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Vol. XIX. No. 74. MODERN WIRELESS. FEBRUARY, 1933.

As some of the arrangements and specialties described in this Journal may be the subject of Letters Patent the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

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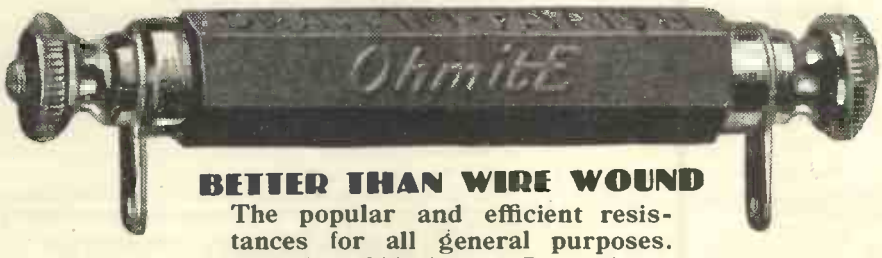

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100,000	3.5	10,000	12.
80,000	4.24	5,000	20.25
60,000	5.	4,000	24.
50,000	5.5	3,000	29.
40,000	6.	2,000	35.
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Modern Wireless

Vol. XIX. No. 74. BRITAIN'S LEADING RADIO MAGAZINE FEBRUARY, 1933

Parliament and Broadcasting—The Thin End of the Wedge?—Hands Off the B.B.C.!

THERE are two special sets in this February issue of MODERN WIRELESS, one for the short-wave listener and the other for the radiogram enthusiast.

The former is admittedly "a big job." It is a five-valve superhet for telephone reception of stations between 16 and 80 metres from all over the world, but as this set has been designed specially by MODERN WIRELESS'S short-wave expert, it is felt that in this number readers will admit they have details for building a short-wave set of outstanding quality and excellence.

The "Mu-Gram" for the radiogram enthusiast is, as its name indicates, a variable-mu screened-grid set, and has several particularly interesting features. For instance, it has a specially ingenious system of volume control designed for the control of powerful stations. On test it was found that the sensitivity for distant reception was of a particularly high order.

We also publish details of a simple accessory for this radiogram receiver in the form of a fireside record player. This accessory, which is quite simple to build, eliminates one of the most annoying features of gramophone reception, i.e. that of getting up every now and then to change records and needles. It is not, of course, an automatic player—being very much simpler in construction and much more inexpensive to build. We have termed it the "Handibox," and think you will agree that the name is apt and well-chosen.

Parliament and Broadcasting

THE B.B.C. has certainly been getting into hot water lately and, as a direct sequel to Poland's complaint about reference to that country in the New Year's Eve broadcast, a group of M.P.'s have taken upon themselves to demand more effective control of B.B.C. activities in Parliament. In fact, a special committee of M.P.'s is being formed, the idea being to keep a closer watch on the B.B.C. and to agitate for reforms.

One M.P. has put down a motion in the House which is tantamount to a vote of censure. He believes that either the Postmaster-General must take all responsibility for political broadcasts by the B.B.C., or Parliament must tell the world distinctly that the B.B.C. is speaking only for itself as a private concern.

Not a Remedy At All

AS the "Week End Review" pointed out recently, the disability from which the B.B.C. suffers is that it is already too closely identified with the Government of the day, and that foreign listeners persist in regarding views expressed through the microphone as official.

"It is typical of the muddle-headedness of politicians," states the "Week End Review," "that as a remedy for this weakness they should propose a closer identification still. We hope something will be done to educate opinion on this subject, otherwise a Parliamentary stampede may place the B.B.C.'s charter in real danger when it comes up for renewal two years hence."

The Thin End of the Wedge?

THERE does seem to be a definite move to insert the thin end of the wedge into the constitution of the B.B.C., for there is no doubt that politicians are peculiarly disturbed at the growing power and influence of broadcasting, and they feel that it ought to be much more under the thumb of Parliamentary control.

As Lord Allen of Hurtwood recently pointed out in a letter to "The Times": "Mistakes are quite inevitable under any constitution, and it has always seemed to me a little short of a miracle that so few blunders should have been made during ten years by an institution dealing with such a delicate subject as the propaganda of news and opinions. . . If the State were to impose its heavy hand on this delicate area of freedom of thought and opinion, we should see broadcasting either becoming lifeless and without initiative or used as a dangerous instrument by whatever party was momentarily in control of the State."

Hands Off the B.B.C.!

IN other words, common sense opinion of to-day demands hands off the B.B.C. It is quite true the B.B.C. made a mistake over Poland, but Sir John Reith, with his usual tact and diplomacy, settled the matter by paying a personal visit to the Polish Embassy. If the B.B.C. made as many diplomatic mistakes as some of our politicians, there would be some real ground for the hullabaloo which has been set up in the Press.

As it is, Lord Allen of Hurtwood hits the nail on the head when he points out that mistakes are inevitable under any constitution, and that it is little short of a miracle that so few blunders have been made by the B.B.C. during the last ten years.

NEW RADIO

How film-producing tactics are being applied to radio-play production on the Continent is interestingly detailed

By A SPECIAL CORRESPONDENT.

I HAVE seen Gielgud, Howard Rose and Company at work play-producing in the B.B.C. studios. I have seen Longstaffe producing a Christmas pantomime, and I have been with Ridgeway in the production of a "Parade."

With B.B.C. ideas in the back of my mind, I found Continental radio-play schemes amazing, especially as carried out at Cologne.

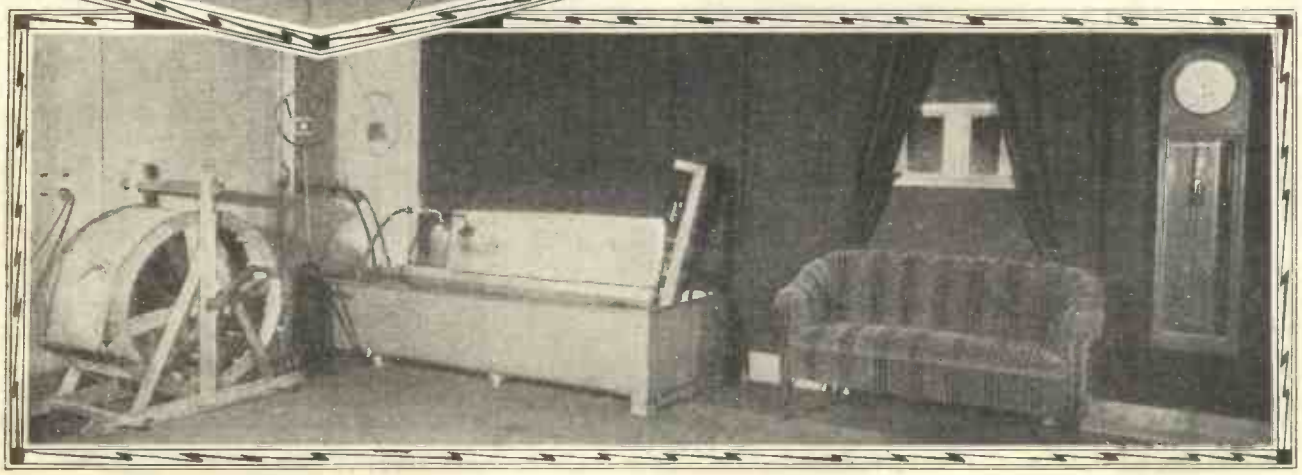
Our radio plays are certainly not so good as they should be. Too many listeners are prejudiced against talk on the wireless, so that they switch off before they have a chance to get the gist of the play that is coming on. In many ways, though, our unpopular radio plays are due to lack of imagination on the part of the producer.

America Behind in Production

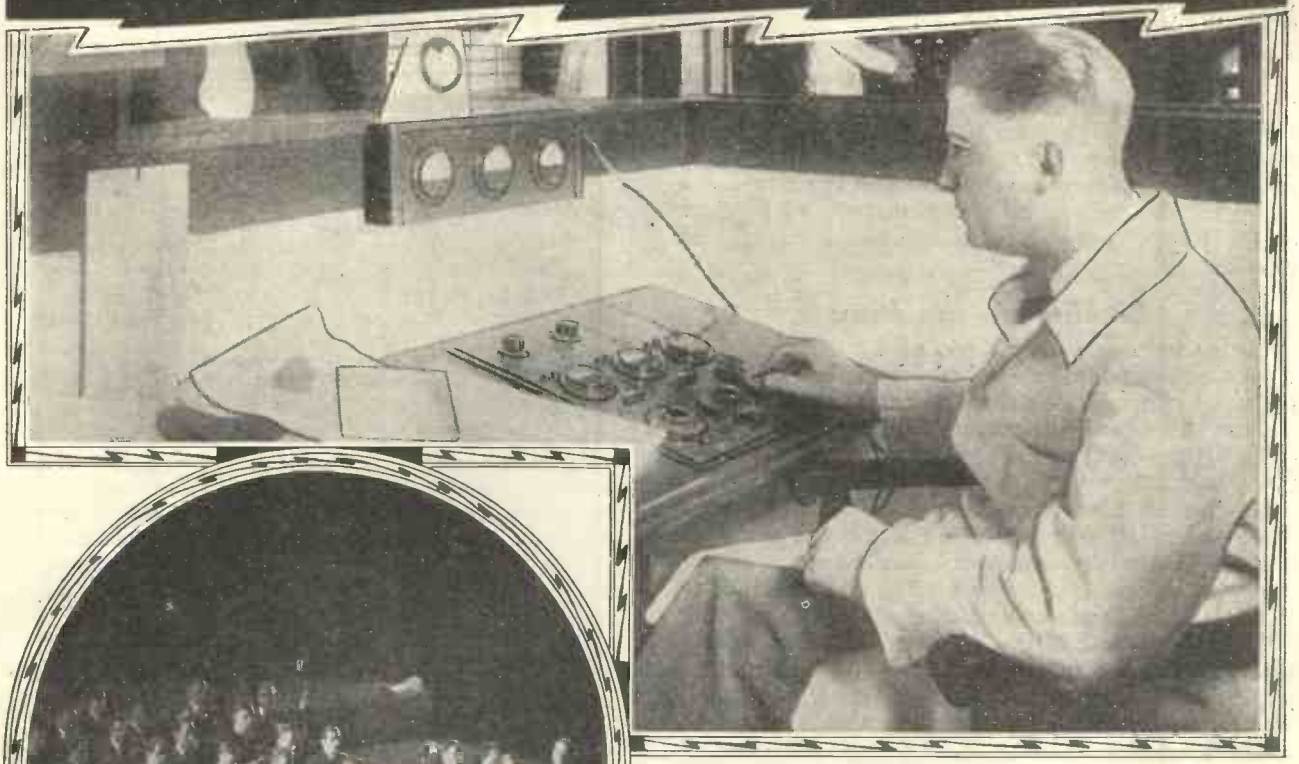
When Cecil Lewis came back from America, having studied studio technique over there, he said quite definitely that the Americans were two years behind us in play producing. Tyrone Guthrie, formerly one of the B.B.C.'s best play men and the originator of that famous play *The Flowers Are Not for You to Pick*, was brought over by a Canadian Broadcasting organisation to produce special historical plays on the other side of the Atlantic.

Canada and America may be behind us in their radio plays, but from a few German microphone sketches which I have heard recently, and which have shown a

The pictures on this page illustrate typical German methods, the top one showing the special studio for experiments maintained by the German State Broadcasting Company. Below it is a scene at the Königs Wusterhausen microphone, during a school's broadcast, which indicates there will be no shortage of trained personnel in Germany. An "effects" studio, with water- and wind-machines, is depicted below, this being part of the Voxhaus Berlin equipment.



PLAY IDEAS ABROAD



The dimly-lit scene in the circle was photographed just prior to some realistic "crowd" noises that were introduced into one successful Berlin production. Above is the control engineer, with his amplifying panel in a sound-proof cabinet, fading out or strengthening the various effects as required by the action of the play.

new kind of technique in that sort of thing, I am beginning to wonder if the Continent cannot teach the B.B.C. something about getting plays "over" successfully.

B.B.C. plays are so impersonal. With recent German efforts there has been a sort of *camaraderie* which keeps the thing going with a swing.

Two Studios for Plays

The Westdeutscher Rundfunk Broadcasting House has two studios specially fitted up for radio plays. This is all the more remarkable, for otherwise this Cologne building is far too small for the immense amount of programme material put over the Westdeutscher circuit.

The two studios are joined by a sliding door which is normally kept open, and semi-circular screens are put round the microphone in each so that although the players can see each other, the microphone in one studio does not pick up speech in the other. At the side of both studios is a little room normally used for the control engineer, but fitted up with a dramatic control panel for the radio-play producers.

There are small windows into each studio, and the producer can so easily signal to the artiste that there is no need for any green light "flicking" arrangement, such as the B.B.C. uses, and this removes one complication of play production.

Music as a Background

There are four knobs on the producer's panel, controlling the volume in the two studios, the volume of the effects from gramophone records, and the fourth acting as a master control on the three subsidiary volume knobs.

While a play is on, an engineer sits at the side of the producer and controls this fourth knob, keeping an eye on the relay peak voltmeter. A relay peak voltmeter is simply a little dial working step by step with the main one at the transmitter, and showing any over-modulation.

The producer doesn't have to worry about this technical snag, and is concerned only with the proportion of volume from the "effects" and his two studios. Music as a background for effect is provided by a quartet sitting out in the corridor leading to the main studio. The fade in and out are done simply by opening and shutting the studio door! A far simpler idea than remote volume controls at the Broadcasting House D.C.P. room!

"Effects" are the Real Thing

Other noises for effects are made, when possible, in the studio, as they have had a lot of trouble in bringing in

Borrowing Production Methods from the Films

effects from gramophone records at just the right moment. Nevertheless, they have quite an expensive library of noise records, many of which have been recorded by the Westdeutscher engineers.

An idea which the B.B.C. does not favour—rightly, I think—is the use of a commenter, who fills in the pauses between the various actions of the play with comments. He takes the place of the captions in a silent film! Often he speaks only a few words at a time, just to convey some movement or action which neither dialogue on the part of the players nor effects records could explain to listeners.

Linking Up the Items

The commenter usually starts off by describing how the scene is laid, and frequently finishes it by reading out the moral. In vaudeville shows he takes the place of the chairman in an old-time music hall, and in this respect he is like the compère of a B.B.C. vaudeville hour, and serves only to link up the items.

He does not have a separate microphone, but speaks closer to one of the shielded microphones in the main studio. There is no echo room, but there is a scheme somewhat on the lines of that tried in the Children's Hour studio at Broadcasting House.

There is one wall of the main studio covered with a hard stone surface imitating marble. Curtains can be pulled over this, and it is rather surprising what a difference there is in the echo in the studio when the curtains are closed or pulled apart.

The Typical Film Producer

The curtains are on silent runners so that even while the players are speaking, echo can be brought into the studio by pulling a rope and disclosing the marble-like walls.

