream from the filament.

SOLENOID.—A coil of wire wound in a long spiral, for the purpose of producing a magneto-motive force along its axis.

STALLOY.—A special steel used widely in the construction of L.F. chokes and transformers.

STEP-DOWN TRANSFORMER.—A transformer which steps down voltage—the current in the secondary being proportionately greater.

STEP-UP TRANSFORMER.—This steps up the voltage.

SULPHATING.—A chemical effect in an accumulator caused by neglect or age and which impedes the action of the device.

TIGHT COUPLING.—The strong magnetic or electric linkage between two coils or circuits.

TRICKLE CHARGER.—An accumulator charger which has a very low output. Batteries can be left connected to such a device throughout the day and night.

UNTUNED (or APERIODIC).—A term applied to an aerial and H.F. transformer or coupling coil indicating that such is not tuned to any one particular frequency.

VOLT.—The unit of electro-motive force or electrical pressure, being that pressure which will drive a current of 1 ampere through a resistance of 1 ohm. The electro-motive force of a single accumulator cell is about 2 volts.

VOLTAGE.—Potential difference in volts.

VOLTAGE DROP.—The voltage used in driving current through a circuit or across a piece of apparatus. Voltage Drop across a 10-ohm resistor passing ½ ampere would be 5 volts.

WATT.—The unit of electrical power, being the power exerted by a current of 1 ampere flowing under a pressure of 1 volt. 746 watts are equivalent to 1 horse-power.

WAVE-LENGTH.—The distance travelled by a wireless wave, while it increases from zero to its maximum value in one direction, reverses, attains its maximum value in the other direction, and falls to zero again.

WAVE TRAP.—A device designed to eliminate an interfering station.

WET BATTERY.—A term that used to be applied to an accumulator, but is now more widely applied to the small Leclanché cell batteries employed for H.T. purposes.

Aerial Interaction

Cases of this cannot, as a rule, be cured by one party only, and the co-operation of both parties concerned is desirable.

The trouble generally arises from the use of small sets which necessitate the employment of large amounts of reaction, and, as a rule, the only certain cure is for both parties to build larger sets, preferably employing neutralised H.F. stages.

Sometimes a cure can be effected by making sure that a different earth is used by each receiver, and, again, the use of a small condenser in series with each earth lead will sometimes improve matters.

Aerials That Swing

There is no need to have the aerial absolutely tight unless short-wave work is being indulged in, when it is an advantage, because a swinging aerial may then affect reception. The advantage of a certain amount of "give" in the aerial wire is that there is less strain upon the mast, supporting stays, etc., particularly with a high aerial, and for ordinary reception a certain amount of give is in no way detrimental. It is, however, important to see that the aerial does not kink anywhere, and if this happens it is sure to break sooner or later, which may give rise to noises in the set.

VARIABLE CONDENSER VALUES

Practical information for constructors in regard to one of the most important types of components.

Practically every modern radio receiver uses at least one variable condenser for tuning purposes and another for reaction control. And for the ordinary broadcast band of wave-lengths the tuning variable generally has a maximum capacity of ·0005 mfd. It would be possible to extend the range of tuning upwards by using a condenser having a higher maximum value, but a point worth noting is that for best results the inductance-capacity ratio should be as great as possible: that is to say a minimum added capacity is the ideal condition.

But should you use a variable tuning condenser of a low maximum capacity, then the range of adjustment is going to be small and the stations it is possible to tune in without coil changing may be fewer in number.

The ·0005 mfd. just mentioned is the sort of compromise we have arrived at after some years of varying from one point to another. But you should always try to keep your stations well down the scale.

STATIONS PER "BAND."

If you find that you receive nothing over the lower dial readings and that 5 G B, for instance, comes in when the variable is practically "all in," a slightly larger coil is indicated and might prove useful.

The lower the band of wave-lengths the greater the number of stations you will be able to squeeze in without coil changing. Let us take for an example, in order to illustrate this, the single tuning circuit arrangement such as exists in an ordinary two- or three-valve receiver employing no high-frequency amplification.

A ·0005-mfd. variable condenser could be used for practically any wave-band. On the higher wave-lengths, such as those of 5 X X, Hilversum, and so on, only three or four stations will be tunable on any one coil, but down on fairly short wave-lengths, that is among the tens of metres, dozens of stations might be heard, one for every microscopic adjustment of the dial.

INDUCTANCE-CAPACITY RATIO.

But the inductance-capacity ratio would be all wrong. There would be far too much capacity and far too little inductance. Also, for easy tuning, it is not advisable to have the stations crowded up against each other all round the dial. There is also another point, and that is that the minimum capacity of the condenser might militate against the tuning-in at all of some of the stations.

You see, it is wrong to talk about a variable condenser as having a capacity range of from zero to something. No variable condenser yet made can provide zero capacity. The average variable has a minimum capacity of about a tenth of its maximum. Thus the minimum of a ·0005 mfd. might be somewhere about ·00005 mfd.

REACTION VARIABLES.

·0002 mfd. is by no means too small a maximum capacity for a variable that is required for use in short-wave reception, but if the variable has an efficient slow-motion control or a vernier dial is available in order that more or less microscopic adjustment of the vanes can be made, then a larger maximum capacity can be used in order to increase the range of tuning. Under these conditions a value of ·00025 mfd. or ·0003 mfd. can be recommended.

Regarding reaction control variable condensers, here again it is advisable within limits to keep down the maximum. Generally speaking, the smaller the reaction variable the broader and smoother will be the reaction adjustment. But if the condenser is too small it will be difficult to confine the control to its range of movement. That is to say, it will necessitate a critical adjustment of other conditions in order to enable the condenser to control reaction over the limited capacity range the small condenser possesses.

The circuit may become a little over-vigorous and you will find it impossible to stop it oscillating, or it may go flat owing to declining H.T. or L.T. and the advantages of reaction become lost. A condenser having a larger maximum would provide greater latitude, or, in other words, introduce a margin of safety on either side.

STICK TO SPECIFICATIONS.

The foregoing remarks are intended only as a general guide. If you are building a receiver to a special design then you should adhere to the specification and, whatever anybody else says, do not depart from the various recommended values.

If you depart from the stipulated tuning variable values then you will throw out the tuning ranges, but it is even more important to stick to the specified reaction variable. Supposing you were to use a ·0005 mfd. instead of a specified ·00005 mfd. say. You might quite conceivably find that the receiver would not stop oscillating even when the variable was at its minimum adjustment. You see, although there might be a 0 on the dial, a variable cannot be turned down to zero capacity. If it is not a particularly well-designed variable its minimum capacity might be more than the maximum of the component value advised.

MODERN WIRELESS

IS THE LEADING RADIO MAGAZINE

Every Month - - - - - *Price 1/-*

SELECTING A SET

Some invaluable hints and tips for prospective set builders and buyers.

The regular reader of a journal such as "P.W." will have no difficulty whatever in picking out just that set which suits his own purposes and pocket the best. But the casual reader can be forgiven if he finds the problem rather difficult, and it is more particularly to him that the following remarks are addressed.

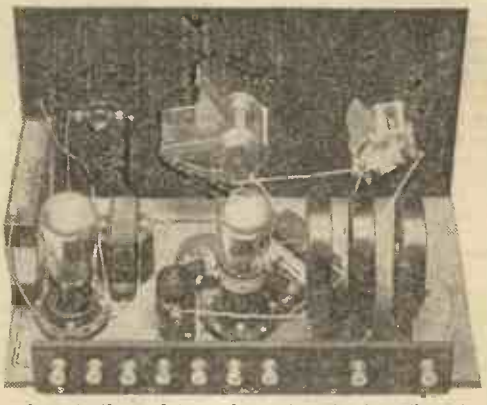
Obviously your first consideration is going to be a financial one.

If you have any doubts whatever about your constructional ability we hope you will put these aside. Providing you rigidly adhere to a published specification you are not likely to meet with much trouble. Nevertheless, we must make the qualification that if you know nothing at all about radio, and have not at least a general idea of the purposes of the various components employed in the average set, it is going to be worth your while to limit your first venture to the building of a fairly simple outfit, such as a crystal set or a one- or two-valver.

Now, regarding the aforementioned financial question, the cost of the actual set is not, by a long way, the only cost that needs to be considered. There are also the costs of the accessories and of maintenance that have to be reviewed.

THE QUESTION OF COST.

First of all, the cost of any particular design can generally be considerably reduced by using throughout those very cheap foreign components that gain such big displays in suburban radio stores. We are not going to say that every cheap foreign radio component is "dud," for this is by no means the case. But a vital point that you should remember is that a high-class British component carries with it the guarantee of its maker. Should it at any time break down or develop a serious fault you will find its manufacturer only too pleased to go a long way, and, perhaps all the way, towards saving you the complete cost of a renewal.



A straightforward two-valver using plug-in coils and transformer L.F. coupling.

And in many cases the higher-priced British components will be definitely worth the money paid for them in regard to their electrical efficiencies. Without mentioning any names, we can say as an absolute fact that we have known cases where two-valve sets made up with quality components have given results as good, if not superior, to those afforded by three-valve receivers employing what are sometimes misleadingly described as "inexpensive" components. Again, we must add that there are notable exceptions to this rule.

Do not put all your money in the set and disregard the accessories. They are every bit as important as the receiver itself. Get good British valves, batteries, loud speakers, etc., for your receiver. A nondescript assembly of valves can ruin an otherwise magnificent set. Likewise it would be incongruously wrong to employ a cheap horn variety of loud speaker with a powerful multi-valver.

STRIKING A BALANCE.

You must strike a careful balance between the cost of the receiver and its accessories; the latter might in many cases mean the greater outlay. The maintenance cost of a five-valve set is going to be very much more than that of a two-valver. First of all, there is the question of H.T. Whether you use dry batteries or an accumulator battery you can write down some few pounds per year on this count. And these pounds are going to be two or three times greater in number in the case of a big set using a super-power valve.

Thanks to the modern dull-emitter valve the L.T. is a comparatively inexpensive item with any set, although you must not forget that accumulators do not last for ever, and that the lives of many, especially when they are handed periodically to some charging stations, do not exceed two years.

Having imposed upon yourself some sort of arbitrary financial limitation, you can then go a step further and ask yourself exactly what sort of set you need. If you have any ear for quality of reproduction at all, then go for the biggest set possible. Remember, particularly, that the purpose of high-frequency amplification is not only to bring in those far-distant broadcasters, or, at least, we had better say that you should not regard it as its only purpose.

For one thing, H.F. amplification is going to allow you to cut out interference more easily, and the more H.F. amplification you have—that is, the more stages—the easier it is going to be to cut out interference without also affecting the quality of reproduction. Again, H.F. amplification is going to permit you efficiently to operate your detector stage with sufficient energy to make reaction practically unnecessary.

IF YOU ARE MUSICAL—

Remember, if you require pure reproduction you must not resort to reaction. For the reception of the local station or 5 G B, 5 X X, Langenberg, and other such stations, you should regard "zero reaction" as your ideal. Two stages of L.F. amplification even again for the local station is better than one stage, for they will help you to get the requisite volume without distortion.

If you have a keen musical ear and cannot go to the expense of a multi-valver you will be happier with telephone receivers and a simple set. If you want to pick and choose your programme from any one of a dozen of so stations every evening, then you should turn your attention to those sets which incorporate

wave-change switches on the panel. On the other hand, you may be prepared to go to the slight trouble of changing coils if and when you need to change the wave-length band of your set.

Some sets, as you will see if you examine the various specifications, are designed so that they are readily adaptable for the reception of short, medium and long waves. It is only the medium and long wave-lengths which will interest the "listening amateur," that is, the constructor whose main interest is the normal published broadcast programmes. The reception of short-wave stations, such as K D K A of America, or 3 L O of Australia, cannot be guaranteed at any definite time by any set, and when on favourable opportunities such a station is received there is liable to be considerable fading and atmospherics.

LOCAL CONDITIONS.

We can say, therefore, that the short-wave work is of purely an experimental nature, although many listeners find it absorbing to listen to the sounds of music from distant parts of the earth.

Now we come to the question of local conditions, a vital point indeed! You may, or may not, be situated in what is known as a "blind spot." There are a good many of these in various parts of the country, especially in Wales and in the south-west of England. A blind spot is an area where reception conditions are very bad. There are other localities which are exceptionally kind to radio, and the difference between the two is sometimes staggering. In a few words, it can be said to be almost the difference between a two-valve and a five-valve set, used at any one point. For this reason, it is wise not to judge too hastily the capabilities of a set by the performances recorded by correspondents in various parts of the country, or, at least, note should be taken at which points the various correspondents are situated.

Regarding local conditions again, interference must not be forgotten. In certain parts of the country, especially those near the coast, shipping transmitters play havoc with unselective receivers. If you live right in London, and your main and perhaps only objective is to receive London, then selectivity is not a problem that will interest you, but if you live in the Midlands or on the coast, and many stations actuate your aerial, then selectivity must assume some importance in your choice of a set.

OPERATING A SET.

There is another very important consideration which we have not yet alluded to at all, and that is the operation of the receiver. If you are not prepared to acquire manipulating skill the fewer controls on the panel the better. The same thing applies, of course, if you want the set to be used by inexpert members of the household.

Two tuning dials are not always only twice as difficult to handle as one dial, sometimes they are four or five times as tricky, and, if the set is not calibrated, and unless the dial readings for each station are carefully noted on a chart, the inexpert operator would find three dials quite beyond him. So far we have said nothing at all about circuits. We mean types of circuits. But you will find that another article in this book adequately covers that subject.

In conclusion just a few words about portable sets. During the past year or so a very large number of portable sets have made their appearance on the market, and no doubt a proportionally large number have been sold. Unfortunately, a number of the cheaper ones are undoubtedly very poor propositions, and readers are warned against being led away by glowing claims which are not substantiated. Radio sets are far from being standardised productions.

FINDING FAULTS

How you can trace faults in sets, accessories and components.

Defects in the wiring of a receiver, or those arising from faulty components, may often be detected by a very simple series of tests with a pair of 'phones and a dry cell. One tag of the 'phone should be connected to one terminal of the dry cell and two flex leads should be connected, one to the remaining 'phone tag and the other to the remaining terminal of the dry cell (a flash-lamp battery is quite satisfactory).

These two flex leads, if now touched lightly together, will produce a strong double click in the 'phones, one click when they make contact with each other, and another when they are separated again. They may thus be used for testing for continuity in leads, etc., since the loud double click is ample evidence that everything is satisfactory.

TESTING FOR CONTINUITY.

A fault in a coil-holder, for instance, such as a break between the terminal and the plug or socket to which it is connected, may now easily be detected, since if one flex lead is connected to the terminal and the other to the side of the holder to which the terminal should make connection, absence of the double click is positive evidence that the component is faulty.

On the other hand, if one of the flex leads is connected to the socket of the coil holder and the other to the plug, if a double click is heard, there is a short-circuit across the holder.

Similar tests may be made with valve holders, both for testing for a connection between each terminal and its socket and for testing for short-circuits between the sockets.

Variable condensers may also be tested by this method, a short-circuit between the plates giving rise to the usual double click, which should *not* be present in the usual way.

It is, of course, essential to see that all leads are removed from the components under test and also that no coils are in position in the coil sockets when these are tested.

Complete circuits may be tested in this manner. For example, if the A.T.C. is in parallel with the A.T.I., in a simple tuned aerial circuit, one flex lead placed on the aerial terminal and the other on the earth terminal will give a certain test for continuity between these points.

INTERFERENCE FROM OUTSIDE SOURCES.

Cases of interference from outside sources such as electric railways, tramway systems, power mains, electric motors, X-ray apparatus, etc., are extremely difficult to deal with, and in many cases it is impossible to effect a complete cure.

Sometimes, however, a certain measure of relief may be gained by one or more of these expedients:

1. Use a counterpoise instead of a direct earth. This should be as nearly as possible a replica of the aerial, erected at a height of ten or twelve feet, just as much care being exercised over its insulation as over that of the aerial.

2. Try a different earth, e.g. if you are using the water main, transfer to a buried plate, etc.

3. Connect a small fixed condenser of about ·0002 mfd. capacity between the earth terminal and the earth lead.

4. Use an indoor frame aerial and no earth.

5. Use Aperiodic Aerial Coupling.

AERIALS AND EARTHS

All the various practical forms of antenna for home use are dealt with in this informative section.

To all intents and purposes the strength of the rectified signals in a one-valve set is proportional with the square of the strength of the signals as they oscillate in the form of high-frequency currents in the aerial. That is to say, if we double their initial strength we obtain signals in the telephone receivers four times as loud. Therefore, a little loss of energy from the aerial becomes a correspondingly greater loss in the 'phones. On the other hand, a comparatively slight increase in the intensity of the energy we manage to guide on to the grid of the valve might mean a really noticeable increase in volume.

These are proved facts, not theories.

AERIALS FOR BROADCASTING.

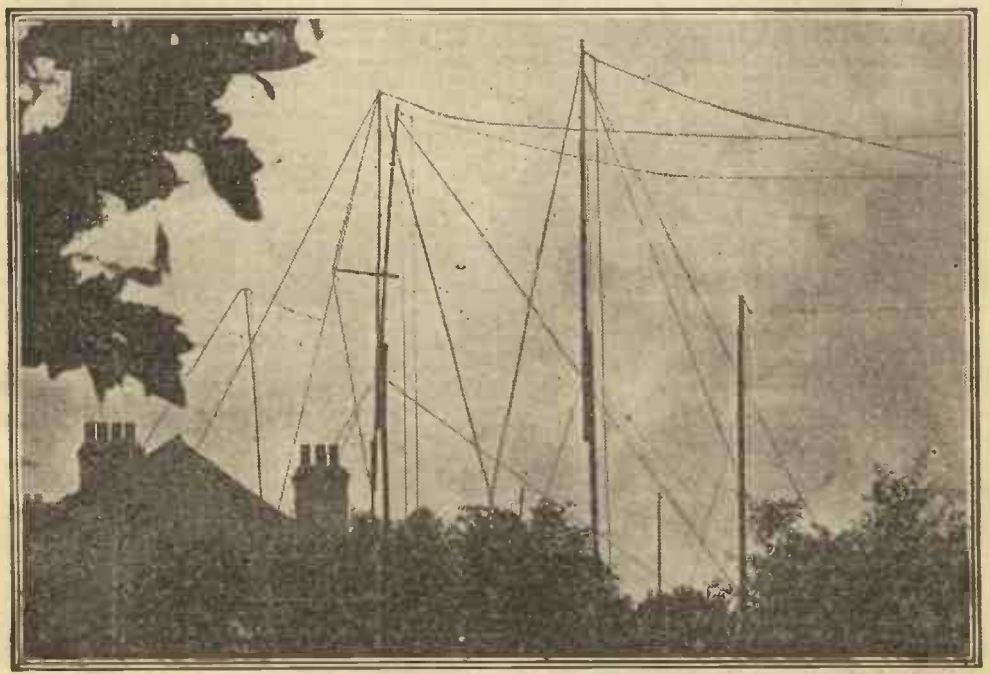
The ideal aerial for broadcast reception would be one of 75 ft. in length, including the down lead, with plenty of height and suspended in space, touching nothing but the aerial terminal of the set and being yards away from anything else. But an aerial wire will not float in air, so it must be held up by some means. Insulators are very necessary evils. But we are jumping ahead too fast. First of all, the high-frequency energy generated in our aerials by the ether waves due to the various broadcasting stations can be lost in part either by absorption or by leakage. And there are two kinds of leaks to deal with—capacity leaks and conductive leaks. In a sense, absorption is leakage, but we are going to differentiate between the two in this article. Our capacity leaks are going to be purely "series condenser" effects, and our conductive leaks direct leaks through conductive paths.

There will be absorption losses if the aerial is very close to and parallel with another aerial, or if it is run along close to metal guttering, etc. But by now practically every listener, let alone the amateur, will know that an aerial must be kept well away from walls, roofs, trees, and other such objects, and we will take it for granted that it is unnecessary for us to go over all the elementary requirements of an efficient aerial. But a few words must be said regarding height.

EFFECTIVE HEIGHT.

You can have an aerial that at no point in its horizontal length is nearer than 40 ft. from the ground that has an *effective* height of only a few inches. Such an aerial might run along a roof throughout the whole of its length.

By "effective height" is meant the average distance between the aerial wire and all earthed objects, such as roof, trees, and walls. An aerial near to such things will have a higher H.F. resistance than it should, and will not possess a good pick-up. (Not a gramophone pick-up! The term indicates



There are some fine aerials in this typical suburban group, but they are, in some instances, unfortunately close to each other.

the active nature of the aerial—its power to pick up signals from the ether.)

One of the reasons why ships can communicate over such long distances with relatively low powers is because their aerials are high and unscreened. The statement was once frequently made that every foot of aerial height gained is of enormous value, and so it is; but you may not notice much improvement in results if you only raise your aerial 12 in. at one end. If you can put it up 12 ft. throughout the whole of its length, then you may add as many more stations to your nightly collection.

REGARDING SELECTIVITY.

There has been of late a tendency to advise the deliberate use of inefficient aerials in the interests of selectivity. Personally, we should say that this is rather an unhappy solution to the jamming problem. Far better it would be to add to the efficiency of the aerial, and to do the same in regard to the selective qualities of the set.

Actually, of course, selectivity as a desirable quality in a radio set is quite valueless unless it is accompanied by adequate sensitivity. The power to select is, in other words, only of use if there are things available from which to choose.

No; if you want to try the desperate plan of reducing the "sensitivity" of your aerial, having tried wave-traps and other such devices, then reduce its length. We would even add, try the experiment of increasing its height simultaneously.

A vertical aerial is, of course, one of the most efficient of all forms of antenna, and as it has no directional qualities, it is an excellent form for broadcast receiving purposes, although difficult to erect.

DIRECTIONAL EFFECTS.

An outdoor aerial can be fairly directional—a point you may have overlooked. Most outdoor aerials take the form of inverted "L's." That is, there is a horizontal or nearly horizontal wire or wires which continue in a vertical wire, generally termed the "down lead."

Such an aerial receives best from the direction to which the down lead is pointing. Therefore, you can, within limits, add or take away the strength of the signals received from various stations by swinging the free end (the end farthest from the down lead) of the aerial round.

It is the practice of quite a number of people to refer to indoor aerials disparagingly, as though they were definitely inefficient. But the fact is that a very good indoor aerial can be better than one of an outdoor type that may look as though it should be good.

INDOOR ARRANGEMENTS.

There are many different ways of arranging an indoor aerial. If possible, it should be fixed up in one of the higher rooms in the house, or in a loft or attic. Height is the initial requirement, and it must not twist about down stairways and through passages. The best plan is to have the set in the upper room wherein is fixed the aerial, and then from the set run extension leads to the downstairs room for the loud-speaker or telephone receivers.

If you happen to be very close to the local station, and this is the only one from which you desire to receive, then there is no reason why you should not sacrifice a certain degree of efficiency and fix up the aerial in a downstairs room, if you so desire and it is more convenient to do so. Practically any kind of wire of the insulated kind can be used, although very excellent material specially manufactured for the purpose is obtainable from such firms as Ward & Goldstone, The London Electric Wire Co., and Smiths, Ltd., etc. Ordinary bell wire will serve quite well. No elaborate insulating need be carried out, as the wire is to be indoors.

EARTH CONNECTIONS.

First of all, however, a good earth connection is required. A lead must run directly from the earth terminal of the receiver to some point such as a main water-pipe. A buried outdoor earth is a very excellent device, but it is an indisputable fact that for consistency and general efficiency a good water-pipe earth has many claims for general attention. Keeping the earth lead as short as possible, and of stout wire, take it, if possible, to a main water-pipe—one which does not go to a tank.

And here is a tip worth remembering. When the plumber comes along to do a repair, get him to solder the earth lead to the water-pipe. Without a great deal of experience, and a proper blow-lamp and tools, you will find it a difficult and even almost impossible task to do such a thing yourself. A good temporary joint can be made by scraping the pipe clean and then very tightly wrapping the cleaned wire round it. Proper earthing clips for making such earth-lead joints can be purchased for a few pence each, but these cannot give you the permanence that a well-soldered connection can. Failing a water-pipe, a gas-pipe can be used as an earth; but, generally speaking, this gives only poor results.

ROUND PICTURE RAILS.

The wire can be strung across the room just below the ceiling between two opposite picture-hooks, but unless it is a very large room the length will prove inadequate. Therefore, four or five separate lengths, widely separated, can be stretched across, the ends terminating in one down lead at the side nearest the set. The other ends are left free, and better reception will be obtained if these ends are pointing away from the station you most often desire to receive.

If this scheme is considered an unsightly one, a wire can be run around the back of the picture-rail; but the wire should not be taken the whole distance around the room. From the centre of one wall, it can be run around the picture-rail until it comes to the centre of the opposite wall, where it must terminate, or an extension be made through the door along a corridor. This extension must be kept in as straight a line as possible, and if it comes to such a point where it has to deviate greatly from a straight line, here it should be terminated.

AN INDOOR EXTENSION.

And, by the way, here is a tip worth noting on the part of those listeners having very small and poor outdoor aerials. If you have only a few feet of outdoor aerial, you can try an extension from the point of entry indoors right across the room. In many cases this will definitely result in an increase of the pick-up qualities of your aerial system.

Many commercial sets are now being made with built-in frame aerials. Frame aerials are, of course, very inefficient, but their wide use has been made possible by the S.G. valve which is capable of giving enormous amplification. (For ordinary sets of only medium power, frame aerials are not likely to prove particularly satisfactory.)

The point to remember in connection with a frame aerial is that it will be highly directional. Unless it is placed correctly in regard to the geographical position of a station, that station might not be heard at all.

MAKING AND USING MAINS UNITS

The Institution of Electrical Engineers issues "Regulations for the Electrical Equipment of Buildings." As an addition to the Ninth Edition they give certain rules governing the design and installation of radio mains devices. Mains units and sets due to reputable manufacturers, such as Radio Instruments Ltd., are built in conformation with these I.E.E. regulations, but there are some makes which are very widely at variance with them. Safe and reliable use of the power mains can be made possible only by strict adherence to such regulations.