When any big play is on—and major productions appear once a month—a gramophone record is switched on to one of the first modulator amplifiers in the control-room,

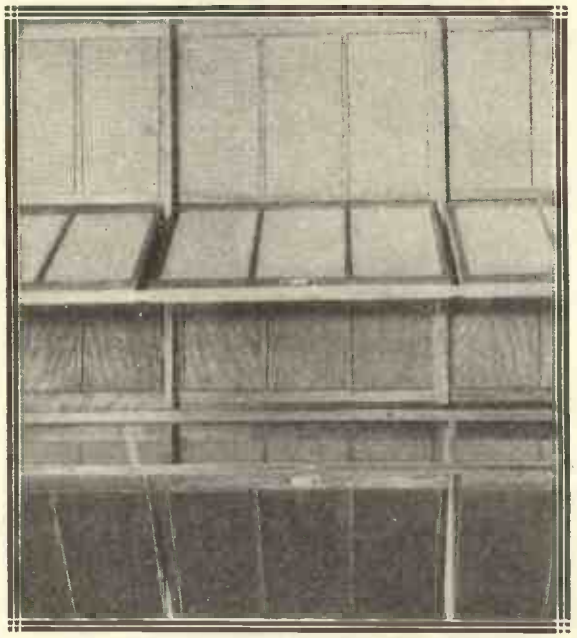
DURING THE BROADCAST

This is not a rehearsal photograph; it was taken in one of the London studios during a recent broadcast, the soloist being Florence Smithson.

and a full-length record is made of the play. This is necessary for copyright reasons in Germany, but also acts as a guide to the producer.

Where the intimate touch comes into the production is that the producer can see the artistes while they are at work, and can come out of his little control panel box

"THE WALLS HAVE EARS"



Owing to the different echo effects introduced by various wall surfaces, this German studio has an ingenious method of using either a wooden-panelled wall or—at the touch of a switch—a cellotex surface.

and make them move to where they should be with respect to the microphone. Doctor Hardt, the station director, has engaged a play producer who was previously in the film world, and who still wears the uniform of a film producer—plus-fours, pullover and a white coat! During rehearsals he dashes continuously from the control room, where he hears the production on 'phones, to the studio, where he vigorously puts the artistes through their paces.

Human Touches in Broadcasting

When the play is in progress he is just as active, but does the whole thing in dumb show—and very well, too. In contrast, while a B.B.C. play is on, the producer is in the D.C. room three floors away and lets the artistes know when the effects are coming in by flicking a green light in each studio.

To anybody who has seen one of these plays in production there is something mechanical about it, which seems to be a disadvantage after the human touch of the Continental play-producing.

COMBINING CARRIERS

by SIR AMBROSE FLEMING F.R.S.

It is no exaggeration to say that the whole future of broadcasting depends on the development of adequately selective receivers. Our distinguished contributor has characteristically original views on the problems associated with achieving high selectivity, and you will be stimulated by his comments thereon.

IN January, 1930, the writer of this article initiated a discussion in the scientific journal "Nature" on the so-called waveband theory in radio reception.

(See "Nature," January 18th; February 8th, 22nd; and March 1st, 1930.) In this discussion several leading physicists took part.

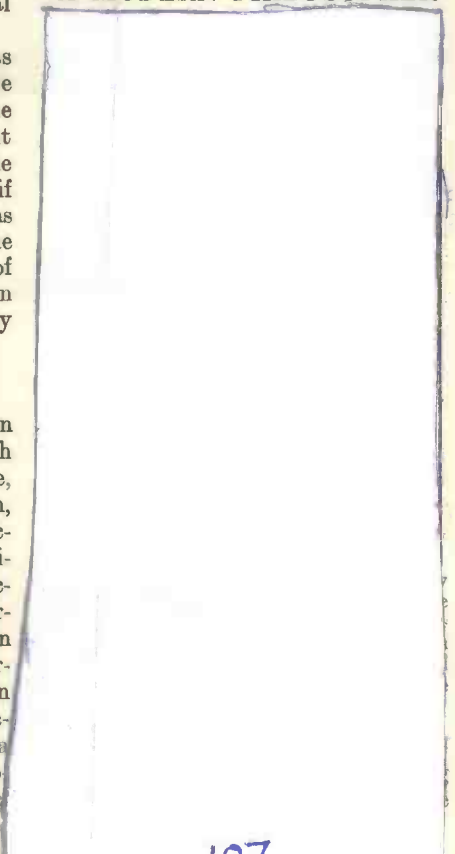
The chief question at issue was whether a modulated carrier wave must necessarily be taken to be the sum of two carrier waves of different frequency, and that therefore the receiver must not be too selective if it is to pick up the range of modulations differing in frequency perhaps to the extent of 9 or 10 kilocycles. Most of the contributors to this discussion seemed to be convinced of the validity of this waveband hypothesis.

Down to Fundamentals

A pamphlet has recently been published by the Radio-Research Board (H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, price 1s. 3d.) with the attractive title: "A Theoretical and Experimental Investigation of High Selectivity Tone-Corrected Receiving Circuits." This led us to believe that in it we might find some decisive information on the above question in dispute, viz., whether a highly selective receiver is less adapted than a not very selective one for the reproduction of orchestral or choral music.

But it must frankly be said that the contents of this official publication are disappointing. The author or authors evidently possess great knowledge and information on radio matters, but they do not seem to have

A MODERN PHILOSOPHER



information which will help radio constructors to discover the structure of receivers which will effect the best all-round reception.

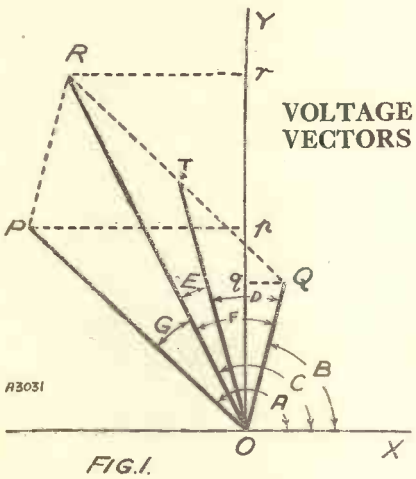
The booklet is sprinkled with mathematical formulæ, but proofs are not given. It may be useful, therefore, to supply a detailed proof of the formulæ 3 and 4 in that booklet, for the sum of two simple harmonic oscillations of different frequency and amplitude, as some readers might find a difficulty in ascertaining it for themselves.

Detailed Proof

Let $e_1 = E_1 \sin 2\pi Nt$ be one oscillation and $e_2 = E_2 \sin 2\pi nt$ be the other. We know that these can be geometrically represented by the projections on one axis of two vectors or lines revolving round a common centre at their ends. Let OP and OQ (see Fig. 1) be these vectors and OR the diagonal of the parallelogram POQR. Then the projection Or of OR on OY is equal to the sum of the projections of OP and OQ or Or = OP + Oq (see Fig. 1). Let the angle POX = A, QOX = B, ROX = C, POQ = 2D, ROT = E, QOR = F, and POR = G, where OT is the bisector of the angle POQ. Hence QOT = POT = D. Hence we have 2D = A − B, C = B + F, or $C = B + D + E = \frac{A+B}{2} + E$ and E = D − G.

"What is Required is Not Inexact Selectivity"

Then since Or=OR *Sin* C and Op=OP *Sin* A and Oq=OQ *Sin* B, we have the equation OR *Sin* C=OP *Sin* A+OQ *Sin* B - - (1)



VOLTAGE VECTORS

FIG. 1.

Two adjacent stations produce voltages across the detector of a receiver, e_1, and e_2, which can be geometrically represented by revolving vectors.

Now $(OR)^2=(OP)^2+(OQ)^2+2OP.OQ\ Cos\ 2D$ - - - - - - - (2)

or $OR=\sqrt{E_1^2+E_2^2+2E_1E_2\ Cos\ (A-B)}$ (3)

Hence $E_1\ Sin\ A+E_2\ Sin\ B=\sqrt{E_1^2+E_2^2+2E_1E_2\ Cos\ A-B}\ Sin\left(\frac{A+B}{2}+E\right)$ - - - (4)

Where E is an angle such that

$$tan\ E=tan\ (D-G)=\frac{tan\ D-tan\ G}{1+tan\ D\ tan\ G} \quad (5)$$

The Two Amplitudes

Let us then redraw the Fig. 1 as in Fig. 2 and let RS=y and SP=x. Then it is clear that y/x=tan 2D, and $y/(x+E_1)$=tan G and $y\ (x+E_2)$=tan D. Inserting these values in equation (5), we find easily that

$$\tan E=\frac{E_1-E_2}{(x+E_1)+\frac{y^2}{x+E_2}}\tan D \quad (6)$$

But $y/x=\tan 2D=\frac{2\tan D}{1-\tan^2 D}$ - (7)

and eliminating y and x between equations (6) and (7) leads to the result

$$tan\ E=\frac{E_1-E_2}{E_1+E_2}tan\ D \quad (8)$$

This gives us the angle E in terms of the two amplitudes E_1 and E_2 and the angle between these vectors. Hence the result of adding together two simple harmonic oscillations of different amplitudes and frequencies, viz., $e_1=E_1\ Sin\ 2\pi\ Nt$ and $e_2=E_2\ Sin\ 2\pi\ nt$ is to produce a modulated oscillation given by the expression

$$\sqrt{E_1^2+E_2^2+2E_1E_2\ Cos\ 2\pi\ N-nt}.\ Sin\ 2\pi\left(\frac{N+n}{2}t+E\right) \quad (9)$$

Where the square root term is the amplitude of the fluctuating modulation of frequency, N—n and the frequency of the carrier wave is altered from N to (N+n)/2.

The formula is somewhat simpler if we make the amplitudes E_1 and E_2 each equal to unity, for then since $1+\text{Cos A}=2\ \text{Cos}\ \frac{2A}{2}$ it follows that $\sqrt{2+2\ \text{Cos A}}=2\ \text{Cos}\ \frac{A}{2}$ and since when $E_1=E_2$, we have *tan* E=O, we arrive at the equation:

$$Sin\ 2\pi\ Nt+Sin\ 2\pi\ nt=2\ Cos\ 2\pi\ \frac{N-n}{2}\ t\ Sin\ 2\pi\ \frac{N+n}{2}\ t$$

or—which comes to the same thing—$\frac{1}{2}\ Sin\ 2\pi\ (N+n)t+\frac{1}{2}\ Sin\ 2\pi\ (N-n)t=Cos\ 2\pi\ nt.\ Sin\ 2\pi\ NE$ - - (10)

It will be seen from equation (9) that two simple harmonic vibrations of different amplitude and frequency combine to produce a modulated vibration of which the frequency depends on the component frequencies, and alters with the amplitude of the audio vibration. We maintain, however, that this modulated wave travels through space *as* a modulated wave, and does not split itself up into two separate carrier waves of different frequency and amplitude. The receiver has to absorb it as a whole, and if the reproduction is not perfect it is because the receiver cannot follow exactly the rapid variations of frequency or amplitude or wave form in the modulations when these are very brief, and moreover the constituent sounds tend to persist in the receiver and telephone after they have ceased in the concert-room.

ADDING FREQUENCIES

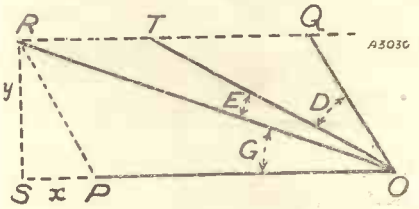


FIG 2

The diagram of Fig. 1 may be redrawn in the simplified manner above, thus showing the result of adding two different frequencies of dissimilar amplitude.

What is required in the receiver is not inexact selectivity, but great nimbleness or response to brief, rapid, ever-varying modulations.

LISTENING TO LENINGRAD

A reader's letter describing an interesting test.

The Editor, MODERN WIRELESS.

Sir,—In the January "M.W.," under the heading, "On the Long Waves," appears a remark about Leningrad testing.

At 06.00 hours G.M.T., January 11th, I picked up a carrier wave on 835 m. approx. This was a telephony station transmitting a metronome beating at 60 per minute, each alternate beat being more pronounced than the other. Every minute a call sign in Morse—TTE—was superimposed, the note being made by a high-frequency buzzer.

At 06.30 hours a feminine voice commenced announcing, in which the two words "Leningrada" and "Radiograma" were constantly repeated.

Yours faithfully,

C. PIPER.

Bushey Heath, Herts.

Is the S.G. DETECTOR worth while?

by M.G. Scroggie, B.Sc. A.M.I.E.E.

Most experimenters have decided opinions as to the suitability of the S.G. valve in the detector socket. Not a few whole-heartedly condemn it, but they may hold different views after reading this easily-understood, expert survey of the advantages conferred by the S.G. detector.

AT one time—not so very long ago—all the valves in a set were the same. They were all triodes—that is, bottles with three things in them—filament, anode and grid—one of each.

Signs of Surrender

Then it was found that for high-frequency amplification much better results were obtainable by putting an extra grid into the valve, and soon no other sort was used for the purpose. Then a valve with two extra grids, the pentode, began to displace the output valve, and has largely succeeded.

The last stronghold of the original simple valve is the detector socket, and now that shows signs of surrendering to modern tendencies. Several of the most prominent radio manufacturers are offering sets without a single triode in them.

What's the Advantage

Is there any practical advantage in using a screened-grid valve as a detector? Some of those who have tried say No. But perhaps that is because they have not adapted the set to suit it. It is not just a case of taking one valve out and plugging the other in.

There are two principal claims in favour of the S.G. valve as a detector. Neither of these, strictly speaking, has anything to do with its "detecting" ability, which is much the same as that of any other valve.

Ten Times as Great

And yet they are useful features for a valve in the detector position, which we must remember amplifies as well.

The first is that the amplification factor is much higher than that of any other type of valve; roughly about ten times as great. It is true that it is not easy to extract all this amplification and put it to use; but it is there waiting for a little ingenuity to call it forth, and we do not have to get nearly all of it to be ahead of others.

Upsetting the Input

That concerns the low-frequency side of the receiver. The other advantage affects the high-frequency circuits, and is perhaps a little more difficult to understand.

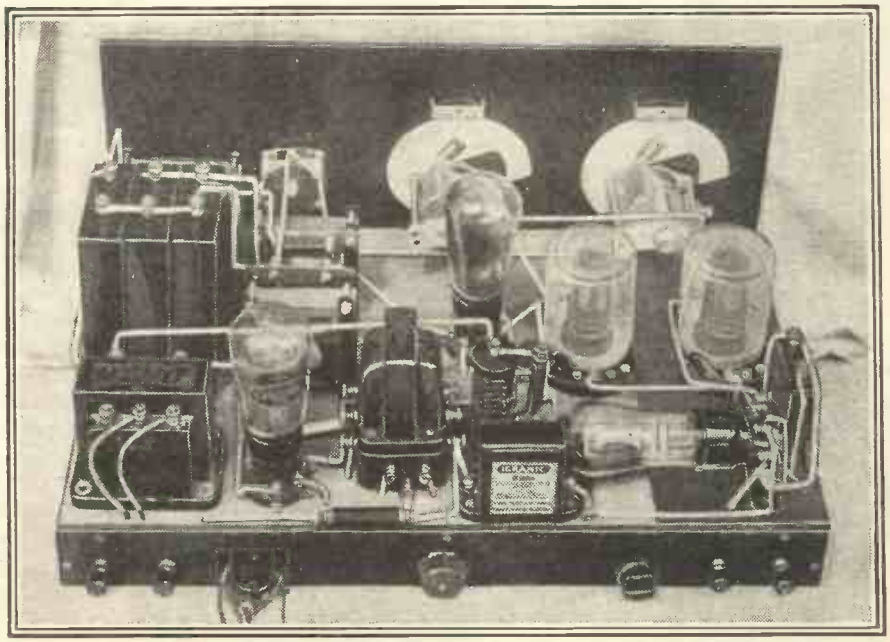
Anyone who has grasped the object of using a screened-grid valve as a high-frequency amplifier should see it quite easily. The extra grid is placed between the input and the output to prevent the amplified output from working back through the valve and upsetting the input circuits.