129. Protection of Live Parts.—All parts (including the terminals and connections of batteries) which are alive or are intended to become alive from the supply mains shall be so guarded as to prevent accidental contact with such parts under normal conditions of use.

130. Construction of Cases.—

(A) Where the apparatus is enclosed the containing case shall be substantially constructed and shall be of (*a*) metal or non-ignitable material, (*b*) mahogany, teak, oak (English) or walnut, or (*c*) other material if a non-ignitable and non-hygroscopic lining is used. All holes for the passage of cables shall be so made as to avoid abrasion of the cables.

(B) Any containing case made of conducting material shall be earthed in accordance with Regulations 101 and 102, and shall be provided with a suitable terminal for that purpose.

(C) The apparatus shall be so proportioned and installed that under normal working conditions no part of it can rise to such a local temperature as will impair its durability, and that the general temperature of the air inside the main containing case does not exceed 120° F.

131. Protection against Excess Current.—The apparatus shall be adequately protected by fuses on both poles of the circuit supplying it. The size of such fuses (see Tables XIII and XIV) shall be based on the normal working current of the apparatus, provided that where the working current is less than 2 amperes no fuse smaller than No. 25 S.W.G. lead-tin alloy need be used.

132. External Cable Connections to Radio Apparatus.—Where the conductor of any cable connected to a radio apparatus is in direct connection with the supply mains, such cable shall be of one of the types specified in Regulations 76 to 81 and shall be installed in accordance with Regulation 87.

133. Isolation from Supply Mains.—

(A) *Earthing Lead.*—There shall be no connection, except through a condenser, between any conductor directly connected to the supply mains and the earthing lead of the radio apparatus which is connected to the earth plate, waterpipe, or other earthing system. The above condenser should preferably be incorporated in the radio apparatus or should be placed as close as possible to it.

(B) *Aerial.*—Where radio apparatus is connected to *direct-current* supply mains the aerial shall only be connected to the apparatus through a double-wound high-frequency coupling transformer adequately insulated for a test pressure of 600 volts, or through a condenser inserted in series with the aerial circuit and immediately adjacent to the aerial terminal. The above transformer or condenser should preferably be incorporated in the apparatus or should be placed as close as possible to it.

Where radio apparatus is connected to *alternating-current* supply mains without the use of a double-wound "mains" transformer, the aerial shall be connected as described above, but the condenser referred to shall have a capacity not greater than ·001 microfarad.

For either *direct-current* or *alternating-current* supply, the insulation-resistance test specified in Regulation 136 A shall be applied to the high-frequency coupling transformer or to the condenser, whichever be employed.

(C) *Head Telephones and Loud Speakers.* These shall be connected to the radio apparatus either through a double-wound transformer or, alternatively, through a circuit which includes a condenser in series with each of the outgoing conductors.

NOTE.—The field circuit of a moving-coil loud speaker having a separately-excited field system may be independently connected to the supply mains in accordance with the Regulations which are applicable.

134. Condensers.—The condensers referred to in clauses (A), (B) and (C) of Regulation 133 above shall conform in all respects to British Standard Specification No. 271—1926 and shall be of either the mica-dielectric or the paper-dielectric type mentioned in that Specification for use in circuits in which the pressure does not exceed 300 volts (600 volts direct-current test pressure).

135. "Mains" Transformers.—Every "mains" transformer shall have its core earthed, and shall be of the double-wound type in which the winding that is in direct connection with the supply mains is effectively separated from all other windings either by an earthed metallic screen or by adequate insulation capable of withstanding a test pressure of 1,000 volts (alternating current). The insulation resistance between the above winding and all other windings, when measured after the above pressure test, shall be not less than 20 megohms when tested with a pressure of 500 volts (direct current) or twice the supply pressure, whichever be the greater.

136. Insulation Resistance.—

(A) The terminals or points at which the aerial, earth, and telephone or loud-speaker connection are made to the radio apparatus, or to the transformers or condensers referred to in Regulation 133 where these are external to the apparatus, shall have an insulation resistance from the "mains" input terminals of the apparatus of not less than 2 megohms when tested with a pressure of 500 volts (direct current) or twice the supply pressure, whichever be the greater.

(B) Every battery connected to the radio apparatus and intended to be in metallic connection with the supply mains shall be adequately insulated so as to have an insulation resistance from earth of not less than 2 megohms, when tested as specified in (A) above.

TWO IMPORTANT VALVE FACTORS

Here are easy-to-follow explanations of valve Impedance and the Amplification Factor. Every amateur should know exactly what these factors are and how they affect the operation of a set.

A few years ago comparatively little importance was attached to the characteristics of valves even by really enthusiastic amateurs. And perhaps it was just as well, for in those days valves were much more inconsistent than they are to-day. Standardisation was attempted, of course, but the processes and the machinery involved in their production were both insufficiently advanced to render the attempts at all successful.

HOW VALVES VARY.

Therefore, the result was that individual valves of similar types varied quite considerably. Even now perfection in this respect has not been attained. As a matter of absolute fact, it never could be, for no two or more manufactured articles ever can be absolutely identical, whether they be made by hand or machinery.

And in a valve the discrepancy of a microscopical nature can affect its electrical characteristics. But such a wealth of scientific research and endeavour has been directed towards the problem that for all practical purposes standardisation has been achieved. Therefore if the present-day amateur buys a valve of a certain type bearing the name of a reputable manufacturer he can safely depend upon it having those characteristics ascribed to the type in question. And what are the special characteristics which have a direct bearing upon the work it will be called upon to do ?

FILAMENT FACTORS.

First of all there are "Fil. volts" and "Fil. amps." And everybody knows all about these for the simple reason that until a certain number of volts are applied across the filament of a valve by means of an accumulator or a dry battery, and until the specified amount of current is flowing through the filament and bringing it to the required temperature, the thing just will not work at all. Therefore, people have been forced to learn about these characteristics; but the same cannot be said about "impedance" and "amplification factor," for the misapplication or an ignorance of these may only mean the difference between bad and good results or between good and very good results!

A great deal has been written about the suitability of valves of certain impedances, and with certain amplification factors for certain specified purposes, and the two terms have been explained briefly many times; but we wonder how many of our readers even now know exactly what they mean. Anyway, what we are going to do on this occasion is to treat the subject from slightly different viewpoints to those usually taken, hoping by doing this that we will be able to leave the least technical reader with a clear idea of the general principles involved.

WHAT IMPEDANCE MEANS.

First of all, let us take impedance. Impedance indicates the resistance of a valve and for that reason is always expressed in ohms. Thus, a valve having an impedance of 20,000 ohms should be no more frightening to the amateur than a pair of telephone receivers stated to have a resistance of, say, 4,000 ohms. It is called impedance in the case of a valve because it is presumed to be the resistance of the valve to fluctuating currents, and capacity and inductance have to be taken into account as well as plain straightforward ohmic resistance. And impedances calculated from statically prepared characteristic curves do not take these into account simply because such curves *are* prepared under static conditions with currents and potentials that do not fluctuate. And when it is added that the frequencies of current and potential fluctuations also should be taken into account, it is easy to see where the amateur can be confused.

But a characteristic curve can be a very good guide, and impedances and amplification factors worked out from this will give very close approximations of the capabilities or purposes of valves. But we cannot regard the "impedance" as anything but plain, straightforward resistance in this case.

"ZERO GRID VOLTS."

And Ohm's Law says that resistance equals voltage divided by current. The current will be the anode current, which is expressed in milliamperes. Our Voltage will be the voltage of the H.T. battery, which will be connected directly across the plate and the filament of the valve with a milliampere-meter in series for measuring purposes. We do not want the grid to affect our readings, so we will leave it connected to the negative pole of the filament lighting battery. Thus, the mystical condition of "Zero Grid Volts" is obtained.

Now, supposing, with an H.T. voltage of 80 volts, 4 milliamperes of current is flowing through the anode circuit, and when the H.T. voltage is increased to 100 volts the anode current jumps up to 5 milliamperes. An increase of 20 volts H.T. has increased the anode current by 1 milliampere. Remembering that "Resistance" equals Voltage divided by Current, all that we have got to do is to reduce our milliamperes to amperes, and to divide this figure into the 20 volts to obtain that mysterious "Impedance" figure. One ampere equals one thousand milliamperes, so we must divide the 20 by ·001, which gives us 20,000. Very simple, is it not ?

THE AMPLIFICATION FACTOR.

Now the amplification factor is nothing more or less than an expression indicating the amplifying power of a valve. A valve amplifies because variations on its grid cause greater variations in its anode circuit, which includes the H.T. battery and telephone receivers or the primary of a transformer. Signals arrive in the form of voltage fluctuations on the grid and evince themselves in the form of variations in the current flowing in the anode circuit.

A variation of the H.T. battery voltage would also cause a variation in the strength of the anode current. Increase the H.T. by 20 volts and perhaps 1 more milliampere of anode current will flow: reduce the H.T. by 20 volts, and, perhaps, the anode current will drop 1 milliampere. Supposing a 2-volt variation on the grid caused as much variation of anode current as the above 20-volt variation of the H.T. battery voltage—i.e. 1 milliampere more or less, then it has taken ten times the amount of anode voltage to do what a certain grid voltage did, and so 10 is the amplification factor. Very easy, after all, isn't it ?

ALL ABOUT LOUD SPEAKERS

The choice of a loud speaker presents a very difficult problem, but here are some practical notes on the subject for your guidance.

One of the knottiest problems with which the radio enthusiast is ever faced is that of choosing a loud speaker. There is first of all the price consideration. You can buy a loud speaker complete for something less than one pound, or you can pay as much as twenty guineas. Once upon a time the loud speaker was regarded as quite an unimportant sort of item. The reason for this was that the average set had such a distorted output that a few more broken notes here and there did not matter.

Nowadays quality of reproduction is, or should be, a primary consideration. With modern components and modern accessories a moderately high degree of tonal purity should be obtainable with even inexpensive hook-ups, and there is not the difference in this respect between the results one can get with a twenty guinea speaker and a fifteen-shilling speaker to-day that there is between the output of the cheapest of modern sets and that of the best set available five or six years ago.

THE THREE GROUPS.

Loud speakers can be roughly divided into three groups. First of all, there is the horn variety, then the cone variety, and finally the moving-coil class. The last will be of interest only to the owner of a de-luxe multi-valve type of set. For the average listener the choice lays between the cone and the horn types. It is a fallacy to imagine that the cheapest of the cones is better than the best of the horn types. It is impossible to draw such an arbitrary distinction. We have in mind one cone speaker which is vastly inferior to a certain horn type of speaker, although it costs exactly twice as much.

Also, it is a startling fact that a large number of cone-type speakers have been credited with a kind of false superiority. The reason for this is to be found in what is known as coloration. This coloration is, in effect, a sort of mellowing which tends to cover up the slight harshnesses due to imperfect set output. On the other hand, these are liable to be exaggerated by the resonances of horn models.

But there is again the question of bass. Invariably the cone type produces more bass although, again, in instances there is much of what is known as "false" bass. This is a resonance effect due to the employment of a large diaphragm. But there may be a corresponding loss in the high notes. It may be mentioned in parenthesis that the average listener will notice the loss of the high notes much more readily than the low.

On the right is a Brown Pick-up, specially suited for use with the famous "Vee" unit, while, below, is an excellent example of the horn variety of loud speaker.

On the left is a moving-coil speaker and, above, a horn model with a wooden flare.

If your set is of the robust character of a Det., 2 L.F. three-valver type, used close to a broadcasting station, say within ten miles or so, then you will probably find more satisfaction in the larger cone speakers. There are very excellent Amplions available: then the Brown family is very representative, and real faithfulness of reproduction is to be found in the Celestion group. Roughly speaking, here you will find quality rises in more or less uniform proportion with price.

Considerable success has accompanied the semi-free edged design of cone mounted on a baffle-board, or in a large cabinet after the fashion of moving-coil practice.

Where the output of the set is of a modest character, similar to that which one would expect from a Det., L.F. two-valver used about fifteen miles from a broadcasting station, then the general sensitivity of the horn variety of speaker will be appreciated, and even with the cheapest of these the results will sound quite pleasing providing the input is small.

A VERY IMPORTANT POINT.

Halve the input and quadruple the purity is the idea that has been propounded. You should always remember that a loud speaker can sound very different when used in different places. Do not judge too much from the demonstrations given to you in radio stores. A loud speaker used on exactly the same set might sound very different when heard in, say, a drawing-room and a shop. But added to this you have, in the usual way, the fact that it will be used with entirely different sets.

The only way you can properly judge a loud speaker is to connect it to your own set in your own home. Unfortunately, few stores will allow you to have speakers on approval. The only alternative is to endeavour to borrow one or two different types from friends.

OTHER PEOPLE'S IDEAS.

Do not pay too much attention to the recommendations of other enthusiasts. People's tastes in loud speakers and loud-speaker reproduction generally vary to an enormous degree. Some like coloration and plenty of it, while others can detect it immediately and hate it.