The upsetting effect in the case of an H.F. valve takes the form of uncontrollable oscillation which renders it impossible to use the set at all effectively. The detector does not make its evil effects so obvious, but they are there all the same.

Damping versus Selectivity

There are, in fact, two evils. One is that resistance, loss, damping—call it what you will—is thrown into the tuned circuit in front of the detector, weakening reception and spoiling selectivity. If there is a reaction control this effect can be overcome—but it is better not to have to overcome it, for it

NOT AS SIMPLE AS ALL THAT



To secure the full advantages of the S.G. detector, the circuit must be specially designed to suit its particular requirements. It would not, for instance, be advisable merely to remove the detector valve in the photograph above and substitute for it an S.G. valve.

There is No Difficulty if Transformer Coupling is Adopted

is very difficult to get back all that is so lost. Besides, many modern receivers have no reaction control.

The other is that the tuning is shifted a little. That is quite unpleasant in a gang-controlled set, for the circuits are thrown out of true, and again range and selectivity are lost.

The higher the amplification of an ordinary triode valve the worse are the effects, so that many experimenters are disappointed with the latest valves having amplification factors of 80 or 90, and find they are scarcely as good as those rated at 30 to 40.

Theory and Practice

That is just where the S.G. valve is really helpful. In spite of its extremely high amplification, these undesirable effects are entirely avoided. But unless it is properly used these theoretical advantages are not obtained in practice. Let us see, then, how to use it.

For some unaccountable reason the S.G. valve detector is usually thought of as the anode-bend type. It is difficult to understand why, for

THAT EXTRA ELECTRODE

The development of the screened-grid valve has ousted the triode from the H.F. amplifiers of most receivers. Will the S.G. usurp the three-electrode valve's present monopoly of the function of detector?

the grid-leak type is much better in every way.

Quite ordinary values are suitable for the grid condenser and leak—0·0001 mfd., and 1 megohm or thereabouts. When we come to the method of coupling it to the next value things are not quite so simple.

Resistance Coupling

Ordinary transformer coupling gives tremendous amplification and very poor quality of reproduction. By connecting a resistance of about 50,000 ohms across the primary of the transformer the quality is improved, and although the amplification is cut down, it is still better than that obtainable with the best triode.

The lower the shunt resistance the better the reproduction and the lower the amplification. At the worst the amplification is so high that there should never be another valve in between the detector and the output valve.

In fact, if you are using a very efficient power valve or pentode you may find all the amplification that you need, using resistance coupling. The amount saved in components will then cover the cost of the more expensive valve.

But resistance coupling is not recommended unless a fairly large H.T. voltage is available. To get a reasonable proportion of the valve's amplification a rather high resistance coupling is required, and that needs volts to push the current through it.

If only 100 volts or so are on tap, a resistance-coupled S.G. valve is likely to prove disappointing. But with the 250 volts that can usually be drawn from a mains-driven set, or even a 180-volt battery, resistance coupling is an excellent and economical method.

The Best Values

A 100,000-ohm anode resistor—more or less according to the available volts—and a 0·5-megohm or 1-megohm leak to the grid of the next valve, with a 0·01-mfd. coupling condenser, are about the best values.

The screen grid is important. It must be connected to filament or cathode through a large-capacity condenser—1 mfd. is advised. And it must be run at a voltage *less* than that of the anode.

There is no great difficulty if transformer coupling is adopted, because the voltage actually at the anode of the valve is very nearly as much as that applied. But a resistance coupling drops a large proportion of the total H.T. voltage, and leaves the anode with a mere residue.

If the H.T. is 200 volts, less than 50 are likely to reach the anode through a 100,000-ohm resistor, so the screen voltage should be about 35; perhaps less with a low-impedance valve. Unless the best voltage is found by trial, results may be very poor.

SOME PRACTICAL ADVANTAGES

1. **Amplification nearly ten times as great as that of any other type of valve.**
2. **In spite of this high amplification, the S.G. reduces damping and so strengthens reception.**
3. **Consequently selectivity is increased as well as range.**
4. **There need never be another valve between the detector and the output valve.**
5. **With high H.T. voltages available, a pentode can be used with plain resistance coupling.**

Usually Worth It

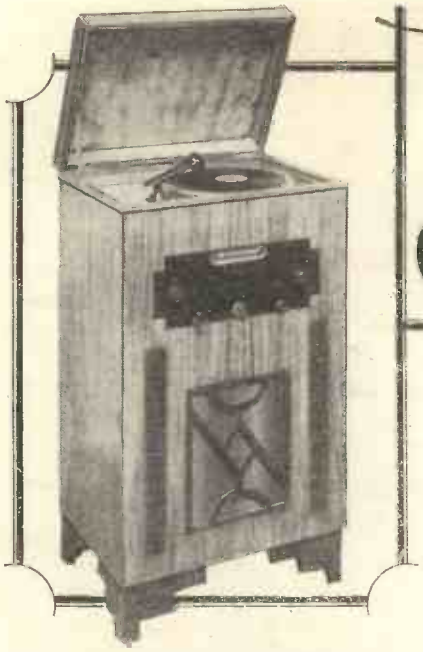
So you see that a little extra trouble is involved in getting the best out of this type of valve. But it is usually worth it.

The usual capacity reaction can be applied, and it is advisable to use a differential condenser. It is generally found that a considerably smaller capacity than usual is enough, owing to the absence of valve damping.

If no reaction is used (and it is not nearly so necessary as with a triode detector), connect a condenser of about 0·0002 mfd. from anode to cathode.

The grid leak can be connected to cathode, or to + L.T. in battery valves, but if you are *very* anxious to get all that is going, a potentiometer control is a valuable refinement.

With a little care as to the details there is no doubt that an S.G. valve can be made to outshine the best performance that a triode can put. Whether it is worth while it is for you to judge.



THE "MU-GRAM"

An UP-TO-THE MINUTE RADIO-GRAM FOR THE Home Constructor

THE variable-mu valve has certainly come to stay, at least, until a system of volume control that is better is found, and it will be difficult to devise a scheme that will beat it. Both mains and battery sets are concerned with this type of valve, and it is not easy to overrate the advantages that ensue from its use.

To be able to control the input to the detector valve from full volume to a whisper, or even less, is not an advantage to be sneezed at, and this the variable-mu valve enables us to do without in any way upsetting the tuning of the set or causing distortion.

The mains variable-mu valve is particularly efficient in its operation, giving excellent control throughout; it is the battery valve that has one slight fault in its working. It is this. When normally used some distance from a station, a 9 volt bias battery across the control potentiometer is ample to give perfect control, but when nearer to a station it is often necessary to employ a battery of 16 volts.

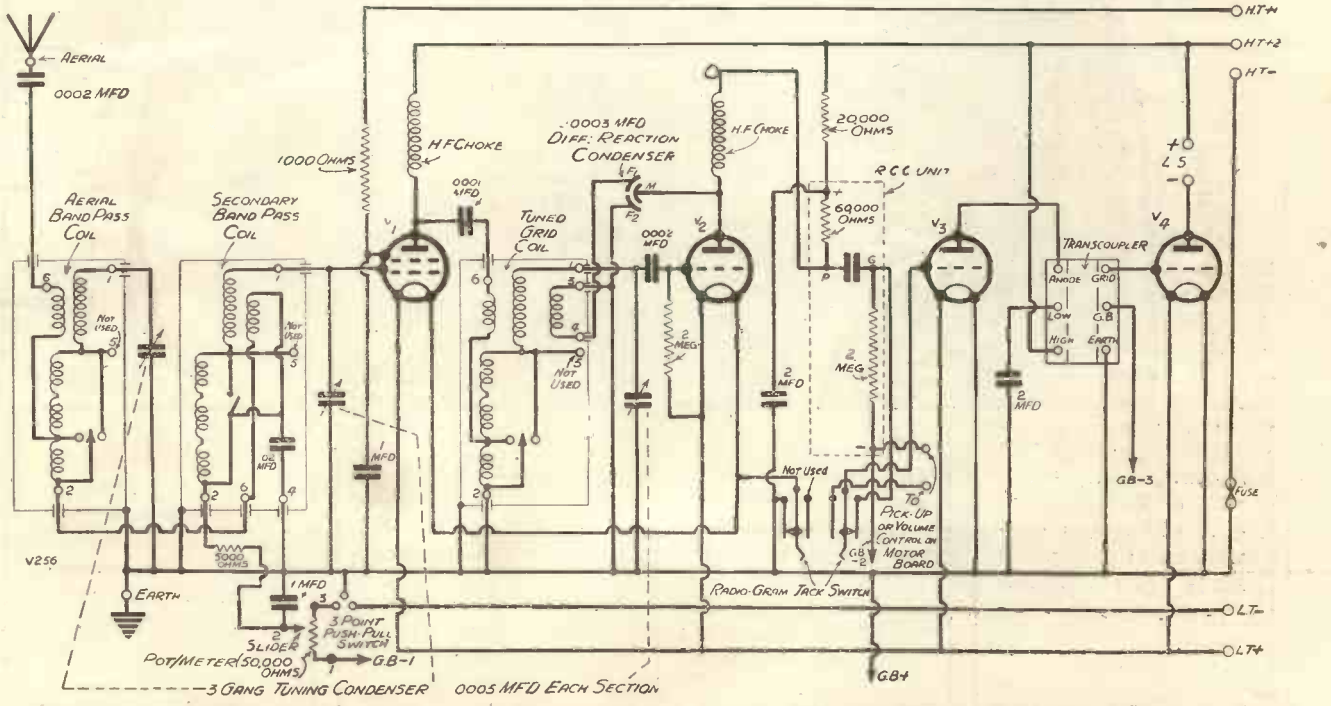
Alternative Arrangement

Sometimes it is not even possible with 16 volts to bring the local down to such a strength that no L.F. valve overloading, with its consequent distortion, takes place.

In such a case things are rather awkward to control, for an increase in battery voltage makes it rather critical in control over weaker stations than the local, while overloading must be avoided at all costs.

Naturally, a second volume control, across the L.F. side of the set, can be used, but two volume controls to carry out one task is rather clumsy, isn't it? There is a scheme that we have developed which overcomes the trouble, however, and in the set to be described here we have given it as an alternative arrangement in the variable-mu valve control.

Band-Pass Tuning—Variable-Mu S.G.—Two L.F. Stages



A powerful four-valve circuit featuring all that is latest in receiver design. High selectivity, variable-mu S.G. stage, R.C.C. coupling, and provision for gramophone reproduction are among the noteworthy features.

Three-gang condenser unit with trimmers for matching-up the circuits. Each section is completely screened, thus ensuring freedom from instability troubles in operation.

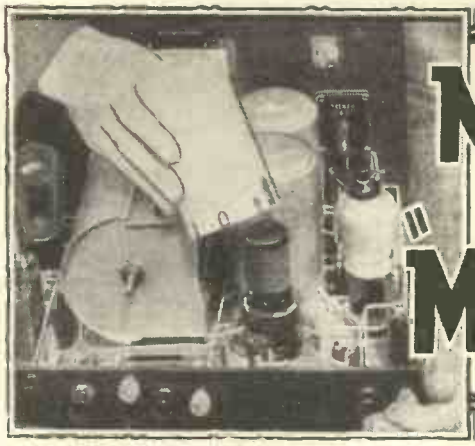
A variable-mu S.G. high-frequency stage is included. This arrangement provides ideal volume control, as it prevents overloading of the initial stages in the set.

A straight-line tuning scale of the illuminated type, which gives great precision in tuning. It has a very handsome front-of-panel appearance and gives the final touch to the set.

The variable-mu control, which by the use of a special split potentiometer can be wired so that the mag. of the detector is reduced if adequate control cannot be obtained on the S.G. stage alone.

This special L.F. coupling unit includes a parallel-fed transformer and the associated resistances and condenser. This arrangement results in exceptionally high quality reproduction.

There is provision for gramophone reproduction, the movement of this single jack making all the circuit changes that are required. The pick-up is left connected permanently to the appropriate terminals.



Making the "MU-GRAM"

BEFORE dealing with the construction, let us explain a little further about the volume-control scheme. We have not incorporated it in the main wiring of the set because it is in only comparatively rare cases that it is necessary to use any aid to the variable-mu control; cases where the location is very near to a local station.

The scheme is shown in one of the photographs and in a special sectional wiring diagram, and briefly consists of this: The variable-mu control potentiometer is divided into two halves—in other words, a split potentiometer is used and the variable-mu valve is controlled over the passage of one section by the slider in the usual way, while as soon as the slider comes over into the second section it begins to decrease the amplification of the detector by lowering the effective resistance of the anode circuit.

Tonal Balance

This method is one that in the normal way would not be used as a volume control, for the decrease of the amplification is not a straight line, the higher frequencies being reduced more than the others, but as in the normal state of affairs, the low notes are lost in volume reduction (or they are apparently reduced first according to the effect of power reduction as applied to the ear via a speaker) before the high notes, so the earlier diminishing of the high notes tends to maintain a balance in the reproduction. That this balance is only apparent, and not real, we are ready to admit, and we would not recommend the scheme as an ordinary volume control in every case, but in the instance of the insufficient control provided by the variable-mu valve when close to the local station, the system is both simple and convenient. Naturally, on distant transmissions it will be unnecessary to go over to the second half of the potentiometer, and so the L.F. volume reduction will not be used, all the control required being supplied by the variable-mu control.

Circuit Details

In cases where the set is to be used some way from the local station (say some 15 to 20 miles or more), the more ordinary method of control should be used, there being no auxiliary control of the L.F. end of the set. This is the method that is shown in the main wiring diagram, the double control being shown in the small diagram on page 114.

And now a few words about the circuit in general. It is a band-pass circuit, connected between the aerial and the variable-mu valve, which latter is transformer-coupled to the detector, this being so arranged by the Varley coil unit that auto-tapped transformer coupling is applied on the long waves, while on the medium waves the transformer coupling is employed.

New Tuning Scale

From the detector we go via a resistance capacity coupling to the first L.F. valve, and thence through a shunt-fed transformer coupling to the output valve. Jack switching is used to provide a break in on the grid of the L.F. valve for pick-up, and the switch also controls the filaments of the detector and screened grid valves, so that when the pick-up is in use, the two preceding valves are turned out.