You need not buy a complete loud speaker. An economical procedure is to purchase a loud-speaker unit and build up a cone typo yourself.

These loud-speaker units are of a moderately uniform degree of excellence. We would certainly recommend the listener who can lay out only shillings on his loud speaker to adopt this course.

Finally, a word in regard to loud speakers fitted with logarithmic horns. These are generally more successful when built on a large scale, as for the "Talkies." Small designs of moderate efficiency have, however, been produced.

Fitting a Potentiometer

Sets employing one stage of H.F. amplification which are inclined to be unstable may be stabilised by the addition of a potentiometer as follows:

Examine the grid of the first valve. You will see that it is connected to one side of a coil, and one side of a variable condenser. The other sides of these two components are joined together and connected either to earth or to the filament circuit.

Disconnect the wire making this connection and, instead, still keeping the condenser joined to the coil, take a lead to the centre or moving arm of potentiometer. The remaining two contacts on the latter must now be connected across the filament terminals of the H.F. valve holder.

If the set now tends to howl or oscillate, it may be stabilised by moving the potentiometer arm towards the positive end. A point will be found where the set stops oscillating, and the best position for general reception is one such that the set has just ceased to oscillate.

How to Neutralise

The following method of neutralising is recommended for use in sets employing one stage of H.F. and provided with a reaction control:

Set the reaction control at minimum and likewise the neutralising condenser. Now, on setting the tuning condensers so that the two tuned circuits are in step with each other it will probably be found that the set is oscillating.

To test for oscillation touch one or other of the sets of plates of the tuning condensers (this may be either the fixed or moving, according to the particular set)

You will probably find that the set will only oscillate under the above conditions when the two circuits are in tune with each other, and this can be used as an indication.

It is convenient to perform the operation at some point near the middle of the tuning range. Now, increase the capacity of the neutralising condenser. (In the case of some such condensers this means screwing downwards.)

Test at intervals for oscillation as this is done, and you will presently find that the set has ceased to oscillate and will not recommence even when the tuning dials are slightly readjusted.

Now increase the reaction a little, until the set once more oscillates and again increase the neutralising condenser setting until oscillation ceases. Slightly readjust the tuning condensers again to make sure that the set is completely stable once more.

FINAL ADJUSTMENTS.

Proceed in this way until it is found that the correct adjustment of the neutrodyne condenser has been over-shot. Once this point has been passed, it will be observed that further increases of the neutrodyne condenser setting no longer stop oscillation but cause it to become stronger.

The object is to find such an adjustment of the neutralising condenser as will permit the greatest setting of the reaction condenser to be used without producing oscillation.

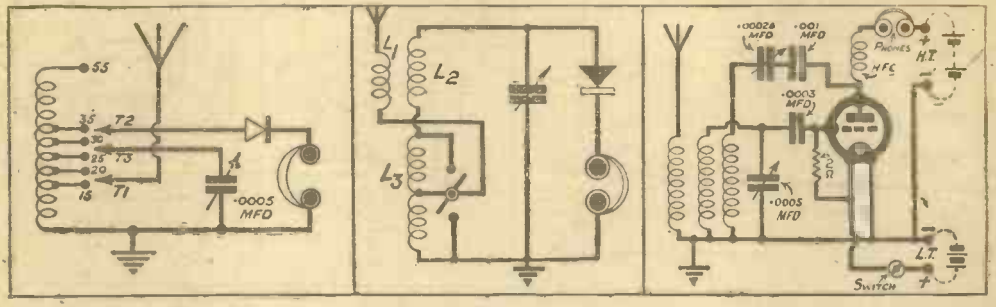
It will then be observed that when the two tuned circuits are in step and the set is brought to the verge of oscillation a slight movement in either direction of the neutrodyne condenser will cause the receiver to break into oscillation.

It is to be understood that in the preceding notes, where a reaction condenser is spoken of, any form of reaction control may be understood.

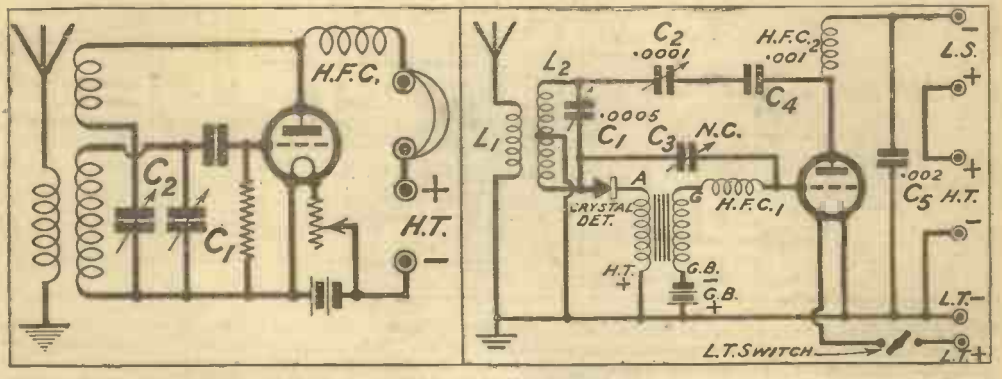
Mains Unit Earths

When an H.T. or L.T. or combined mains unit is used a direct earth connection is inadvisable, especially in the case of D.C. (See article on "Making and Using Mains Units.") The earth terminal of the set should be joined to the one terminal of a one or two mfd. fixed condenser, the other terminal of this being taken to the waterpipe or buried earth. Generally it is unnecessary to have any earth connection at all when the mains are used, as these give the desired earthing effect. Removing altogether the earth often reduces or eliminates interfering "hum."

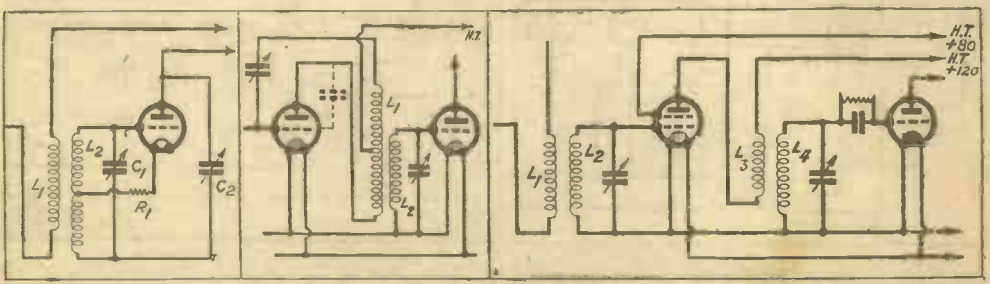
SELECTED "P.W." CIRCUITS



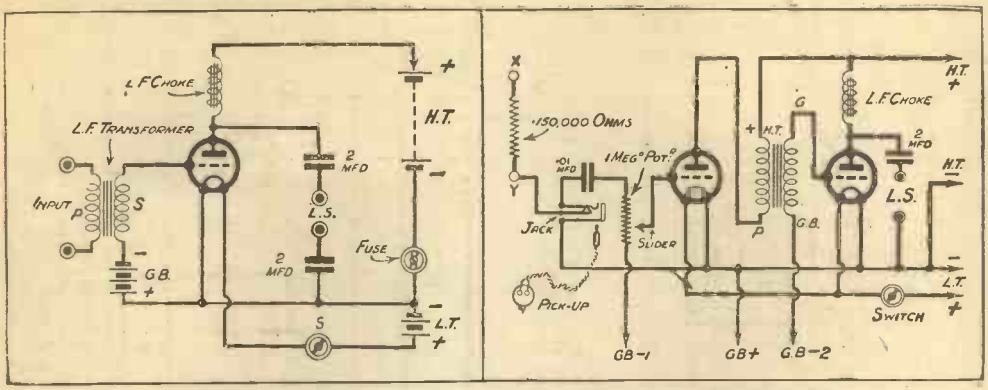
Left, a sensitive and selective type of crystal circuit. Tapping T_3 is normally placed on the 55-turn point, T_1 and T_2 being adjusted for best results. Numbers indicate turns of No. 24 D.C.C. wire on a 3-inch tube. Centre, a standard form of wave-change crystal circuit. L_1, No. 25 or 35, L_2, No. 60, L_3, No. 150 centre-tapped. Right, the popular Reinartz circuit as a single-valver arranged for plug-in coils.



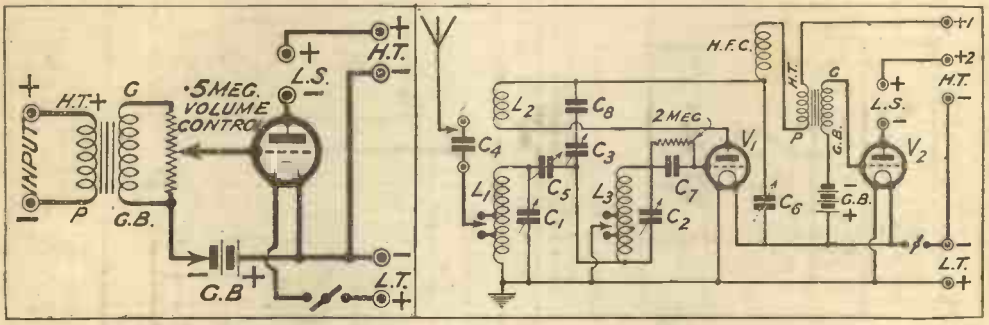
Left, a typical circuit of Reinartz type in which the reaction condenser is placed at the lower end of the reaction coil, thereby reducing hand-capacity effects. Right, a recent development of the "Trinadyne" circuit, employing a crystal detector and a valve which gives reaction and L.F. amplification. L_3 is a centre-tapped coil, C_3 a condenser of the neutrodyne type, and the valve an L.F. or small power. (H.F. type for headphone work.)



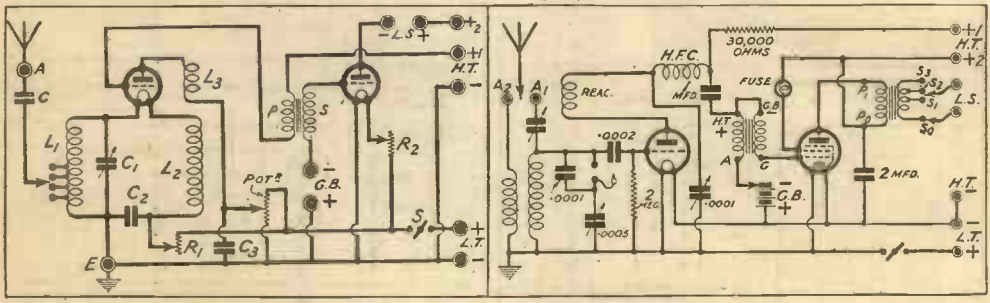
Some typical methods of H.F. inter-valve coupling. Left, split-secondary neutralising circuit. Centre, split-primary neutralising circuit in which the dotted condenser represents the plate-to-grid capacity of the valve. Right, plain transformer coupling as often used with screened grid-valves.



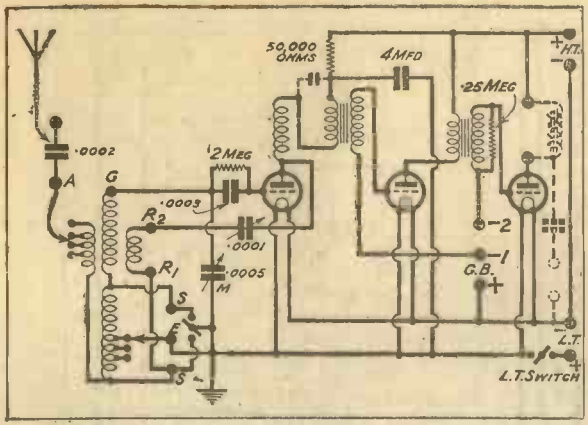
Left, a single-valve L.F. amplifier incorporating a safety fuse and an output filter properly arranged to reduce battery coupling-effects and to isolate the loud speaker completely when a mains unit is used. Right, a two-valve L.F. amplifier for use with any set not already incorporating L.F. stages, and with a jack for the insertion of a plug connected to a gramophone pick-up. Note the volume control marked "1 meg. Potr."

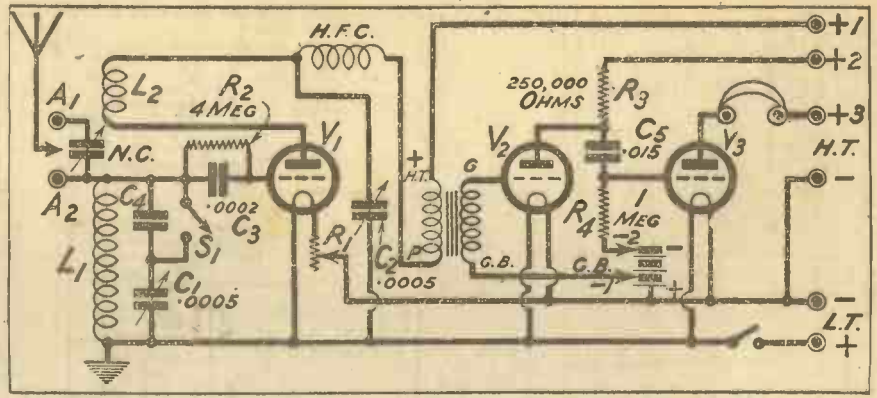


Left, a single-valve L.F. amplifier similar to the one above, but including a volume control and omitting the output filter. Right, an exceptionally high selectivity two-valve circuit for the Regional scheme. Coils L_1 and L_3 are of the "X" type (60 for low waves and 250 for long waves). Note the special reaction scheme: C_2 (·0001 mfd) is the main control, C_4 (·0001 mfd) is a compression-type adjustable condenser giving a preliminary control of reaction. C_3 is a neutrodyne-type condenser providing a small capacity to couple the two circuits together.

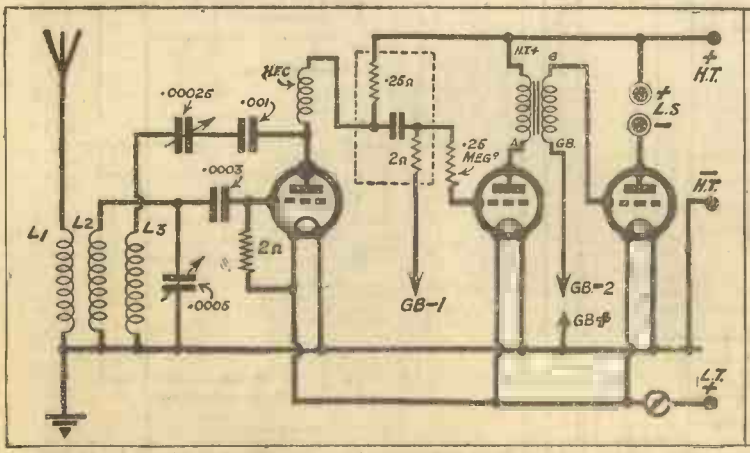


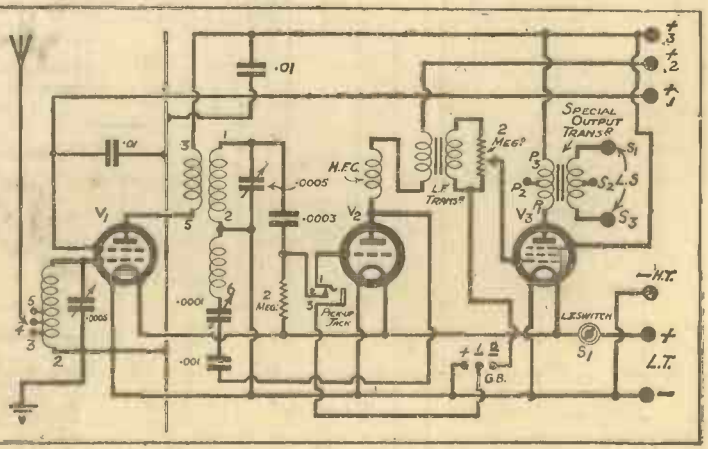
Left, a good example of the Filadyne circuit in one of its later forms. Note the division of the tuning coil into portions so that separate filament chokes are no longer necessary. The potentiometer provides the control of reaction. Right, a good modern form of two-valve short-wave circuit, using a pentode in the L.F. stage (note the special output transformer). The resistance-feed method is used for the L.F. transformer connections, and the set can be used on the broadcast waves by inserting suitable coils.



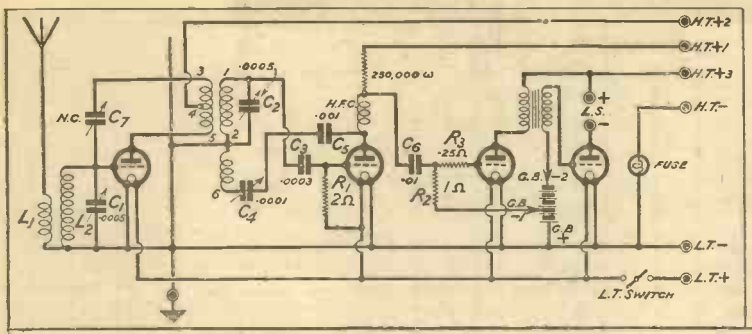


Left, a powerful three-valve combination of the detector and L.F. type. Wave-change switching is provided for by the use of a "Titan" coil unit. The L.F. stages are both transformer coupled and an anti-battery-coupling filter is provided at the detector stage. The dotted connections show how an output filter can be added if desired. Right a very good three-valve circuit for short-wave work with special devices enabling it to be used for reception of the local station also when suitable coils are inserted. Condenser C_4 should be of ·0002 mfd capacity.

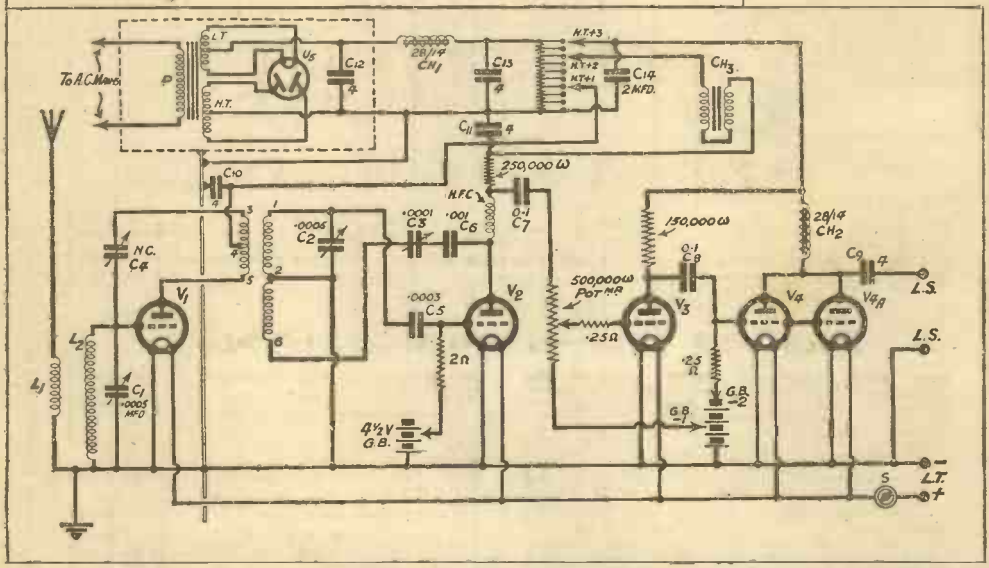




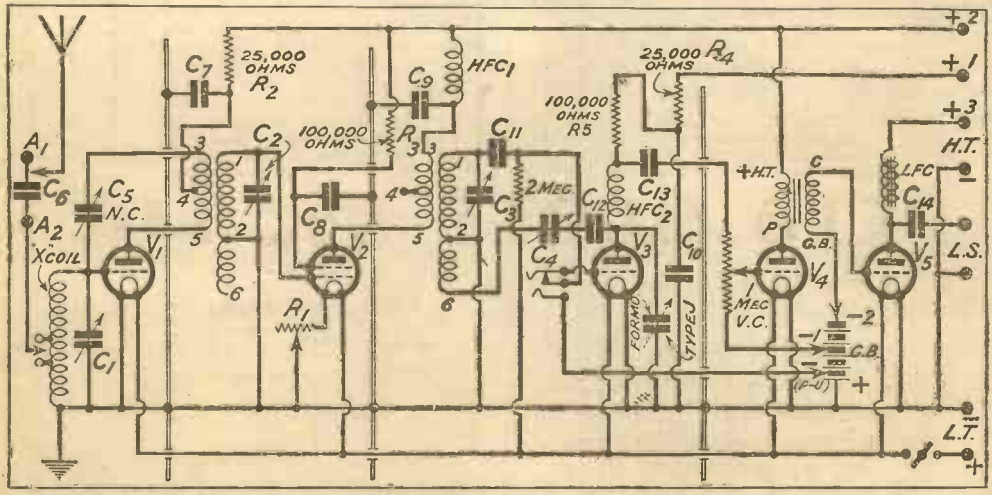
Left, one of the simplest and most useful general-purpose three-valve circuits (detector and two L.F. stages). The detector circuit is of the Reinartz type with three plug-in coils, and the L.F. stages are of the R.C. and transformer variety. Right, a very sensitive three-valve circuit particularly good for long-distance work. A screened-grid H.F. stage is provided and a pentode L.F. stage. With suitable screening 6-pin coils can be used here, as the numbers indicate.



A good general-purpose four-valve circuit for 6-pin coils. The H.F. stage is of the split-primary neutralised type, followed by a leaky-grid detector, a resistance-coupled L.F. stage, and then a final transformer-coupled stage. A little screening is required for the best results.



A five-valve circuit designed to give very fine quality of reproduction and a large output with suitable valves. Note the built-in mains H.T. circuits (alternating-current mains).



A particularly good five-valve combination consisting of a neutralised H.F. stage, a screened-grid H.F. stage, detector (note the jack for gramophone pick-up), one R.C. coupled L.F. stage and one transformer stage.

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BROADCASTING STATIONS

The wave-length and other details were completely revised and brought right up to date at the time of going to press.

METRES	
1935	Kaunas (Lithuania), 7 kw.
1875	Huizen (Holland), 6·5 kw.
1796	Lahti (Finland), 40 kw.
1725	Radio Paris (C F R) (France), 12 kw.
1635	Königswusterhausen (Zeesen) (Germany), 26 kw.
1554	Daventry (5 X X) (Gt. Britain), 25 kw.
1481	Moscow (Old Komintern) (R A 1)-(U.S.S.R.), 12 kw.
1444	Eiffel Tower (F L) (France), 12 kw.
1411	Warsaw (Poland), 8 kw.
1348	Motala (Sweden) (relays Stockholm), 30 kw.
1304	Kharkov (U.S.S.R.), 4 kw.
1200	Stamboul (Turkey), 5 kw.
1200	Boden (Sweden), 0·6 kw.
1153	Kalundborg (Denmark), 7·5 kw.
1116	Novosibirsk (U.S.SR.), R A, 4 kw.
1073	Rostov-Don (U.S.S.R.), 4 kw.
1071	Scheveningen Haven (Holland), 2·5 kw.
1071	Hilversum (Holland), 6·5 kw. After 5.40 p.m. daily.
1010	Basle, 0·25 kw.
1000	Leningrad, 20 kw.
938	Moscow (C C S P), 2 kw.
870	Tiflis, 4 kw.
840	Nijni Novgorod, 1·8 kw.
800	Kiev, 1·2 kw.
778	Petrozavodsk (U.S.S.R.), 2 kw.
770	Ostersund, 0·6 kw. Relays Sundsvall.
760	Geneva (Radio-Genève), 0·25 kw.
700	Minsk (U.S.S.R.), 4 kw.
680	Lausanne (Switzerland), H B 2, 0·6 kw.
570	Freiburg-im-Breisgau (Germany), 0·35 kw.
570	Hamar (relays Oslo), 0·7 kw.
566	Ljubljana (Yugoslavia), 2·5 kw.
565	Smolensk (U.S.S.R.), 2 kw.
560	Augsburg (Germany), 0·25 kw.
560	Hanover, 0·35 kw. Relays Hamburg.
550	Budapest (Hungary), 20 kw.
542	Sundsvall (Sweden), 0·6 kw.
533	Munich (Germany), 1·5 kw.
525	Riga (Latvia), 3 kw.
517	Vienna (Rosenhügel) (Austria), 15 kw.
511	Archangel (U.S.S.R.), 1·2 kw.
509	Brussels No. 1 (Belgium), 1 kw.
501	Milan (Italy), 7 kw.
497	Moscow, 1·2 kw.
493	Oslo (Norway), 1·2 kw.
487	Prague (Czechoslovakia), 5 kw.
479	Daventry (5 G B) (Gt. Britain), 25 kw.
473	Langenberg (Germany), 13 kw.
466	Lyon (La Douai), France. Relays Ecole Sup., 5 kw.
459	Zurich (Switzerland), 0·63 kw.
453	Porsgrund. Relays Oslo, 0·7 kw.
453	Aix-la-Chapelle (Germany), 0·35 kw.
453	Aalesund (Norway), 0·3 kw.
453	Salamanca (Spain), E A J 22, 1 kw.
453	Bolzano (Italy), 1 B Z, 0·2 kw.
453	Danzig, 0·25 kw. Relays Königsberg.
453	Klagenfurt, 0·5 kw. Relays Vienna.
453	Tromso (Norway), 0·1 kw.
453	Uppsala, 0·15 kw. Relays Stockholm.
453	Tammerfors. Relays Helsingfors, 0·8 kw.
450	Moscow (S P), R A 2, 1 kw.