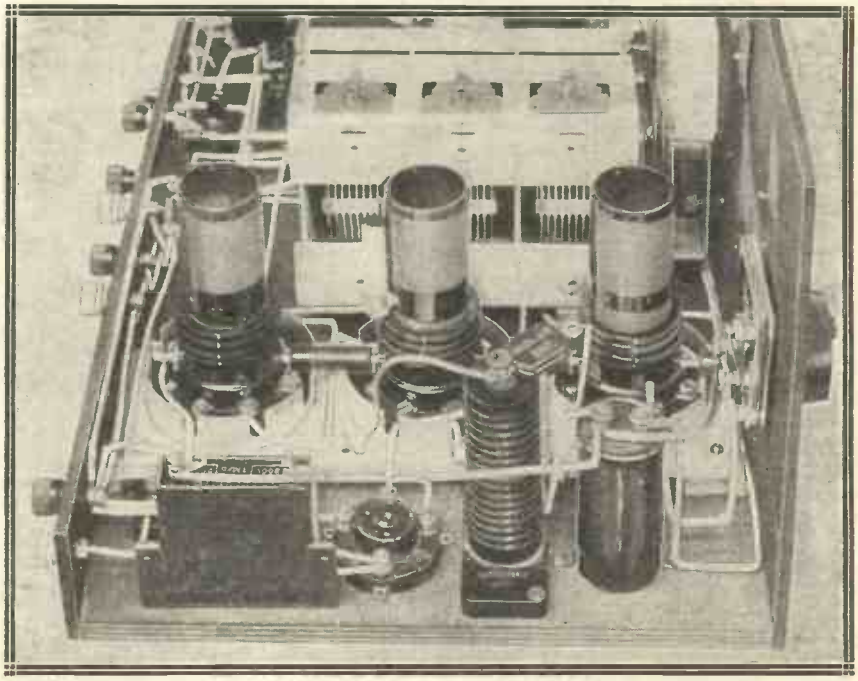
A triple gang condenser is used for tuning, while the new type of straight scale reading makes it very easy to manipulate. Decoupling is arranged for on the screening-grid feed and by means of the special terminal on the transcoupler for the first L.F. stage. Also the detector anode is decoupled in the usual way.

Compact Layout

The rest of the circuit is straightforward in every way, and there are no tricky snags that will be come against when the set is being built. In fact, this procedure is quite easy, if care is taken, although the whole outfit is very compact and no space is wasted.

The variable condenser is mounted

A GANGED CONTROL SIMPLIFIES THE TUNING



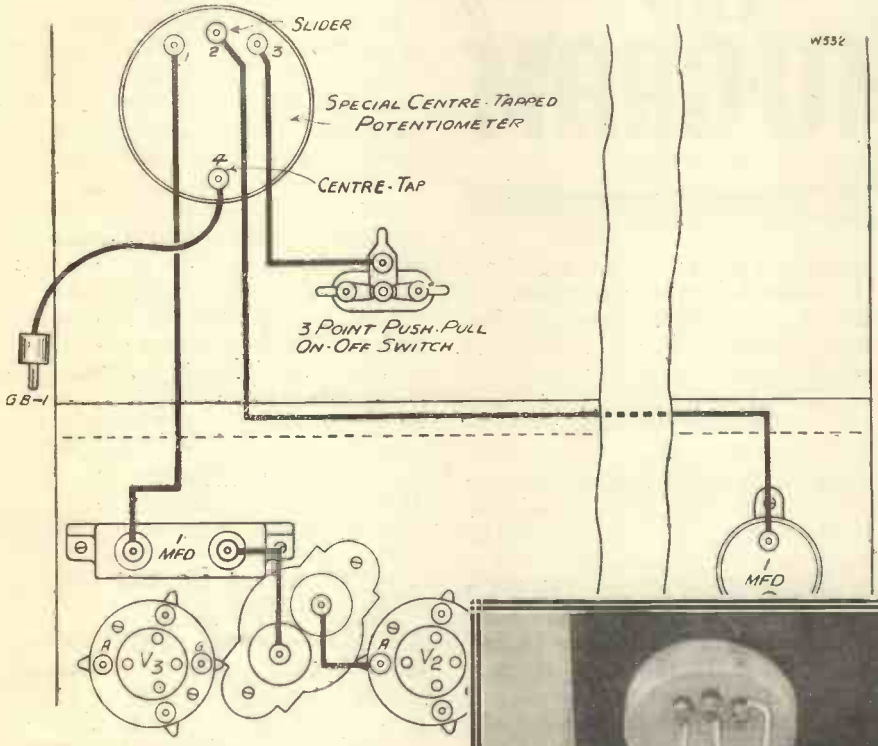
All three tuned circuits are matched up and controlled by one knob, accurate ganging being obtained by adjustment of the small trimmers seen on top of the three-section condenser unit.

by means of the special feet and brackets supplied by the manufacturers, and this enables the trimmers to be upright and easily accessible. Incidentally, very little trimming was necessary with the original receiver.

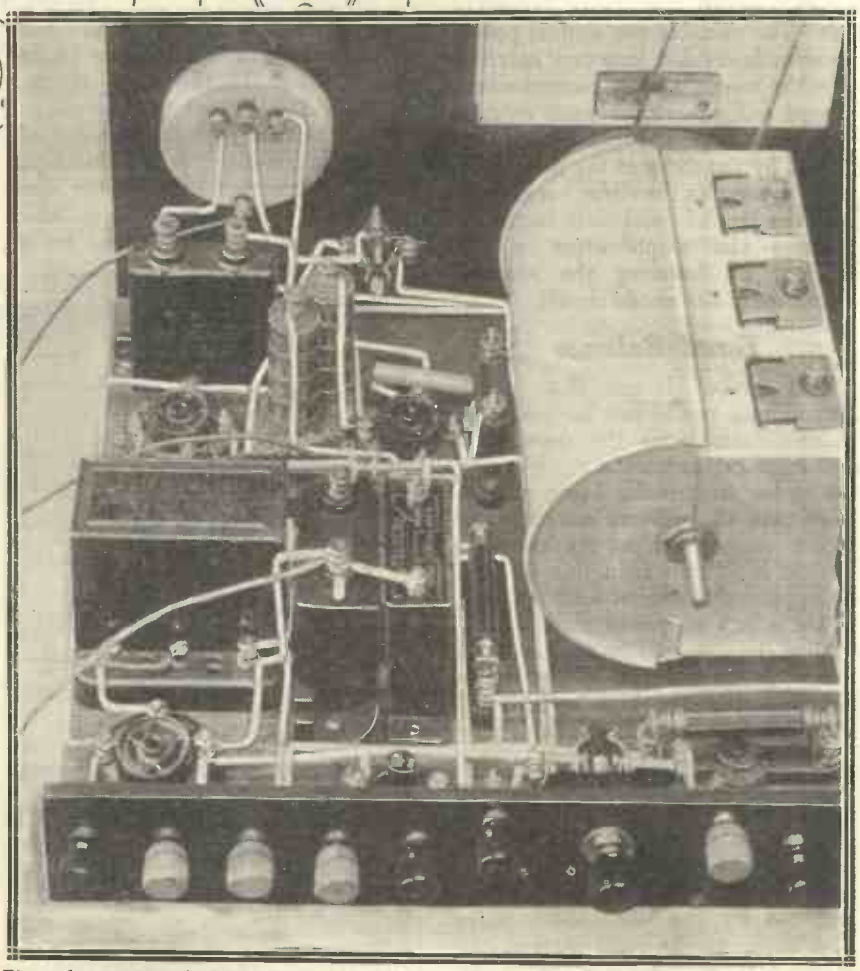
Similarly, the vexed question of alternative coil and transformer connections is bound to crop up—it does so with practically every set. In fairness to readers who want to read about the particular set instead of building it, we cannot fill up a lot of room with extra diagrams or descriptions showing how A's " trans-coupler-former " can be wired up in the place of B's " former couple " or C's "trans " something else.

The fact remains, however, that there is no standard of terminal *marking*, let alone positioning in these new components, and so unless leaflets are provided with the various components showing clearly how they may be used *in the place of another make*, it is going to be difficult for the set-builder.

WIRING UP THE SPLIT POTENTIOMETER—



—IN THE SET



The volume-control potentiometer is in two sections. The first half works as a normal variable-mu control, while the remaining portion is brought into use if it is necessary to reduce the amplification of the detector stage as well.

One thing is important, and that is that lengths of wire should be soldered to the fixed vanes of the condenser sections before the condenser is mounted on the baseboard, otherwise it will not be possible to connect these up after the condenser is in place. These leads are for connection to the tuning coils, whose gang assembly runs alongside the condenser unit. Don't forget, too, to add the lead which goes from the fixed vane tag of the section of the condenser nearest the panel to the ·0002-mfd. T.C.C. condenser by V_2, for this lead also runs underneath.

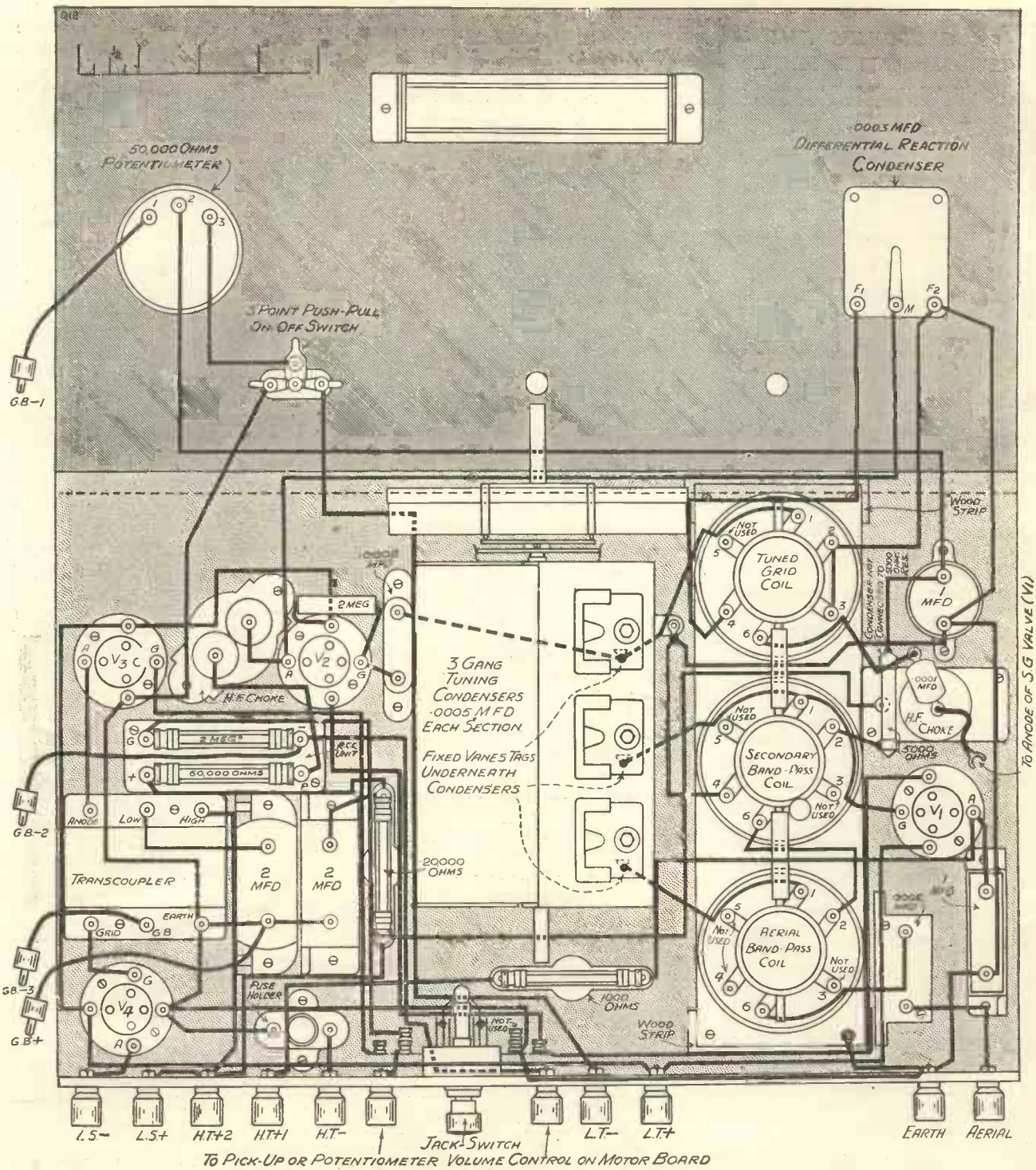
Improving Appearance

Note that a wooden batten or strip is used to raise the metal base of the three-coil unit, so that the knob on its spindle for wavechanging is in line with the tuning-control knob and the on-off switch. It is a point that makes no difference to the operation of the receiver, but it does a whole heap to improve its appearance.

As regards components, the alternatives given in our list have been carefully worked out, for in a compact design like this there are inevitably many otherwise suitable makes of

Specifying Alternatives

A far worse state of affairs exists in the coil world. Here there are coils with winding arrangements quite as suitable for a certain set (I am not discussing this one particularly), and yet we cannot specify them because not only are the relative terminal positions of the two (or more) coils different from one another, but the



The black lines connecting the various terminals show how the "Mu-Gram's" components are wired together.

marking of the terminals does not correspond throughout.

It is a ridiculous state of affairs. True, certain makers give leaflets away with their coils, showing how the windings are arranged, but this is not always the case, and it is not always sufficient to allow the home constructor to replace the specified coil with another "just-as-good" alternative. Therefore, we cannot give all the makes that can be used (with certain wiring modifications) in our list of alternatives.

A Safeguard

This will no doubt militate against some of the sets being built—many will say, "I should have built that, but I want to use a '——' coil I have on hand, and as it is not listed in the alternatives, I suppose it is not suitable."

In such cases, where you have doubt as to the suitability or otherwise of a certain component for a particular set, why not drop our Query Department a line, telling them the make and type of component and asking their advice, and/or for a diagram showing how the component can be used? It will clear up any doubts you may have and it will safeguard you from using something that may not be suitable, and which may ruin the operation of the set.

ACCESSORIES AND RECOMMENDED MAKES

Loudspeaker. — Celestion, B.T.H., Blue Spot, Baker's Selhurst, G.E.C., Ferranti, Marconiphone, W.B., Lanchester Ormond, Igranic, Clarke's Atlas

Batteries.—H.T.: This should be of ample size to deal with the requirements of the valves chosen. Pertrix, Magnet, Ediswan, Lissen, Ever Ready, Drydex, Marconiphone.

L.T. Accumulator.—Ediswan, Exide, Lissen, etc.

G.B.: One 16½-volt. See above list.

Pick-up.—British Radiophone, Marconi, Audak, Bowyer-Lowe, Celestion, Bulgin, Blue Spot, Varley.

Gramophone Motors. — Garrard, Junior, Collaro.

Mains Unit.—This should have two plus tappings, with output to suit valves chosen. Atlas, Ferranti, Regentone, Ekco, Tunewell, Heayberd, R.I.

Aerial and Earth Equipment.—Electron "Superial," Goltone "Akrite," Graham Farish "Filt" Earthing Device.

An important feature in the circuit of the set is the 5,000-ohm resistance in series with the slider of the variable-mu control potentiometer. This resistance is inserted to prevent the band-pass condenser being short-circuited when the potentiometer is turned to full volume.

Using a Pick-Up

When using a pick-up, it is, of course, desirable that a volume control be employed, and this must be fitted with the pick-up on the motor-board of the radiogramophone unit. The volume control on the set does not control the receiver when switched over to gramophone.

It may be argued by some that the pick-up switching arrangements should be controlled from the panel or the motor-board of the radiogramophone. Such is undoubtedly the desire of many set owners, but the receiver described herein was designed more for a dual purpose than as a radiogramophone pure and simple.

Clean Panel Layout

It is, in fact, a radio receiver with pick-up switch that is specially suited for inclusion in a standard type of radiogram cabinet, the lay-out being arranged so as to give as clean a panel as possible. The switch jack for the pick-up is easily operated, even if it is at the back, for the plug part does not pull right out, giving no awkward trouble in replacing, as would be the case if an ordinary jack were employed. It can be reached round the side or over the top of the cabinet with the greatest of ease.

If the set is used separate from the gramophone cabinet, the switch and pick-up terminals are particularly well placed.