METRES	
447	Paris (P T T) (Ecole Supérieure), France, 0·8 kw.
441	Rome (1 R O) (Italy), 3 kw.
436	Stockholm (Sweden), 1·5 kw.
436	Malmberget. Relays Boden (Sweden), 0·25 kw.
430	Belgrade (Yugoslavia), 2·5 kw.
427	Kharkov (U.S.S.R.), 4 kw.
424	Madrid (Union Radio) E A J 7 Spain, 2 kw.
418	Berlin (Witzleben) (Germany), 1·5 kw.
413	Dublin (2 R N) (Ireland), 1 kw.
412	Rabat (Morocco), 10 kw.
408	Katowice (Poland), 10 kw.
403	Berne (Switzerland), 1 kw.
399	Glasgow (5 S C) (Gt. Britain), 1 kw.
394	Bucarest (Roumania), 0·12 kw.
394	Fredriksstad (Norway). Relays Oslo, 0·7 kw.
390	Frankfurt (Germany), 1·5 kw.
385	Genoa (1 G E) (Italy), 1 kw.
385	Wilno (Poland), 0·5 kw.
381	Toulouse (Radio) (France), 8 kw.
377	Manchester (2 Z Y) (Gt. Britain), 1 kw.
372	Hamburg (Germany), 1·5 kw.
368	Radio L L (France).
368	San Sebastian (E A J 8) (Spain), 0·3 kw.
368	Seville (Union Radio) (E A J 5) (Spain), 1·5 kw.
364	Bergen (Norway), 1 kw.
360	Stuttgart (Germany), 1·5 kw.
356	London (2 L O) (Gt. Britain), 2 kw.
352	Graz (Austria). Usually relays Vienna, 7 kw.
351	Algiers (Algeria).
351	Leningrad (U.S.S.R.), 1·2 kw.
349	Barcelona (Radio Barcelona) (E A J 1) (Spain), 8 kw.
346	Strasbourg (France), 0·1 kw.
342	Brünn (Czechoslovakia) 2·4 kw.
339	Bremen (Germany). Relays Hamburg, 0·35 kw.
335	Cadiz (Spain), 0·5 kw.
335	Posen (Poland), 1·2 kw.
332	Naples (1 N A) (Italy), 1·5 kw.
329	Montpelier (France), 0·2 kw.
329	Paris (Petit Parisien) (France).
325	Breslau (Germany), 2 kw.
322	Göteborg (Sweden), 10 kw.
322	Falun (Sweden), 0·5 kw.
319	Dresden (Germany), 0·25 kw.
316	Marseilles (P T T) (France), 0·5 kw.
314	Oviedo (Spain), 0·7 kw.
313	Cracow (Poland), 0·5 kw.
310	Cardiff (5 W A) (Gt. Britain).
308	Radio-Vitus (France).
308	Zagreb (Yugoslavia), 0·7 kw.
305·6	Agen (France).
304	Bordeaux-Lafayette (P T T), France, 1 kw.
301	Aberdeen (2 B D) (Gt. Britain), 1 kw.
298	Hilversum (Holland), 6·5 kw. Until 5.40 p.m.
295	Tallinn (Estonia), 0·7 kw.
293	Kosice (Czechoslovakia), 2 kw.
293	Limoges (France), 0·5 kw.
291·4	Lyon (Radio) (France), 0·5 kw.
291	Viborg (Finland), 0·4 kw.
288·5	Bournemouth (6 B M) (Gt. Britain), 1 kw.
288·5	Bradford (2 L S) (Gt. Britain), 0·13 kw.
288·5	Dundee (2 D E) (Gt. Britain), 0·13 kw.
288·5	Edinburgh (2 E H) (Gt. Britain), 0·35 kw.

METRES	
288·5	Hull (6 K H) (Gt. Britain), 0·13 kw.
288·5	Liverpoo' (6 L V) (Gt. Britain), 0·13 kw.
288·5	Plymouth (5 P Y) (Gt. Britain), 0·13 kw.
288·5	Sheffield (6 F L) (Gt. Britain), 0·13 kw.
288·5	Stoke-on-Trent (6 S T) (Gt. Britain), 0·13 kw.
288·5	Swansea (5 S X) (Gt. Britain), 0·13 kw.
286	Montpellier, ·2 kw.
283	Notodden (Norway), 0·05 kw.
283	Magdeburg (Germany), 0·5 kw.
283	Innsbruck (Austria), 0·5 kw.
283	Stettin (Germany), 0·5 kw.
283	Berlin Relay (Germany), 0·5 kw.
283	Uddevalla (Sweden), 0·05 kw. Relays Göteborg.
283	Varberg (Sweden), 0·3 kw.
281	Copenhagen (Denmark), 0·75 kw.
280	Radio-Liège.
279	Bratislava (Czechoslovakia), 12·5 kw.
276	Königsberg (Germany), 2·5 kw.
274	Turin (Italy), 7 kw.
272	Rennes (France), 0·5 kw.
270	Trollhättan, 0·45 kw. Relays Göteborg.
270	Hudiksvall, 0·15 kw. Relays Sundsvall.
270	Norrköping (Sweden), 0·25 kw. Relays Stockholm.
270	Kaiserslautern (Germany), 0·25 kw.
268	Barcelona (Radio Catalana), E A J 13, 10, kw.
268	Strasbourg, 0·1 kw.
265·4	Lille (P T T) (France), 0·7 kw.
263	Moravska-Ostrava (Czechoslovakia) 10 kw.
261	Newcastle (5 N O) (Gt. Britain), 1 kw.
259	Leipzig (Germany), 1·5 kw.
257	Horby (Sweden), 10 kw.
255	Toulouse (P T T) (France), 1·5 kw.
253	Gleiwitz, 5 kw.
251	Almeria (Spain) E A J 18, 1 kw.
250·9	Schaerbeek (Brussels) (Belgium).
246	Abo (Finland), 0·5 kw.
246	Kalmar, 0·2 kw. Relays Stockholm.

METRES	
246	Saffle, 0·4 kw. Relays Stockholm.
246	Eskilstuna (Sweden), 0·2 kw. Relays Stockholm.
246	Jakobstad (Finland), 0·25 kw.
246	Linz (Austria), 0·5 kw.
246	Kiel (Germany). Relays Hamburg, 0·35 kw.
246	Cassel (Germany). Relays Frankfurt, 0·25 kw.
246	Kiruna (Sweden). Relays Boden, 0·2 kw.
246	Cartagena (Spain), 0·4 kw.
242	Belfast (2 B E) (Ireland), 1 kw.
241·3	Rjukan, Relays Oslo, Norway, 0·18 kw.
239	Nimes (France), 1 kw.
239	Nürnberg (Germany). Relays Munich, 2 kw.
238	Bordeaux-Sud-Ouest (France).
237	Juan-les-Pins (Nice) (France).
237	Orebrö. Relays Stockholm (Sweden), 0·2 kw.
235·5	Charleroi (Belgium).
234	Munster (Germany), 0·5 kw.
231	Boras. Relays Göteborg (Sweden), 0·15 kw.
231	Umea (Sweden), 0·2 kw.
231	Malmö (Sweden), 0·6 kw.
231	Hälsingborg (Sweden), 0·2 kw.
228·4	Biarritz (Côte d'Argent, France), 1·5 kw.
227	Cologne (Germany), 2 kw.
224·4	Cork (6 C K) (Ireland), 1 kw.
223	Radio-Luxembourg (Experimental), 2 kw.
221	Helsingfors (Finland), 0·9 kw.
218	Karlstadt (Sweden), 0·25 kw.
218	Flensburg (Germany), 0·5 kw.
218	Ornskoldsvik, 0·2 kw. Relays Sundsvall.
218	Björneborg (Finland), 0·8 kw. Relays Helsingfors.
216	Halmstadt (Sweden), 0·2 kw.
204	Gävle (Sweden). Relays Stockholm, 0·2 kw.
203	Kristinehamn (Sweden), 0·25 kw.
202	Jönköping, 0·25 kw. Relays Stockholm.
200	Leeds (2 L S) (Gt. Britain), 0·13 kw.
196	Karlskrona. Relays Stockholm (Sweden), 0·25 kw.

MAKE YOUR SET SELECTIVE

Details of a simple scheme that can be applied to practically any set.

The use of what is generally termed "Aperiodic Aerial Coupling" is often beneficial in increasing selectivity, cutting out unwanted noises, etc., etc., and old sets can be converted as follows:

Mount another coil socket by the side of the existing aerial coil, so that the coupling between the new coil and the existing one will be as tight as possible. From one of the terminals on the new socket take a wire to a new terminal on the panel or terminal strip; this will be the new aerial terminal. Connect the other terminal on this new socket to earth.

NEW COIL SIZES.

The coil sizes used will now be slightly different, and, in general, will be as follow:

In the old aerial socket, which now becomes the secondary coil, for the broadcast band a No. 60 or 75 coil. For Daventry, a No. 200 or 250.

In the new socket, for the broadcast band, a No. 25, 35 or 50 will be needed, and for Daventry a No. 75 or 100.

In the case of sets employing a stage of H.F. amplification, this improvement may sometimes have the effect of rendering the set a little unstable, in which case a potentiometer should be used. (See "Fitting a Potentiometer" on another page.)

EVEN CHEAPER.

Another simpler and cheaper method of applying aperiodic aerial coupling is as follows. Wind thirty or so turns of 24-gauge cotton covered wire in the form of a hank coil, and secure its turns by tying thread around it. This coil should be of approximately the same diameter as the existing aerial coil. These two coils can be tied together by thread. The connections are exactly the same as in the first case.

The coil described will be suitable for the normal broadcast band; one of seventy or so turns will be needed for the 5 X X range.

YOUR L.T. BATTERY

The selection and maintenance of radio accumulators is dealt with below.

If you are fortunate enough to know of a really good service station for L.T. batteries, your accumulator will be automatically kept in condition by this charging station. The actual condition of the whole battery and its separate cells should be checked there by experts who know just how to cure any little troubles that may arise.

The symptoms by which the condition of a cell is tested are the voltage and the specific gravity. The voltage is tested by means of a voltmeter, before, during, and after the charging, and also while the accumulator is discharging.

Similarly the specific gravity of the electrolyte is tested during the various stages of charging and discharging, and if the tests are scrupulously carried out the slightest disorder in the cells will be detected at its very beginning.

AT CHARGING STATIONS.

The chief points watched in a charging station, apart from the rates of charge, etc., are :

(*a*) "Topping up" the cells (distilled water is used to make up for any losses of the acid solution due to evaporation)

(*b*) Scrupulous cleanliness of the connections is essential. The connecting bars should be tight and well fitting, the terminals coated with petroleum jelly to prevent them being attacked by the acid, and in general the battery should be kept clean, cool and dry.

(*c*) The little filling plugs should always be placed back in position after the electrolyte has been tested or renewed, and it is important that the small holes in the plugs (arranged for allowing gases, etc., to escape) should not become blocked up.

About every twelve months the old electrolyte should be poured away and replaced by new electrolyte of the correct specific gravity.

HYDROMETER TESTS.

The voltage of an accumulator is tested by a voltmeter. The hydrometer, although it is an instrument for testing an accumulator, does not measure the voltage of the accumulator at all.

The use of the hydrometer is simply the measurement of the "density" or "strength" of the accumulator's acid. The conditions of the acid (or, to give it its proper name, the electrolyte) alters according to the condition of the accumulator in very much the same way as the voltage rises when the accumulator is "fresh," and falls when it is discharged.

As testing the voltage across the terminals will indicate whether the cell is fully charged or is run down, so will the strength of the acid indicate whether it has been charged recently or whether it is in need of recharging. When an accumulator which is in ordinary good condition has been recently recharged, the "density," or, again, to give the right name, the "specific gravity" of the acid is 1·2.

DENSITY OF ELECTROLYTE.

After the battery has been in use and is run down (with its voltage down to about 1·85) the specific gravity will be down to 1·17. The fall in the specific gravity from 1·2 to 1·17 is a gradual one, which keeps pace exactly with the condition of the accumulator.

With the hydrometer test we merely find out how much lower than normal is the density of the liquid in the cell. In fact, the hydrometer tests the electrolyte of each cell (thus giving a reliable indication of the condition of the cell), but it is in no way concerned with the voltage.

CAPACITY OF ACCUMULATOR.

A glance at the maker's figures shows the filament current of each valve, and these must be added together in order to get the total current consumption. Supposing the H.F. valve has a filament current of ·1 ampere, the detector valve has a current of ·1 ampere, the first L.F. valve has ·1 ampere, and the power valve has a current of ·15 ampere.

As stated, these must be added together and the total current consumption of the set will then be found to be ·45 ampere. The ability of an accumulator to supply current is reckoned in ampere hours. By adding up the current consumption of each valve in the set, you have found out the number of amperes—i.e. ·45. The next thing to find out is the number of hours. If the set is to be used for four hours per day for a fortnight, you can reckon the total number of hours for each two weeks will be about sixty.

If this figure (sixty) is multiplied by the figure of the total amperes taken by the set—i.e. ·45—you will get the required number of ampere hours.

SIZES TO USE.

Multiplication of 60 by ·45 gives an answer of 27. This, then, is the number of ampere hours which you will take out every fortnight, and although there is not an accumulator which gives exactly 27 ampere hours, there is a size "30 actual ampere-hours." made by practically every accumulator manufacturer.

As it is advisable to always have a little in hand this is the size of accumulator you require, and if you instal a "30 actual" accumulator and work it as stated with the valves mentioned you will find that it will keep the filament current supply up properly.

Be sure, however, to note that you purchase an accumulator rated at 30 *actual* ampere-hours, as the 30 "ignition" rating has a capacity of only about half this figure.

Testing Dry H.T. Batteries

If you have a really good high resistance voltmeter this will give a reliable indication of the condition of the dry battery if it is connected to it after the set has been in use about an hour, i.e. whilst the battery is still on load. If the voltage is tested in this way (about once a week) after the battery has been in service for a month or so, it is the work of only a moment to verify that it is in good condition. But make sure that the voltage is always read while the battery is on load, and has been supplying current for some time, and do not let the total voltage of the battery drop below about 80 per cent of the rated voltage.

EVER READY

REGD. TRADE MARK

BRITAIN'S BEST BATTERIES

For Perfect Reception and Long Life—

always insist on

EVER READY

THE POPULAR HIGH TENSION	
66 volt - -	9/6
108 volt - -	15/6
POPULAR POWER HIGH TENSION	
60 volt - -	13/6
64 volt - -	14/6
99 volt - -	22/-
105 volt - -	24/-
120 volt - -	27/-

LEADING SHORT-WAVERS

The following details of the most important of the short-wave broadcasters were very carefully checked, on the day of going to press, with the very latest available information.

SHORT-WAVE STATIONS.

METRES

104·5 Perth (Australia), 6 W F, 0·25 kw.

84·24 Copenhagen (7 R 1). Experimental transmission TUESDAY and FRIDAY, after close of ordinary transmissions.

80 Constantine (Tunis) 8 K R. MONDAY and FRIDAY.

70 Vienna (O H K 2). (Transmits on SUNDAY for 15 minutes after each hour from 5 p.m. till 11 p.m.)

67·65 Döberitz (A F K), 5 kw. MONDAY, WEDNESDAY and FRIDAY, 10 a.m. to 11 a.m. and 6 to 7 p.m.

61 Radio L L (France).

58 Prague (Czecho-Slovakia).

56·7 Nauen (A G J) occasionally after 5 p.m.

52 Bergedorf (Germany) A F L, 3 kw.

50 Karlsborg (Sweden) S A J.

50 Moscow R F N. TUESDAY, THURSDAY and SATURDAY, 1 to 2 p.m.

50 Barcelona Radio Club E A J 25. SATURDAY, 8 p.m. to 9 p.m. News and gramophone records.

49·83 New York (N.Y.), W 2 X B R. Relays W B N Y, 1 kw.

49·5 Cincinnati (Ohio), W 8 X A L, 0·25 kw. Relays W L W from 11.50 p.m., except Friday and Saturday.

49·5 Council Bluffs (Iowa), W 9 X U, 0·5 kw. Relays K O I L.

49·4 Vienna (U O R 2), 0·4 kw. Testing, TUESDAY and THURSDAY, 12.10 p.m. to 1.10 p.m.; WEDNESDAY and SATURDAY after the evening programme.

49·34 Newark (N.J.), W 2 X C X. Relays W O R, 0·5 kw.

49·02 New York (N.Y.), W 2 X E. Relays W A B C, 5 kw.

49·02 Richmond Hill (N.Y.), W 2 X E. Relays W A B C, WEEKDAYS 11 p.m. to 5 a.m. SUNDAY, 3.50 p.m. to 5.30 p.m.

47 Funchal (Madeira), C T 3 A G, 0·3 kw. Test transmissions SATURDAYS, 10 p.m. to 1 a.m.

44 San Lazaro (Mexico), X C 51. 8 a.m. and 8 p.m.

43·5 Rome (Italy), I M A. SUNDAY, 5 to 7.30 p.m.

43 Madrid E A R 110. TUESDAY and SATURDAY, from 10.30 p.m. to 12 midnight.

42 Perth (Australia), 6 A G. 11.30 a.m. and 4 p.m.

41 Radio Vitus. Testing.

40·2 Lyons (Rhône), Y R. DAILY except SUNDAY, from 4.30 p.m. to 5.30 p.m.

40 Döberitz, A F K (or D O A), 5 p.m. to 7 p.m. DAILY; occasionally other times.

37 Vienna (E A T H). MONDAY and THURSDAY, 9.30 p.m. to 11 p.m.

33·7 Posen (Poland), 0·3 kw. Testing MONDAY and THURSDAY, 11 p.m. to 12 midnight.

32·5 Sydney (2 B L).

32·5 Paris, Eiffel Tower (F L). Time Signal 8.56 a.m. and 8.56 p.m.

32 Berne (Switzerland), E H 90 C.

31·55 Melbourne, 3 L O.

31·48 Denver (Col.), W 9 X A. Relays K O A, 0·75 kw.

31·43 Schenectady (General Electric Co.), N.Y., W 2 X A F, 10 kw. (Aer.). MONDAY, 11 p.m. to 5 a.m. TUESDAY, 11 p.m. to 4.30 a.m. THURSDAY, 11 p.m. to 5.30 a.m. SATURDAY, 11 p.m. to 5 a.m. Relays W G Y.

31·4 Hilversum, Holland, P C J, 25 kw. THURSDAY, 7 p.m. to 9 p.m., in English; 12 midnight to 1 a.m., in Spanish. FRIDAY, 1 a.m. to 2 a.m., in Portuguese; 2 a.m. to 4 a.m., in Spanish; 7 p.m. to 9 p.m., in English. SATURDAY, 1 a.m. to 2 a.m., in Dutch: 2 a.m. to 5 a.m., in English, French, and Spanish; 5 a.m. to 7 a.m. in English.

31·38 Zeezen, Daily, 7 p.m. onwards

31·28 Sydney, 2 F C.

31 Nairobi (Kenya), 7 L O. DAILY, 5 p.m. to 8 p.m. Relays 5 S W occasionally from 8 p.m. to 9 p.m.

30·91 New York (W 2 X A L). TUESDAY, 12 midnight to 5 a.m. WEDNESDAY, 12 midnight to 2 a.m. FRIDAY, 12 midnight to 4 a.m. SATURDAY, 12 midnight to 3 a.m., 0·5 kw.

30·75 Agen. TUESDAY and FRIDAY, 10 p.m. to 11·15 p.m.

27·27 Posen (Poland), 0·3 kw. Testing MONDAY and THURSDAY, 11 p.m. to 12 midnight.

25·6 Winnipeg (Canada), C J R X, 2 kw. DAILY (except SUNDAY), from 10.30 p.m. to 12.30 a.m. SATURDAY, 6 a.m. to 7 a.m.

25·53 Chelmsford (5 S W), 15 kw. (Aer.). DAILY (except SATURDAY and SUNDAY), from 12.30 p.m. to 1.30 p.m., and from 7 p.m. to 12 mdnt.

25·25 Pittsburg East (Westinghouse Electric), W 8 X K. Relays K D K A at intervals.

23·35 Oakland (California), W 6 X N. Relays K G O. TUESDAY, WEDNESDAY and FRIDAY, from 5.30 p.m. to 9 p.m., 5 kw. WEDNESDAY also from 2 a.m. to 8 a.m.

22·2 Vienna, 0·24 kw.

22 Schenectady, W 2 X A F, MONDAY and THURSDAY, 7 p.m. to 9 p.m.

19·56 Schenectady, W 2 X O, SUNDAY, 7·30 p.m. to 10·30 p.m. TUESDAY and FRIDAY, 7 p.m. to 8 p.m.

19·56 Schenectady (General Electric Co.), W 2 X A D, 6 kw. SUNDAY, 7.30 p.m. to 4 a.m. MONDAY, WEDNESDAY, FRIDAY, and SATURDAY, 11 p.m. to 5 a.m. Relays W G Y.

19·6 Lyngby (Denmark) (Experimental).

17·35 Schenectady, W 2 X K., TUESDAY, THURSDAY, SATURDAY, 5 p.m. to 10 p.m.

17·2 Nauen (A G C).

17 Bandoeng, Java (Radio-Malabar), P L F, 30 kw.

16·88 Huizen (Holland), P H I, 40 kw. 3 p.m. to 5 p.m.

16·3 Kootwyk (Holland), P C K.

15·74 Bandoeng, Java (Radio Service), P L E. WEDNESDAY, 1.40 p.m. to 3.40 p.m.

15·5 Nancy (France), 9 p.m. to 10 p.m.

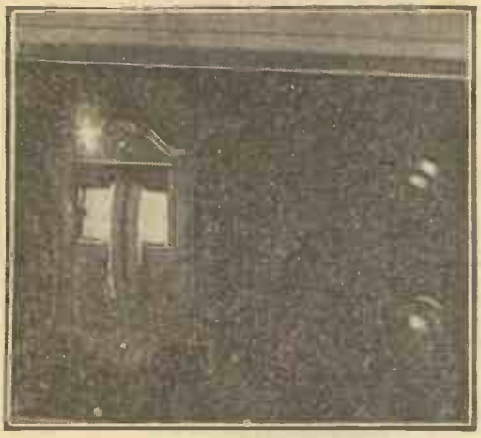
15·02 Buenos Aires.

YOUR TUNING CONTROLS

Variable condensers, with and without slow-motion movements, "vernier" dials and other such devices are dealt with in this helpful and interesting section.

Some variable condensers have slow-motion mechanisms incorporated in their structures. Good examples of this type are to be seen in various of the Ormond, G.E.C., J.B., Brandes, Ediswan, and other first-class makes; and from many points of view this type is preferable to a straightforward design having only a direct drive, but which is fitted with a "vernier" dial.

When you have a condenser geared within itself at about a 6 : 1 ratio—that is, you have to rotate the dial six times in order to rotate the vanes once—then it would be unnecessary to employ any additional fine tuning device. Given a 6 : 1



Here you see a double drum drive; a quite modern type of control with distinctly attractive features.

ratio and a nice, large, milled dial, the closest possible adjustments can easily be made.

But many of the above-mentioned slow-motion condensers have direct drives as well, and in this case the DX enthusiast is very well served.

It is very irritating to have only a very slow-motion movement, for this means that the knob or dial has to be twisted dozens of times when one wants to move over wide areas. In order to get from 2 L O to 5 G B, for instance, one has to twist and twist until one's fingers ache.

"MICROSCOPIC" MOVEMENTS.

When, however, a moderately low gearing is employed—say, 5 or 6 to 1—this trouble is not encountered. Thus it would seem that a ratio or gearing could be arrived at that would satisfy everyone and dispense with the necessity for a direct drive.

But this is by no means the case, and manufacturers have had a difficult time arriving at a design that would prove universally acceptable. Some enthusiasts like a "microscopic" movement, while others like a slow-motion that isn't too slow. The condenser is a component which, above all others, reacts most strongly to individual manipulators!

The problem is, however, half-way towards solution by providing both direct and vernier controls. The latter can take many forms and adopt many faults. Nowadays there are quite a few very excellent slow-motion condensers and dials on the market, although it is not so long ago that such were remarkably rare.

Whether the mechanism be integral with the condenser or fitted additionally in the form of a dial, both the direct and the vernier controls should preferably be in constant gear. Then the fingers can slip off the dial or knob communicating the direct drive and immediately follow up the movement on the slow-motion dial or knob. Obviously the two knobs and dials can be placed in relation to each other still further to facilitate this operation.

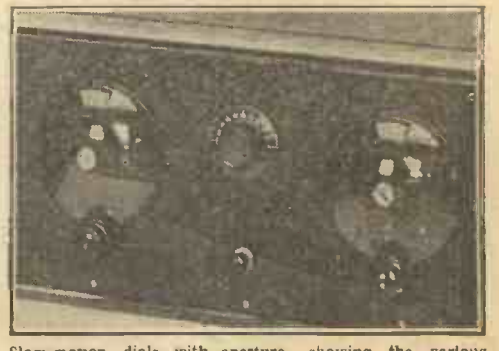
For a very long while we waited in vain for a condenser or dial which provided smooth actions in both their direct-control and geared-down movements. Manufacturers did not seem to encounter much difficulty in getting smooth slow-motion movements, but in doing this the direct drive seemed to become unusually harsh and hard. The reason for this is not difficult to see.

VARIOUS TYPES OF GEARING.

The most obvious way to achieve a slow motion is to fit a large cogwheel on the spindle of the condenser, and to engage a small cogwheel with it. A knob is then fitted to the small cogwheel, *et voilà* slow motion. You have to rotate the little cogwheel many times before the big cogwheel moves round 180 degrees and carries the vanes of the condenser with it.

But if you now attempt to adjust the condenser by its original direct drive, i.e. by means of a plain dial fitted to the spindle of the component, some fair amount of extra force must be applied, because the large cogwheel has to drive the small cogwheel round many times for every half revolution of the dial. You see, you gear down for easy, smooth movement, and it is only fair to assume that when you gear up, you get the reverse; and actually this is what happens when you go so crudely to work.