The construction of the set will present no difficulties if the few points already raised are carefully considered, and it will not be long after commencement that the set will be complete and ready for test.

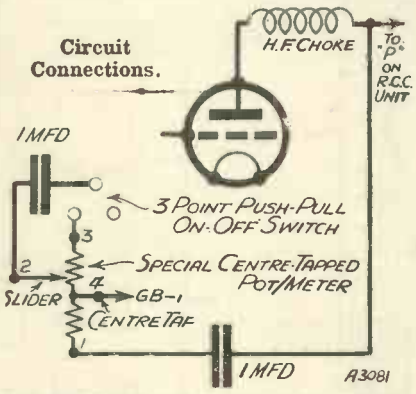
A Point to Watch

A few words to those who desire to use the "Mu-Gram" as an ordinary set with pick-up mounted on a separate motor-board. In this case it is advisable not to have the leads between the set and the pick-up longer than can be helped, especially if electric light mains are present in the house.

Long leads are apt to pick up stray noises such as mains hum, and are greatly to be deprecated. In any case it is an advantage to use the new pick-up shielded flex in all radiogram receivers for the pick-up connections.

One thing you may not have noticed unless you have studied the photographs carefully, and that is the fact that the pick-up terminals are mounted on the terminal strip at a higher level than the other terminals. This is to clear the pick-up jack-switch arms which run along just behind the terminal strip.

ADDITIONAL CONTROL



The theoretical conception of the double-control scheme illustrated in practical form on page 114.

THE PARTS EMPLOYED AND SUGGESTIONS FOR SUITABLE ALTERNATIVE MAKES

PANEL
1 16 × 8 in. (Permcol, Goltone, Direct Radio, Peto-Scott, Wearite, Becol, Lissen).

BASEBOARD
16 × 10 in.

CABINET
Adaptogram (Peto-Scott).

VARIABLE CONDENSERS
1 3-gang ·0005-mfd. (Utility Standard with protective cover, and feet for mounting).
1 Straight Line Dial (Utility).
1 ·0003-mfd. Differential Reaction (Telsen W185, Graham Farish, Lotus, Polar, Bulgin, Keystone, Ormond, Ready Radio, J.B. Utility).

FIXED CONDENSERS
1 2-mfd. (Lissen L.N.134, Igranic, Dubilier, Telsen, Ferranti, Goltone, Sovereign, Peto-Scott, Formo).
1 2-mfd. (Telsen W.226, or see above).
1 1-mfd. (Telsen W.227, or see above).
1 1-mfd. (Dubilier Type 9200, or see above.)
1 ·0002-mfd. (T.C.C. Type 34, Graham Farish, Dubilier, Goltone, Telsen, Ready Radio, Ferranti, Lissen, Watmel, Igranic, Peto-Scott, Sovereign).
1 ·0002-mfd. (Lissen type L.N.10, or see above).
1 ·0001-mfd. (Dubilier Type 665, Telsen, Igranic, T.C.C., Goltone "Midget").

VARIABLE RESISTANCES
1 50,000-ohm wire wound (Magnum Type 1131, Graham Farish "Megite," Wearite, Watmel, Tunewell, Sovereign, Colvern, Varley, Igranic, Lewcos, Lissen).
1 50,000-ohm (for pick-up) (Wearite, or see above).

FIXED RESISTANCES
1 20,000-ohm with holder (Graham Farish "Ohmite," Ferranti, Dubilier, Sovereign, Watmel, Ready Radio, Bulgin, Colvern, Varley).
1 1,000-ohm with holder (Graham Farish "Ohmite," or as above).
1 2-meg. Grid Leak with wire ends or terminals (Lissen L.N.5446, Graham Farish, Dubilier, Goltone, Ready Radio, Igranic).
1 5,000-ohm with wire ends or terminals (Dubilier 1-watt type, Graham Farish, Colvern).

L.F. COUPLING UNITS
1 R.C.C. Unit (Graham Farish Type "B").
1 Transcoupler (Bulgin L.F.10).

COILS
1 Three-Gang Unit (Varley Type B.P.13).

H.F. CHOKES
1 H.F. Choke (Lewcos Super, Telsen, Ready Radio, Slektun, Bulgin, Igranic, R.I., Wearite, Varley, Goltone, Lissen).
1 H.F. Choke (Igranic (code letters, "BICHO"), R.I. Ready Radio, Telsen, Slektun, Bulgin, Lewcos, Wearite, Watmel, Lissen, Varley, Goltone, Tunewell, Lotus, Dubilier, Sovereign, Graham Farish).

SWITCHES
1 Three-point Shorting (Lissen L.N.5071, Bulgin, Wearite, Telsen, Ready Radio, Tunewell, Goltone, Ormond, Magnum, W.B.).
1 Jack Switch (Lotus No. 9).

VALVEHOLDERS
4 Four-Pin type (W.B. small pattern, Lotus, Lissen, Igranic, Benjamin, Clix, Tunewell, Ready Radio, Wearite, Bulgin, Telsen, Goltone).

COMPONENTS FOR SPECIAL VOLUME CONTROL
1 Special Dissolver, 100,000 ohms each side (Magnum).
1 1-mfd. Fixed Condenser (T.C.C. Type 50).

MISCELLANEOUS
1 Fuseholder (Bulgin F.5, Telsen, Goltone, Belling & Lee, Magnum).
1 Terminal Strip, 16 × 2 in.
11 Indicating Terminals (Belling & Lee type "R," Eelex, Clix, Bulgin, Igranic, Goltone).
7 Wander Plugs (Belling & Lee, or as above).
2 Accumulator tags (Clix, Belling & Lee, Goltone, Eelex).
8 yds. Insulated Sleeving (Goltone).
12 yds. 18 S.W.G. Tinned Copper Wire (Goltone).
1 60 milliamp Fuse (Belling & Lee "Screfuse," Telsen, Goltone).
2 Blocks wood, 3 × ¾ × ¾ in.
Flex, Screws, etc.

And now for the set in action. It is easy to handle, as you will have gathered, but before actual programme use it must be tested and ganged up. This test should be carried out before the set is placed in a cabinet.

First of all, we must place the valves in the holders, give them the correct voltages, and so forth. A variable-mu screened grid battery valve goes in V_1, an H.L. type of valve in V_2, an L type in V_3, and a power valve in V_4.

Choosing Voltages

This latter will depend as to its size on whether the set is to be used with an H.T. unit or dry batteries. If the latter, then the valve must be "smaller," to keep the anode current consumption down to limits within the capabilities of the battery to supply. The list of valves will give alternative choice.

The available maximum H.T. voltage should not be below 120, and should be 150 if possible. Then the full voltage should be given to H.T. + 2, and about 80 volts to H.T. + 1. The grid-bias voltage maximum will depend on the output valve. It will probably be between 9 and 18 volts, but in any case a voltage not less than 9 should be used for G.B. — 1.

This is the bias for the variable-mu valve, and if you are within 15 miles of a station it will be best to use $16\frac{1}{2}$ or 18 volts, together with the alternative volume-control scheme.

This latter merely requires a "fader" type volume control instead of the usual type, and also an extra fixed condenser, as shown in the small extra diagram. In action the control is turned anti-clockwise to reduce the amplification provided by the variable-mu valve, and then at half-way, reduction of amplification is applied to the detector-L.F. circuit, further decreasing the volume.

But to return to the ganging of the set. The other G.B. plugs go as follows: — 2 into $1\frac{1}{2}$ or 3 volts negative, and — 3 into the required voltage as shown by the makers of the output valve chosen, and in accordance with the H.T. voltage applied to H.T. + 2.

The First Station

Pull the pick-up switch "out." Join up aerial and earth, loudspeaker, and switch the set on. With the wavechange switch in the medium position and variable-mu control fully to the right, turn the tuning knob slowly. It will not be long before you come to a station. If it is powerful, try for a weaker one—the weaker the better for our purpose. Then when tuned-in (without using reaction) full, unscrew the three terminals on the gang condenser.

Then re-tune the station, and commence to screw up the two back ones (farthest from panel), adjusting each a little as you go on, and re-tuning with the condenser knob till you find a position with maximum strength.

Adjusting Trimmers

When this is found try the effect of slowly screwing up the trimmer nearest the panel, keeping the main condenser adjusted to maximum setting. You will soon find a setting at which the best results are obtained.

If the station you choose is in the middle of the waveband, you need bother no further; but if it is at either end, try a station at the opposite end of the band, and re-check your adjustments.

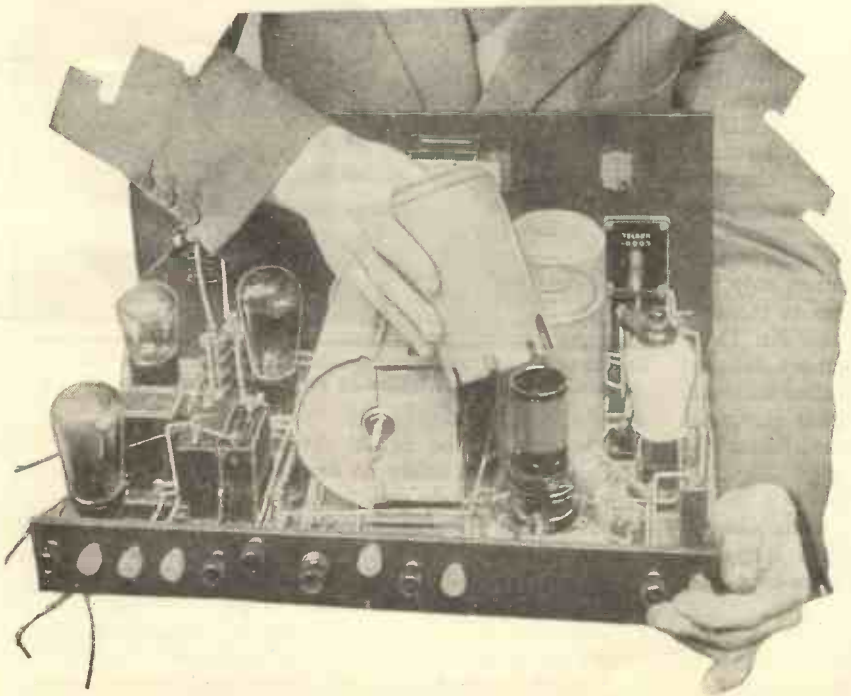
You will find that the adjustment will hold pretty well over both medium and long wavebands, though on the latter the tuning will probably be a little broader.

The fitting of the set into a radio-gram cabinet is perfectly straightforward, and needs no further comment.

YOUR GUIDE TO VALVE TYPES

	H.F. Stage	Detector	1st L.F.	Output	Output Mains Unit
Mazda	S.215V.M.	H.L.2	L.2	P.220	P.220A.
Mullard	P.M.12V.	P.M.1H.L.	P.M.2D.X.	P.M.2A.	P.M.202
Cossor	220V.S.G.	210H.L.	210L.F.	220P.A.	230X.P.
Marconi	V.S.2	H.L.2	L.210	L.P.2	P.2
Osram	V.S.2	H.L.2	L.210	L.P.2	P.2
Tungsram	—	H.210	L.G.210	P.220	S.P.230
Lissen	S.G.2V.	H.L.2	L.210	P.220	P.X.240
Eta	—	B.Y.1814	B.Y.1210	B.W.604	B.W.602
Six Sixty	SS.215V.S.G.	210H.L.	210D.	220P.A.	220S.P.
Clarion	—	H.2	H.L.2	P.2	—

FULLY CANNED COILS AND GANGED CONDENSER



Designed on the most up-to-the-minute lines, the set has all the vital parts very thoroughly screened. The metal coil and condenser covers can be readily removed for inspection purposes when required.

Photo by S. W. Hodkinson, Carshalton.

THE MAN

Every serious musical item that is broadcast is checked for quality by a listening official.

ALTHOUGH you may grumble about the programmes you are not *compelled* to listen. So your lot is not so hard as that of some of the B.B.C. programme officials. *They have to hear every serious musical item that is ever broadcast!*

These folk are either very lucky or very unlucky, according to your views on the programmes. The chief of them is Mr. Stanton Jefferies, the former musical director of the B.B.C.

When he was the director, in the days when the Corporation was a company, Stanton Jefferies not only had to choose the musical programmes but listen to them on the pilot loudspeakers at Savoy Hill. When Mr. Percy Pitt took over the musical directorship, Stanton Jefferies was still busy with the selection of programme material, and he had to appoint a small staff of skilled musicians to take charge of the "control" of the actual items.

The Music Control Cubicles

Now that Dr. Boult waves the musical director's baton, and the number of programme hours has increased, Stanton Jefferies finds that he and his staff are kept busy at the music control panels.

At about the centre of the Broadcasting House studio tower is one of the music control cubicles, to give the little rooms their proper name. This is where every serious musical item is heard and censored. Dance music at tea-time and at the end of the evening programmes escape the censor's attention, and so do the vaudeville and talks.

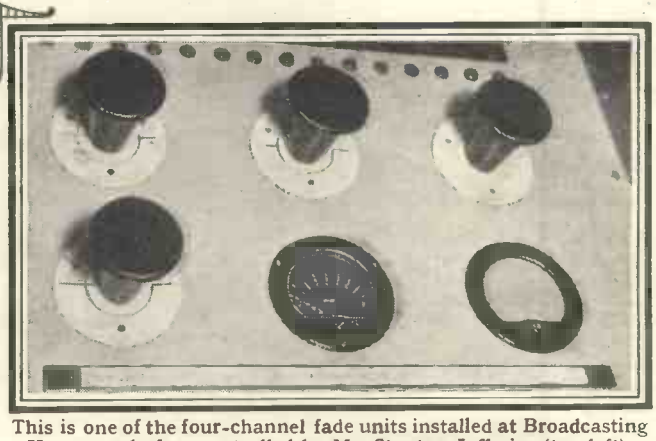
These are the *only* exceptions. Even the music in radio plays, if there is much of it, is controlled at one of these central points.

"Our business," said one of the members of the balance and control staff to me, "is to have a cross-check on the engineers' volume-control settings. The engineers regulate the amplifiers and microphone inputs to avoid overloading, and if there were no cross-check—done by somebody who really understands music—it might level-out everything and so spoil the musical light and shade.

Building Up the Climaxes

"Every serious musical item is followed by one of our section who sits with the score in front of him. At the last rehearsal of the orchestra he has marked the score with the extra loud and extra soft passages, and so he knows just when to open or shut the 'throttle.'

"The job is tricky, for the potentiometers have to be handled with care. Also, there is this snag. The limits of volume in the actual studio are far greater than those which can safely be dealt with in the transmission chain, and infinitely greater than are permissible with the average set. So we have to build up the climaxes artificially on the volume controls, and prevent the *ppp* passages from being lost entirely."



This is one of the four-channel fade units installed at Broadcasting House, and often controlled by Mr. Stanton Jefferies (top left).

I asked how the items were judged, knowing that in the Savoy Hill days one of the music listening-rooms was the first to be fitted with a visual programme meter.

"In the new music cubicles we don't have meters," explained the B. and C. operator. The control-room engineer, two floors above, watches a programme meter to avoid amplifier overloading; but we, in the music

WHO HEARS IT ALL!

How the Control Engineer has to limit or increase volume is interestingly described below

By A Special Correspondent.

cubicle, judge entirely by a speaker connected either to one of the amplifiers, *or actually to a receiver.*"

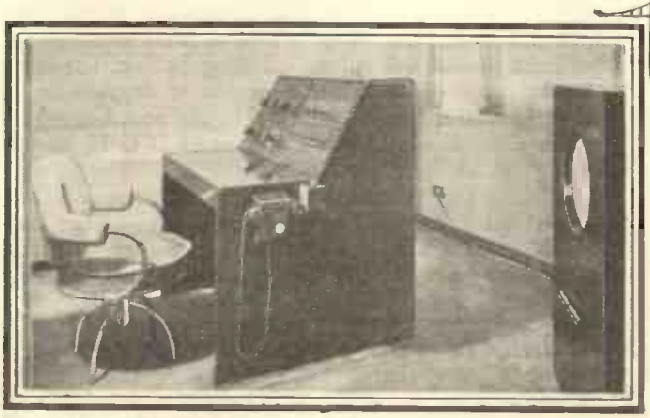
I was shown the apparatus in the music control cubicle —just a sloping black desk with four large knobs and two rows of keys, and in the corner of the room a pilot loudspeaker and a two-valve amplifier.

There is No Resonance

While we were talking about this control gear, I remarked on the curious effect of the sound in the room, and it was explained that although this control cubicle is not strictly inside the studio group, it is, nevertheless, sound-treated so that the loudspeaker sounds well and there is no resonance.

The B.B.C doesn't claim that this kind of room is ideal for reception. It is too dead, and with little echo. But it is ideal for concentrated listening where resonance would mislead the control experts.

For my benefit they switched on the pilot speaker. This was done by 'phoning through to the control-room, where are the master keys which can switch the speaker and A.C. amplifier on to the amplifiers or to a check receiver.



The right-hand picture shows part of the control-room arrangements at the Queen's Hall, London, while above is a control desk in a music cubicle at the Broadcasting headquarters.

One of the outside light music orchestras was playing; a good test for reception. It meant, too, that the music control cubicle was not needed for volume control, this being done at the Outside Broadcast control point. The quality on the pilot speaker was excellent. The control men have an exceptional guide in regulating the volume, and my only criticism is that this speaker equipment is at least three times as good as that in the average home, and so may be misleading.

I inquired how it was done, and was told that the speaker was a modified-commercial energised M.C. job, with a resistance-coupled A.C. two-valve amplifier giving an output of about one watt.

When the control men are listening on the B.B.C. amplifiers, this speaker amplifier for balance and control is connected through a trap valve (to prevent feed-back) to one of the main amplifiers. When it is used for direct reception tests it is connected to a check receiver which has one screened-grid stage and two detector valves in push-pull to prevent overloading. A good idea, but not typical of amateur equipment.

At the last rehearsal before every orchestral concert, the music library sends down a special copy of the scores of the pieces to be played. Duplicates of nearly every piece are kept so that the balance and control men can mark their own scores with the special potentiometer stud settings.

He Controls the "Throttle"

There are no exciting scenes in the music cubicle during the broadcast, for the control-room engineers have made sure that the lines are right, and that the main amplifier cannot overload. When everything is O.K., the control position man 'phones through to the music cubicle, and then the musical expert, closely following the marked score, has it all his own way with the potentiometer knobs.

He listens to the music as a whole, as you or I might do, and opens or shuts the "throttle" when necessary.

THE EMPIRE

Your link with the Empire, whether at home or abroad, is to be found in this first-class short-wave receiver.

MUCH has been said and written during the last two months about the new Empire short-wave station at Daventry; so much, indeed, that I do not propose to add more than the smallest possible amount to the welter of adjectives and superlatives already in circulation.

My sole contribution, in fact, to the spate of words is this: "The Empire Station works, and works well. It speaks for itself. Now how about some receivers on which to listen to it, wherever we may be?"

Reliable and Easy to Operate

The "Empire Super" has been built chiefly to please overseas readers, who have, with commendable perseverance, been aiming missiles (in the form of letters) at me for some time. The Overseas Reader is in a class by himself; hence the capital letters.

He wants a biggish receiver, and one that will not let him down. It must, however, be easy to operate and *reliable*. If it were possible to design a set that would surmount the obstacle of varying reception conditions, that would be the set for him.

As that isn't possible, he wants the next best thing; and the next best thing is a superhet. I have been in close touch for some weeks past with ten or twelve individual readers of "M.W." who live in distant parts, and, without exception, they have all asked me to design for them a superhet rather than any other type of receiver.

Having been brought up to do what I am told, quickly and without question, I sat down with a writing pad and a blue pencil, and—there *was* the superhet. Furthermore, it worked extraordinarily well. It brought in stations I had never heard before, and it did the most incredible things with the stations I *had* heard. It was only when it began tuning-in stations all on its own that I woke up and found myself confronted with a blank piece of paper except for "aerial" and "earth" symbols on the left-hand side.

But enough of this. The blue pencil functioned, the "powers-that-be" looked over the circuit and uttered sage remarks, and work started. And the "Empire Super," as you see it in the diagrams and photographs, was the final result.

It is not a big superhet as superhets go, but I find it quite big enough for any ordinary requirements, and it has the undoubted advantage of being a reasonably quiet set. When I got to that nerve-racking moment at which the last blob of solder has fallen in position, battery leads have been connected up, and valves inserted in their holders with a mental "Good-bye for ever!" I was, I admit, all worked up.

A Very Quiet Background

I switched on, donned the 'phones, and nothing happened. No mush, no crackling noises, no signals were heard. Nothing was there except a faint microphonic ring from one of the valves. Taking hold of the dials, I moved both of them for a couple of degrees or so, and—*whooOOSH!*—what a signal! My ears tingled for days as a result of tuning-in our friend D G U, Nauen, sending out his interminable "A B C's."

So, before I delve into the detail work, I should like to say that the "Empire Super" is but a five-valver, and, as such, is *not* a noisy set. It gives rather more volume on the short-wave broadcasting stations than the average

CLASSIFIED LIST OF THE COMPONENTS YOU REQUIRE

CHASSIS
1 Special metal chassis, 21 in. × 7 in. × 9 in. fitted with 2 vertical screens and 5 valve holders (Burne-Jones).

VARIABLE CONDENSERS
2 Special short-wave ·00015 mfd. (J.B.).
2 Slow-motion drives (Igranic Indigraph, catalogue reference "Vinad").
3 ·0001-mfd. compression (Formo, Goltone, Sovereign, Telsen, Colvern).

FIXED CONDENSERS
1 2-mfd. (Lissen L.N.134, Telsen, T.C.C., Dubilier, Igranic, Formo, Ferranti).
3 2-mfd. (T.C.C. type 50, Telsen, Lissen).
2 2-mfd. (Dubilier 9200, Telsen, Igranic, Ferranti, Formo, T.C.C., Lissen).
1 ·0003-mfd. (Dubilier 620, Graham Farish, T.C.C., Goltone, Ready Radio, Lissen, Ferranti, Watmel, Telsen, Sovereign, Peto-Scott, Igranic).
1 ·001-mfd. (Graham Farish, or as above).

VARIABLE RESISTANCE
1 50,000-ohm wire-wound potentiometer with insulating bush (Lewcos, Graham Farish, Watmel, Wearite, Tunewell, Colvern, Varley, Igranic, Sovereign, Lissen, Magnum).

FIXED RESISTANCES
1 40,000-ohm with wire ends or terminals (Dubilier 1 watt, Graham Farish "Ohmite," Sovereign, Watmel, Colvern, Varley, Ready Radio, Wearite).
1 30,000-ohm (Dubilier 1 watt, or see above).
2 25,000-ohm (Graham Farish "Ohmite," or see above).
2 10,000-ohm (Graham Farish "Ohmite," or see above).
1 1-meg. grid leak with terminals or wire ends (Graham Farish "Ohmite," Goltone, Lissen, Igranic, Dubilier, Ready Radio).

COILS AND HOLDERS
2 Sets of short-wave (Bulgin types S.W.2, S.W.3, S.W.4—two of each type). 2 holders for these (Bulgin S.W.8).

H.F. CHOKES
2 Short-wave (Igranic [catalogue reference "Chort"] and Silektun, or Bulgin, Peto-Scott).

INTERMEDIATE TRANSFORMERS
2 (Colvern 110 K.C.).

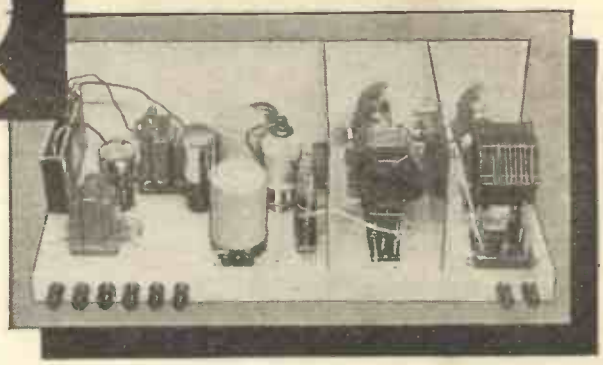
SWITCH
1 3-point shorting (Telsen W.108, Lissen, Wearite, Bulgin, Tunewell, Ready Radio, W.B., Ormond, Magnum, Goltone).

L.F. TRANSFORMER
1 medium ratio (Telsen Ace W.66, Igranic, Atlas, Bulgin, Multitone, Lissen, Varley, Silektun, R.I., Ferranti, Graham Farish, Tunewell, Ready Radio, Lotus, Lewcos, Sovereign).

OUTPUT CHOKE
1 (Lissen L.N.5300, Igranic, Telsen, R.I., Tunewell, Varley, Lotus, Lewcos, Wearite, Ferranti).

MISCELLANEOUS
2 Accumulator spades (Clix, Eelex, Belling-Lee, Goltone).
8 Indicating terminals (Belling-Lee type B).
6 Wander plugs (Eelex, Clix, Goltone, Bulgin, Igranic, Belling-Lee).
6 Yards of sleeving and 8 yards of tinned 18-gauge copper wire (Goltone).
6-B.A. bolts and nuts, flex, etc.

SUPER



Designed and described by our popular contributor, W. L. S.

"Four" using an S.G., D.2 circuit, but, at the same time, it is infinitely more selective, more easy to handle, more stable and, apparently, more reliable.

It is intended for loudspeaker work, naturally, but it is not too noisy for use with 'phones, should one want to find some of the impossibly weak stations that crop up from time to time.

For Home or Overseas Use

A good volume control is provided, and by making judicious use of it some very fascinating work may be done with headphones. I know, however, that the average overseas reader has not much patience with 'phones. Social conditions are very often such that loudspeaker reception is essential.

I don't want the home reader to think that this is no set for him. Everything that it will (or I hope it will) do for the Empire Dweller on the Empire Station it will also do for the Londoner who wants to listen to Sydney or the Americans.

Let us deal first of all with the theoretical side of it. The circuit diagram will tell its own story to most of the readers who are contemplating the building of such a set, but for the benefit of those to whom theoretical diagrams are mere collections of cabalistic signs, I will describe it.

The first valve is a straightforward S.G. amplifier. Its grid coil is a standard plug-in short-wave coil, also provided with a reaction winding which is, in this case, used for aerial coupling, via terminal "A_1." Provision has also been made, however, for using a capacity-coupled aerial. A compression-type condenser with a maximum capacity of ·0001 is made available via terminal "A_2," and the two very different types of coupling are therefore available with the minimum loss of time.

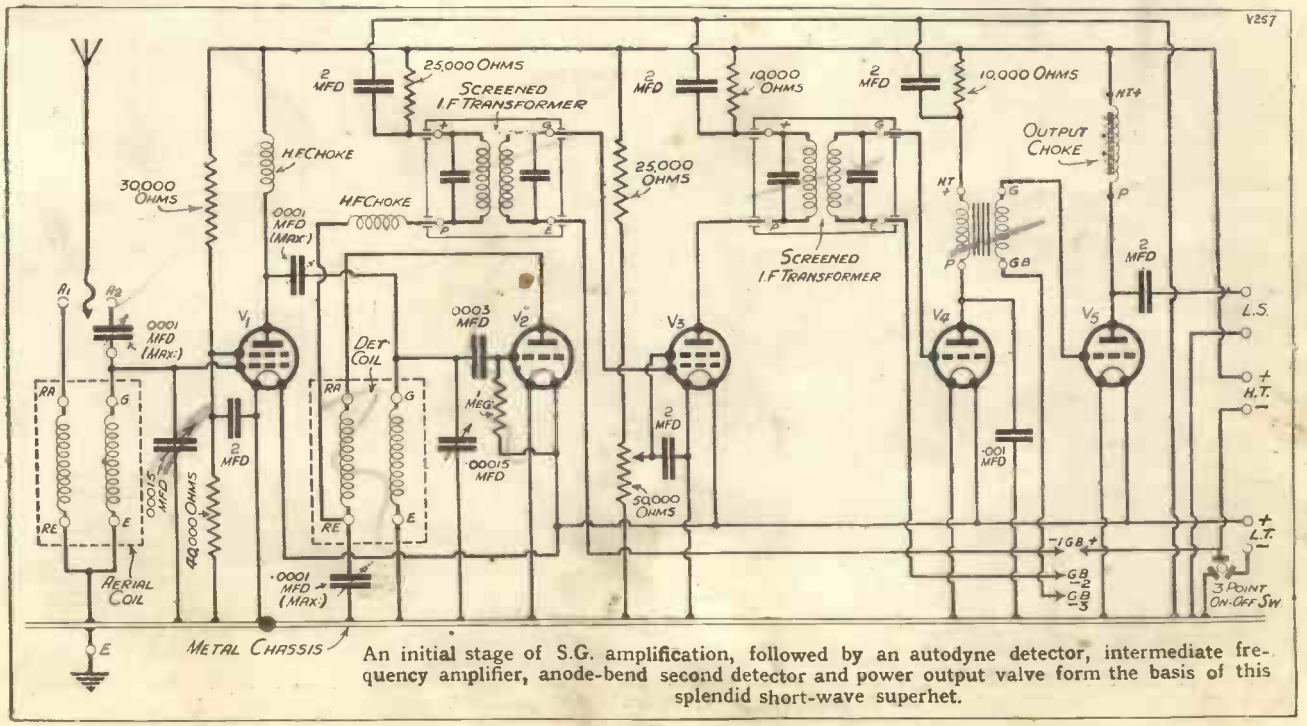
The first valve is parallel-fed and coupled through another compression condenser to the grid coil of the first detector, which is a perfectly "straight" short-wave detector.

Anode-Bend Second Detector

The coil used is identical with the S.G. coil, except, of course, that the reaction winding in this case is used as such. This leads off through a short-wave H.F. choke to the first I.F. transformer, and then through a decoupler to positive H.T.