In some cases manufacturers solved the problem satisfactorily by replacing the above-described cog-

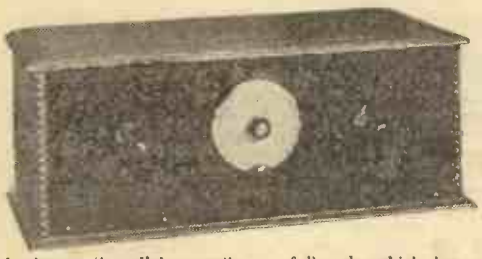


Slow-motion dials with apertures showing the various readings.

wheels for friction wheels, although it takes clever craftsmanship to produce happy results even with this arrangement.

You can generally tell a badly-made dial or condenser that employs this scheme by a varying drag on the direct drive. The dial twists quite easily for a time, then suddenly gets a trifle stiff. Then you encounter a very loose patch, and so on.

But we must hastily interpolate that there are



A slow-motion dial revealing a full-scale which has a "hair-line" indicator.

several very excellent dials using friction gearing, as there are that incorporate ordinary cogwheels. Gear-cutting is almost an art, and can be really successfully tackled only by first-class concerns having first-class machinery.

Among the smoothest working of all slow-motion devices are those embodying epicyclic forms of gearing and gearing making use of ball-bearings in one or other of several very ingenious manners. Here one meets with truly velvety actions, both on the direct and vernier controls.

One must always be very wary that one does not choose a dial or condenser the movement of which has inherent backlash, as this fault is a very serious one, but rather difficult at times to detect when the component is not mounted on a panel.

Every tiniest movement of the knob or dial of the condenser in the one direction or the other should be accompanied by corresponding movements of the vanes, although these may be almost too small to be seen. If you have a dial which requires moving several degrees in the one direction before the control "takes up" or starts to operate the vanes, then we would advise you to scrap it for another of sounder construction.

DRUM-DRIVE CONTROLS.

A great deal of the advantage of slow-motion gearing is lost if the control is in the form of a tiny, smooth knob. A large milled dial in itself contributes "slow-motion" qualities and makes for easier adjustments, and where you have gearing in addition, fine tuning is very greatly facilitated.

There is a great deal to be said for "thumb controls" such as are to be encountered on "drum-drive" condensers and dials, and these are becoming very popular these days. But you should see that your thumb-control, if you incline to this type, has plenty of surface and projects sufficiently through the panel so that you do not have to use your finger-nails to get at it.

THE "P.W." STANDARD LOADING COIL

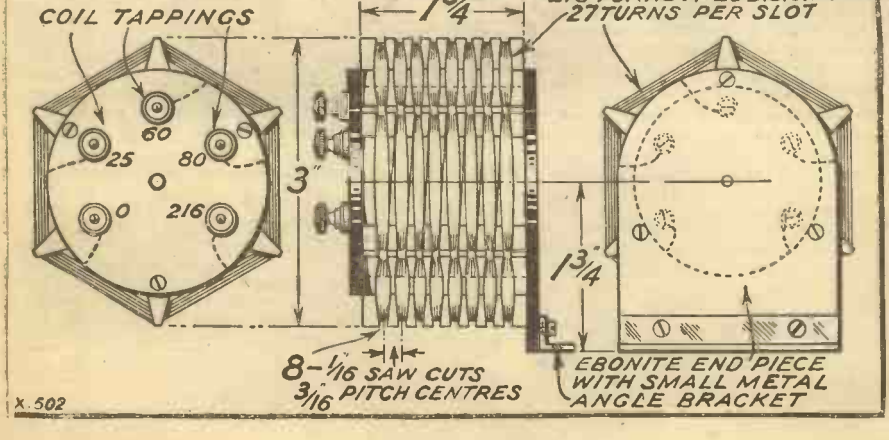
This component figures as an integral part of the "P.W." "Titan" Coil which is described on another page.

The main points in construction can be gathered from the accompanying illustration, which shows (left) the arrangement of the terminals, the method of arranging the turns (centre) and (right) the other end piece and method of supporting the coil.

Those who desire to do so can obtain one of the standard formers (Burne-Jones, Paroussi, Ready Radio, Wright and Weaire, etc.) which has a series of saw-cuts in the ribs. These form slots for the winding, and in each of these must be wound 27 turns of 26 D.S.C., making 216 turns in all.

Tappings can be brought out in any convenient fashion, at 25, 60, and 80 turns, counting from the beginning, which should be labelled 0. The end of the winding should be marked 216.

If a ready-made former is not to be employed a piece of ribbed "Becol" tube may be used, 1¾ in. long, and 3 in. diameter over the ribs. In this case eight saw cuts should be made, right down to the full depth of the ribs, and each about 1/16 in. wide. A space of ⅛ in. should be left between these cuts. Any desired method of mounting may be employed, but of course no metal must be placed in the field of the coil. Small brackets as shown can be used.



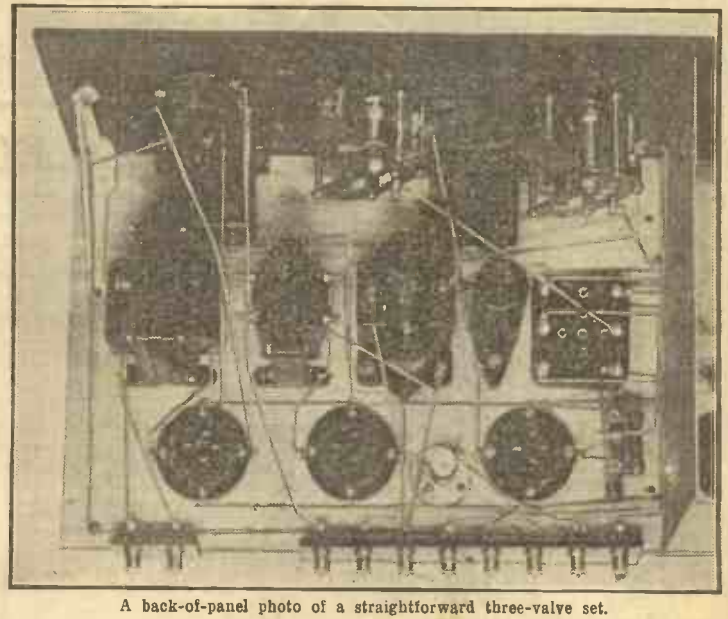
COMPONENTS FOR YOUR SET

Some practical advice on the selection of parts for home-constructor receivers.

When there is general standardisation the lot of the home constructor will be much easier. Until then, however, he must be careful in his choice of components, for with different makes they are liable to vary to a considerable degree, and these variations are not always confined to mere dimensions and shapes.

Take the so-called R.C.C. unit, for instance. In its essentials this consists of but three items, an anode resistance, a grid condenser and a grid resistance. Yet some R.C.C. units incorporate other things as well, and it may easily happen that these other things might not agree with the circuit in which you desire to use the unit.

At least one well-known make of R.C.C. unit incorporates an additional resistance. this being included for the purpose of preventing high-frequency energy passing through the article into the L.F. valve. In many cases this would prove a beneficial addition but in other R.C.C. units one is liable to find a fixed condenser connected across one of the resistances for the purpose of by-passing high-frequency currents so that the device can be successfully employed in certain circuits. In other hook-ups such a condenser might prevent the receiver from operating. Again, should you be requiring to purchase an R.C.C. unit for a particular set, make certain that the condenser and resistances are of the correct values, for in this respect there is wide variation.



A back-of-panel photo of a straightforward three-valve set.

L.F. transformers appear to be settling down into a more or less stable condition of uniformity. Practically all L.F. transformers of good make are interchangeable. The leading transformer makers such as, for instance, the Ferranti people, issue N.P.L. curves for their products and these are guarantees of good performance.

COILS AND CHOKES.

Many amateurs are now replacing aerial plug-in coils for the tapped varieties in order to introduce greater selectivity in the more-old-fashioned types of sets. Such coils are not quite uniform and it should be remembered that the position of the tappings may influence the tuning range of a set.

But, generally speaking, the tapping that is used is taken from the centre of the coil or a point somewhat lower. Although it should be remembered that much depends upon the individual aerial and earth conditions, a 60-turn tapped coil will provide practically the same tuning range as one of 40 turns used in plain parallel condenser tuning aerial position.

The main requirements for an L.F. choke when it is used for the output circuit of a loud-speaker receiver is that it should have ample inductance and should be able to handle a fair degree of current without saturation. Further, it should have a low ohmic resistance—something in the hundreds, and certainly not in the thousands, of ohms.

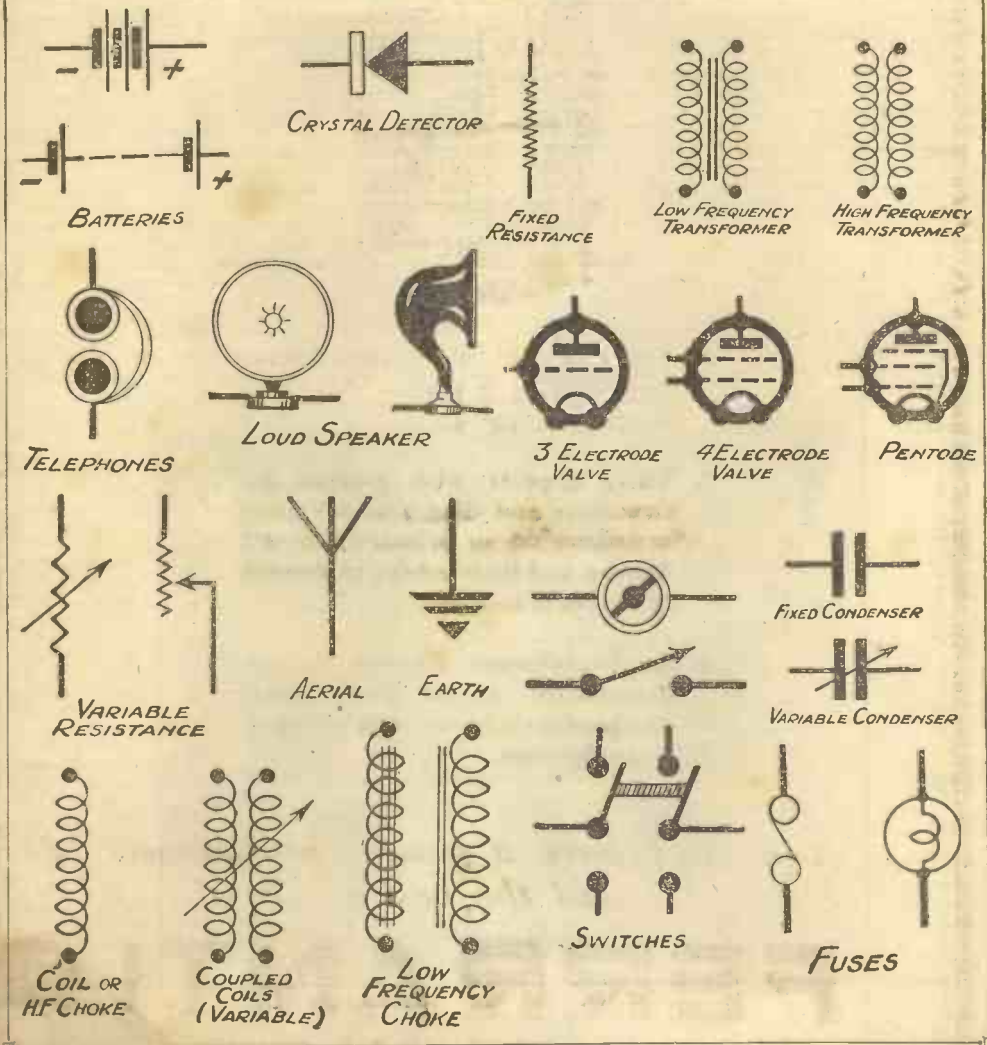
CONDENSERS FOR MAINS UNITS.

Regarding fixed condensers, the constructor should not get into the habit of considering that the only factor of these that matters is capacity. Certainly this is the main feature in the majority of cases, but where a condenser is subjected to any big degree of voltage it must be of a more robust electrical nature than one used, for instance, in series with the aerial in order to sharpen tuning.

This is why "high-voltage" fixed condensers are specified in a high-class L.F. amplifier for grid-coupling purposes. Such a condenser has to withstand a high voltage, therefore its dialectric must be of mica or some such reliable material. And this question of strength and reliability in the fixed condenser is extremely important in the case of mains units. In such devices, condensers guaranteed to have been tested at a voltage twice that of the mains with which the unit is to be employed should be chosen. These will be more expensive, but the outlay will be distinctly worth while.

In the description of POPULAR WIRELESS receiver designs ample details of all the necessary components are always given.

RADIO DIAGRAM SYMBOLS



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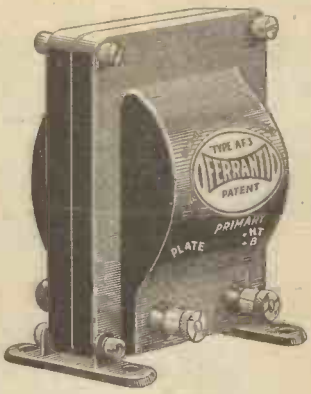

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