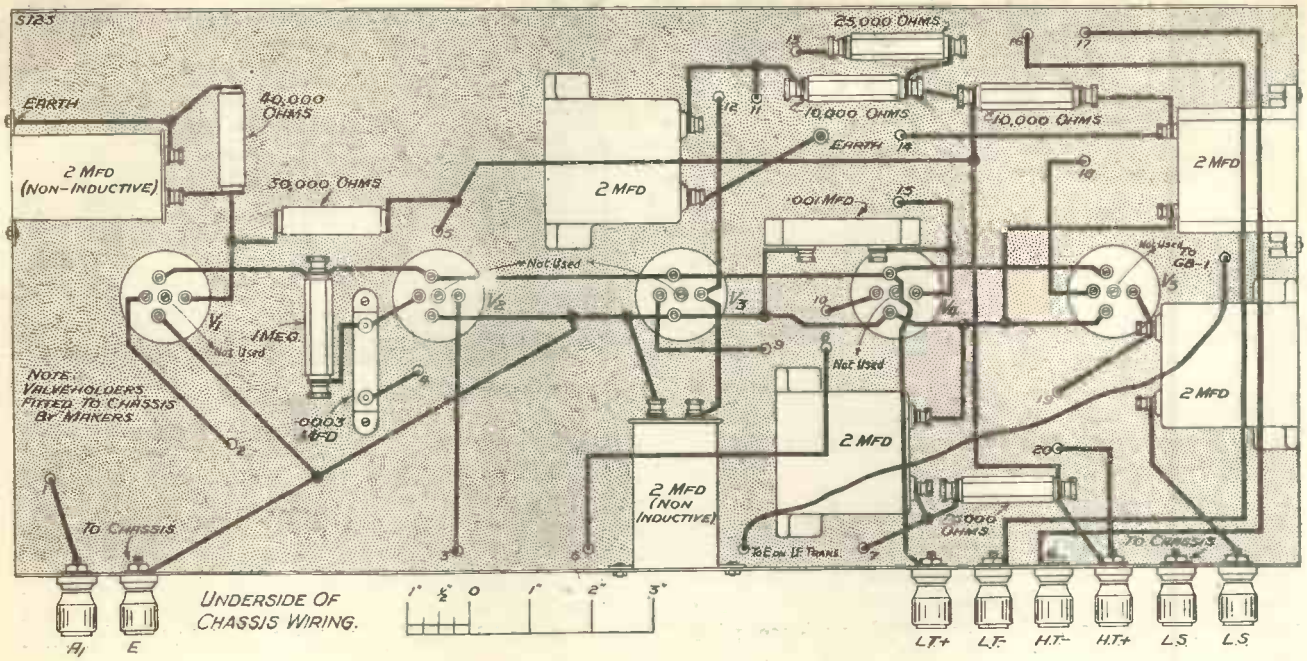
The next valve is again "straight"—a perfectly ordinary, unoriginal I.F. (intermediate frequency) amplifier (screened-grid, of course), which feeds on to the fourth valve, which is the second detector. This valve has been arranged to work on the anode-bend principle after careful comparison with the leaky-grid method.

A Wonder Set That Gives World-Wide Reception

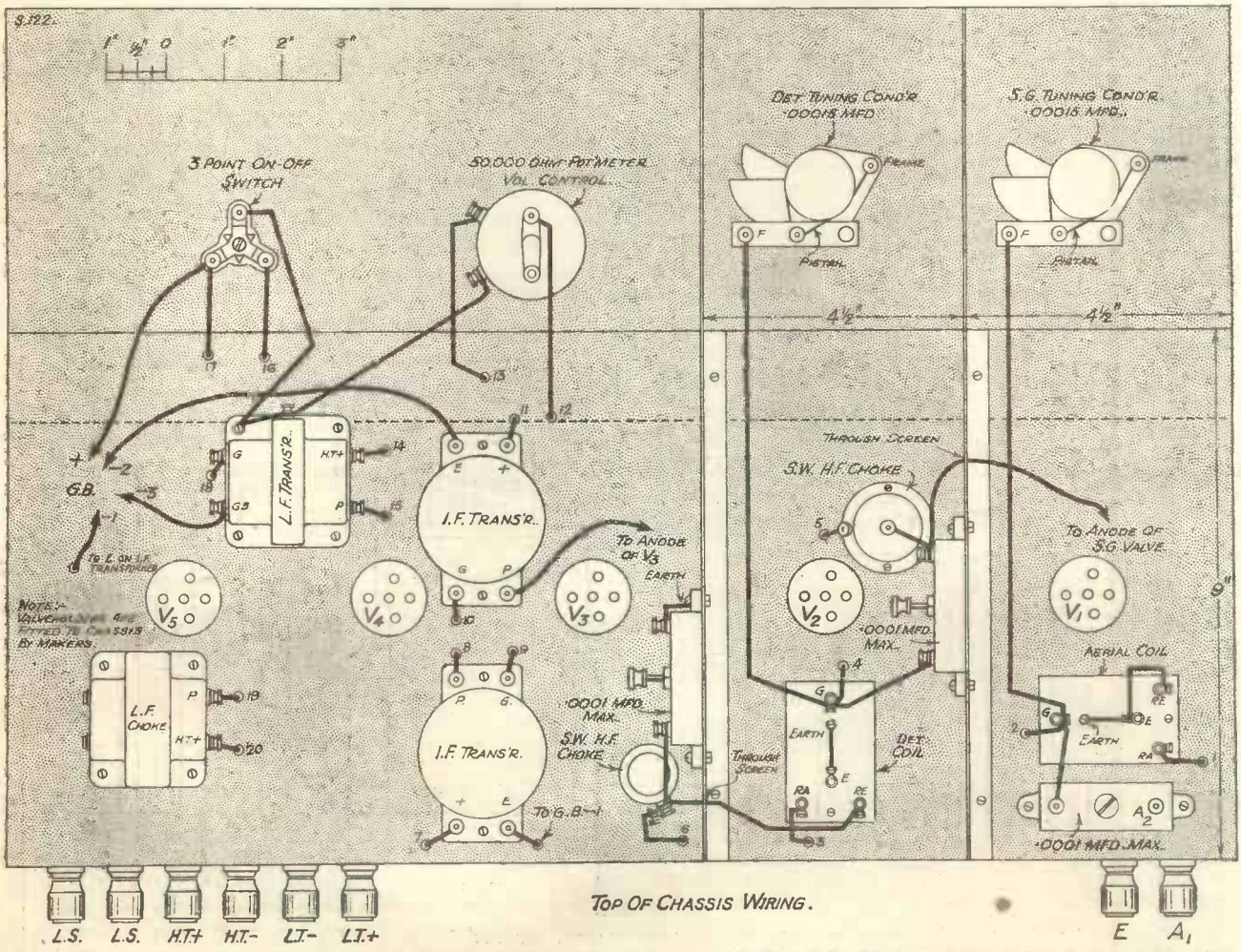


An initial stage of S.G. amplification, followed by an autodyne detector, intermediate frequency amplifier, anode-bend second detector and power output valve form the basis of this splendid short-wave superhet.

Most of the Wiring is Below the Baseplate



A Tidy Design Which is an Aid to Efficiency



Considering the size of the set, the wiring is remarkable for its simplicity. Practically all the leads are out of sight below the chassis, and all earth returns are taken to the framework.

The Last Word in All-Metal Short-Wave Receiver Design

The wide variation in the strength of the received stations that may be passed on to this valve seems to rule out "leaky-grid" if we are at all keen on efficiency. This is followed up by the last valve, which is a plain transformer-coupled L.F. amplifier equipped with choke output.

Volume control is effected by varying the voltage on the screen of the I.F. amplifier, a method that seems to work very well. A definite "zero" can be obtained on the very loudest stations, and the control is smooth and silent.

A few words on the superhet. principle will probably not come amiss at this point. Your short-wave signal is picked up on the aerial, amplified by the first S.G. valve and handed on to the first detector. This valve is not working now as a detector only, but it functions also as an oscillator.

How It Works

Unless it *is* oscillating, no signals appear at the far end of the set.

The duty of this valve is to produce an oscillation 110 kc. away from the frequency of the station. If you are receiving a station on 6,040 kc., for instance, the detector is tuned either to 6,150 or 5,930 kc. The result is a beat of 110 kc., corresponding to a real received wave at that frequency—a wave of about 2,700 metres.

The short-wave "signal" has now been virtually transformed into a new "signal" on about 2,700 metres. The I.F. transformers are tuned to that wavelength, and the I.F. amplifier does its job up there just as it would do if it were an H.F. amplifier working on a received 2,700-metre wave. It is then detected by the second detector, amplified at low frequency by the last valve, and finally devotes its energy to heating the loudspeaker windings and to making the pleasant sounds usually associated with loudspeakers.

Tuned in the Normal Way

Don't imagine from this that there is anything complicated in the process of tuning the first detector 110 kc. away from the station. In the actual operation of the set one doesn't know anything about that part of it. The effect is simply that of tuning-in a station or a signal in the normal way, and the fact that the detector is actually 110 kc. away from that station can be forgotten altogether.

The I.F. transformers are sharply tuned to that frequency, and all that one has to do to tune-in a station, naturally, is to turn the dial until one hears it!

Now let us examine the constructional side of the set. It has, by request, been made up in "chassis" form. This form of construction gives great rigidity and a very neat appearance, as well as undoubted efficiency of screening. It also has the merit of being very little more trouble than the conventional panel-and-baseboard layout.

Personally, I would rather make a "chassis" set than the other type every time. All the wiring is short and direct, and the business of making sure that all the bends in the wiring are really angles of 90 degrees and not 89 degrees is done away with, since they come off their various terminals and disappear immediately through the nearest hole!

Two diagrams have been prepared, one showing the top of the chassis and the other the underside. The holes are numbered, so that there should not be the slightest difficulty in following them. The chassis, as supplied, is fitted with the five valve holders in the correct places, and also with the two vertical screens, and the holes for the terminals at the rear are also ready drilled.

Soon Built

As a matter of interest it may be mentioned that only three clear days elapsed between my receiving the chassis and having the finished set working on the bench. During these three days I was only able to put in something like a quarter of the available time into this particular job, so that it may be said that seven or eight hours covered the whole thing.

Remember, too, that such a job does not take nearly so long when one has nice clear wiring diagrams to work to. *I* had to start "from A" and work without any diagrams except mental pictures.

I don't advise anyone to depart much from the layout

SUITABLE ACCESSORIES

Loudspeaker.—B.T.H., Blue Spot, Baker's Selhurst, G.E.C., Ferranti, Marconiphone, H.M.V., W.B., Lanchester, Ormond, Igranic, Clarke's Atlas, Celestion.

Batteries.—H.T.: This should be of ample size to deal with the requirements of the valves chosen. Pertrix, Magnet, Ediswan, Lissen, Ever Ready, Drydex, Marconiphone.

L.T. Accumulator.—Ediswan, Exide, Lissen, etc.

G.B.: One 16½-volt unit. See above list.

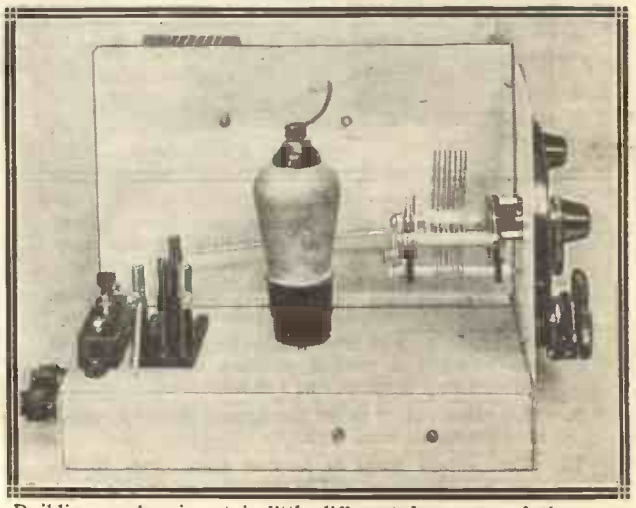
Mains Unit.—This should have output to suit valves chosen. Only "output" tap is used. Atlas, Ferranti, Regentone, Ekco, Tunewell, Heayberd, R.I.

Aerial and Earth Equipment. — Electron "Superial," Goltone "Akrite," Graham Farish "Filt" Earthing Device.

THE VALVES TO USE

Make	H.F. Stage.	1st Detector.	Intermediate.	2nd Detector.	Output.	Output Mains Unit.
Mazda	S.G.215	H.L.2	S.215V.M.	H.L.2	P.220	P.220A.
Mullard	P.M.12	P.M.1H.L.	P.M.12V.	P.M.1HL	P.M.2A.	P.M.202
Cossor	220S.G.	210H.L.	220V.S.G.	210H.L.	220P.A.	230X.P.
Marconi	S.22	H.L.2	V.S.2	H.L.2	L.P.2	P.2
Osram	S.22	H.L.2	V.S.2	H.L.2	L.P.2	P.2
Tungsram	S.210	H.210	—	H.210	P.220	S.P.230
Lissen	S.G.215	H.L.2	S.G.2V.	H.L.2	P.220	P.X.240
Eta	B.Y.6	B.Y.1814	—	B.Y.1814	B.W.604	B.W.602
Six Sixty	215S.G.	210H.L.	S.S.215V.S.G.	210H.L.	220P.A.	220S.P.
Clarion	S.G.2	H.L.2	—	H.L.2	P.2	—

SIMPLIFIED CHASSIS CONSTRUCTION

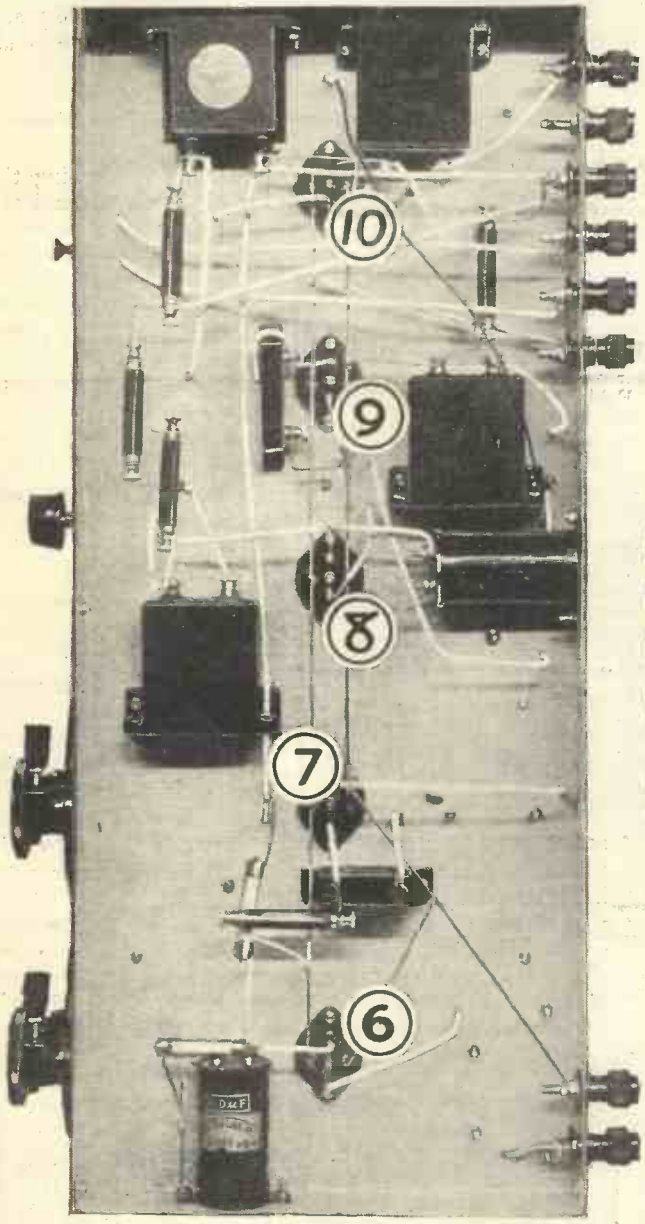


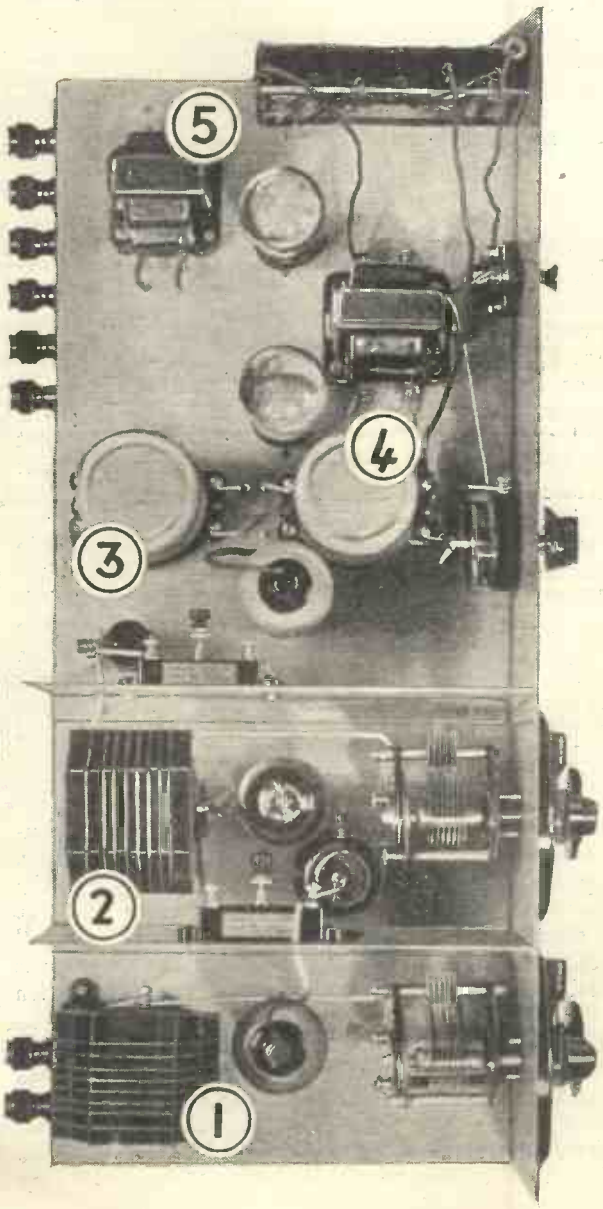
Building a chassis set is little different from one of the more conventional type, but the appearance of the finished article is unusually pleasing to the eye.

THE EMPIRE SUPER FROM ABOVE AND BELOW

TEN FEATURES OF DESIGN

1. A preliminary stage of S.G. amplification that really pulls its weight.
2. Easy-to-handle plug-in coils are used throughout, one pair being required for each waveband covered.
3. The first I.F. transformer, coupling the first detector to the intermediate frequency amplifier.
4. The second transformer connecting the I.F. valve to the second detector.
5. An output transformer, which avoids any direc current from the H.T. supply having to flow through the loudspeaker.





6. The S.G. H.F. valve holder seen from below. Note how the method of mounting permits very short wiring.
7. The first detector valve holder with its associated components mounted in close proximity.
8. The single stage of intermediate frequency amplification occupies a central position in the set, and operates at a frequency of 110 kilocycles.
9. This valve holder is for the second detector, which is of the anode bend type.
10. The output stage is located here, close to the output transformer and loudspeaker terminals.

It Brings in all Stations Between 16 and 80 Metres

shown. For one thing, considerations of space don't allow much variation; for another, if a layout works well, there is not much point in altering it.

Note that the two sets of short-wave coils are arranged to be at right angles, in spite of the screen between them. This is probably a necessary precaution, since a single vertical screen doesn't do so very much work when one gets down below 30 metres.

I think all the constructional details are perfectly clear, but there are some small points worthy of mention. First, the volume-control potentiometer has to be insulated from the front panel. The panel is, of course, earthed, and the spindle of the potentiometer goes to the screen of the I.F. valve, which we most decidedly don't want earthed.

Earthing the Moving Vanes

Next, the terminals at the rear are all insulated from the chassis except the "earth" terminal and one of the loudspeaker terminals. Another point arises in connection with the variable condensers used. They happen to be of the type that has a frame connected to neither set of plates. Connection to the moving plates is made by a pigtail, which goes to the centre terminal in the little strip of ebonite at the rear of the condenser.

This "pigtail" terminal, being the moving-plate connection, has to be earthed, and this has been done on each condenser simply by connecting it across to the "frame" terminal, which is the upper one on the condenser. This is clearly shown in the wiring diagram. Should another make of condenser be used, there will be no necessity for a connection of that sort, so long as the moving plates are connected to the chassis *somehow*. In most cases that would be done automatically as soon as the fixing nut was screwed down, but with these actual condensers used the spindle does not touch the front panel at all.

You may notice that there are two holes that are not numbered on either diagram. These have been left blank because the wire concerned does not make connection to anything underneath, but simply goes down and comes up again. It is a grid-bias negative lead, going from the I.F. transformer nearer the back of the chassis to the grid-bias battery on the left, and it was neater to take it underneath than to let it straggle about over the top of the chassis.

Each of the holes concerned is marked, so that this point should be quite straightforward.

You will notice that the output choke resembles a transformer in that it has four terminals. It is a tapped choke intended for a variety of purposes, but in this particular set only the outside ends have been used. It so happens that the two free terminals are very useful for connecting a pair of 'phones when they are wanted. The volume is somewhat less than is obtained at the loudspeaker terminals, which is a distinct advantage.

There is quite a lot to be said about the operation of the set, to which we will now turn. I will assume that you know enough about the job to check over the wiring carefully. The valves required are two S.G.'s, two H.L.'s, and a good power valve. The S.G.'s are, of course, inserted in valve holders V_1 and V_3, and the two flex leads bearing their anode connections duly put in place. The H.L.'s go in valve holders V_2 and V_4, and the power valve in V_5.

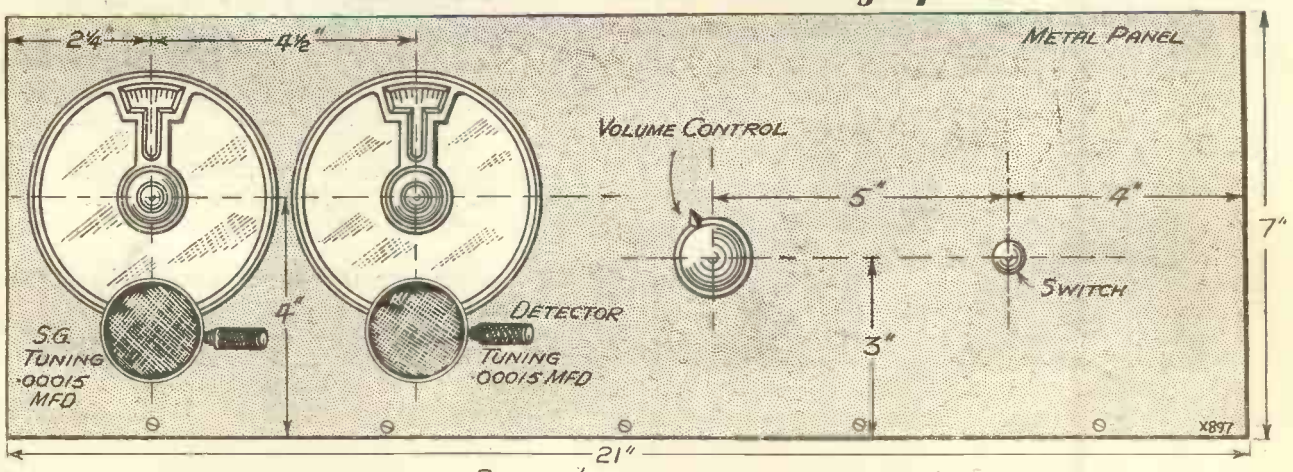
Grid-Bias Voltages

Suitable L.T. is connected to the appropriate terminals, and a 9-volt grid-bias battery installed in its little space at the end of the chassis. Suitable G.B. voltages are G.B.—1, —1½ volts; G.B.—2, —3 volts; and G.B.—3, up to —9 volts. This is assuming that an H.T. supply of 120 volts is connected across the H.T. terminals, and a small power valve is in use. Mains-unit power valves will require more negative voltage on —3.

At the base of each of the I.F. transformers are two small levers controlling the small adjustable condensers contained within them. These can only be set accurately when an actual station is being received, but if they have not been moved since the transformers were unpacked they will probably be found to be nearly correct.

If they have been shifted, for the preliminary test it is the safest plan to see that they are all in roughly the same positions. An easy way of doing this is just to

Metal Panel—Micrometer Dials—Straightforward Control



PANEL LAYOUT

Hand-capacity, which on some short-wave receivers can be very troublesome, is eliminated completely in this set by the use of a metal panel. This fact, combined with the slow-motion dials, makes the set surprisingly easy to tune.

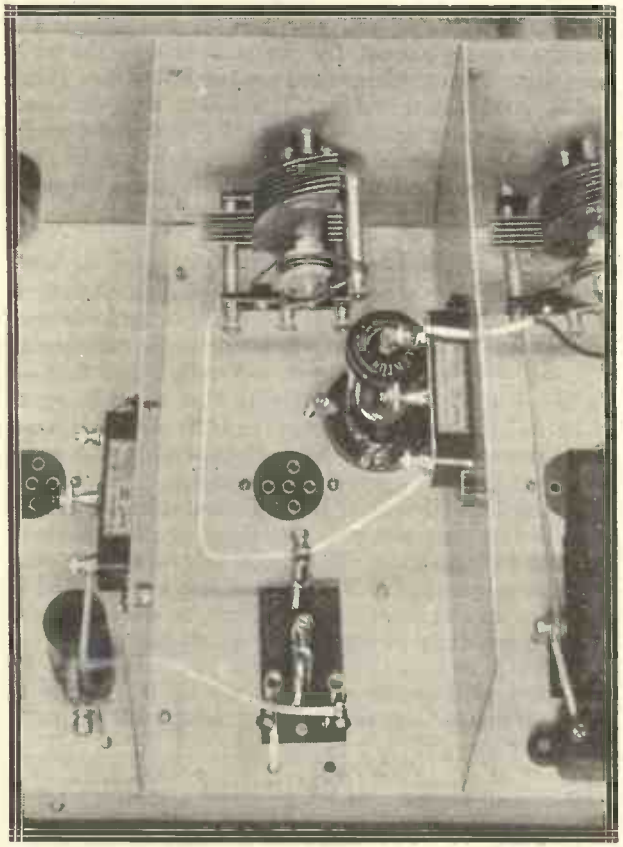
swing each one round in a clockwise direction as far as it will go. Then when the set is working, final adjustments may be made.

Adjusting the Compression Condensers

The three small compression condensers now have to be set. For a start it is safe to set each of them about half-way in. There is one on each vertical screen, and the other is on the chassis near the aerial terminal. To start with I suggest that terminal A_2—on the condenser itself—should be used for the aerial connection, as this will generally give the strongest signals.

Insert two coils of similar size; you should have two with 10 turns, two with 7, and two with 5, and I suggest that the "7's" be used. With the ·00015 condenser the 46–50-metre stations are received right at the top end of the dial with these coils, and if you set both tuning

THE DOUBLE-DUTY STAGE



The second valve in this receiver performs a double duty; besides acting as first detector, it creates a beat frequency of 110 kc., which is passed on to the other valves for rectification and amplification.

condensers nearly "all-in" you should receive something almost at once.

Ensuring Sufficient Oscillation

If you hear nothing at all, even after swinging the condensers round a little, you will probably find that the detector is not oscillating. Look to the volume control, by the way, and make sure that it is not set at zero! If the detector does not seem to oscillate, this may be speedily remedied by screwing down the reaction condenser a little further. The reaction condenser, of course, is the compression condenser mounted on the vertical screen nearer the middle of the set.

Do not screw it in so far that the detector "screams," although, apart from that, it doesn't matter how hard it is oscillating. There is no business of keeping it just on the point of oscillation, as in the case of a normal receiver.

Doubtless by now you have heard something, whether morse or telephony. You will find that the two tuning dials should be rotated slowly "in step," and you may arrange that the two dial readings are practically the same by adjustment of the coupling condenser between the S.G. valve and the detector—on the other vertical screen.

Once Set They Can Be Left

This business of "juggling" the two compression condensers is not easy to describe, but it is only a point of playing with them until you get the best results, and once this point has been found there is no reason for altering the settings.

Home readers who have reached this stage of the proceedings will probably be hearing Moscow or the Vatican at tremendous strength and setting the condensers on these stations. It is better, however, to find a weaker station on which to do it. While you are at it, adjust the trimmers on the I.F. transformers by pushing them gently round with a screwdriver. The "best position" should be quite definite and easy to find.

On the original set the smallest coils (5 turns), although marked "8 to 20 metres," actually covered a range of 16 to 33 metres roughly. The 19-metre broadcasters will be found fairly near the bottom of the dials with these coils in position. The 25-metre group comes about half-way up, and the 31-metre group near the top.

About the "Second Channel"

With the 7-turn coils the 31-metre stations are found again near the bottom, and, as already mentioned, the 49-metre stations are at the top. Just below them (at about 70 degrees on the 100-degree dial) is the 40-metre amateur waveband, which should be productive of plenty of signals to play with while making adjustments to the set.

Every station will, of course, be found at two different positions of the detector tuning condenser—one when the detector is 110 kc. above the signal frequency and the other when it is the same amount below. In practice, however, if the two dials are always rotated "in step," you will have no bother through getting muddled between the two. No bad cases of interference from the "second channel" have yet cropped up.

A Good Aerial Not Needed

There is not much point in reproducing a long list of stations heard. Suffice it to say that all the short-wave stations one would expect to find at the various times of day at which the set has been used have all been there. Sydney has been particularly good and reliable.

I might as well mention here that the aerial is a very unimportant matter. I found that a few feet of wire across the room, using terminal A_2, gave equally good results as my outside aerial.

A direct earth appears to be an advantage, but in some cases would probably not be necessary.

Further points concerning the operation of the set and the placing of stations will be dealt with next month. For the present, "Good hunting."

There is just one warning I must add. As the chassis is supplied enamelled, it is as well to scrape it a little where the "earthed" terminals and variable condensers have to make contact with it, to ensure that the contact is good.

The "HANDIBOX"

An extremely useful and easy-to-build unit that can be employed in conjunction with any set suited to record reproduction. It contains an electric gramophone motor, pick-up, volume control, and ample space for a large number of records. This practical unit merits the serious attention of every radiogram enthusiast.

Described by

FREDERICK LEWIS.

WE Britishers are a home-loving people; we are not necessarily lazy or indolent, but we like comfort and ease. The writer of this article is no exception, otherwise this might never have been written, for the object to be described would not have come into existence.

Being fond of music, both radio and gramophone, but being equally fond of leisure, it was borne on my consciousness that I could surely do better than getting up from my armchair every time I wanted to put a record on my radiogramophone—which is situated at the other end of the room.

ALL THE MATERIALS YOU WILL NEED

1 Univolt Gramophone Unit (Peto-Scott).
4 Hinges, 2 in. × ½ in.
5 ft. of ¾-in. draught-excluding felt.
1 1-in. hook catch and eye.
1 lid stay.
2 pieces of wood, 15 in. × 16¾ in. (sides).
2 pieces, 12¾ in. × 17 in. × 18 in. × 17 in. (front and back).
1 piece, 17½ in. × 15 in. (base).
1 piece, 12¾ in. × 15¾ in. (top).
1 piece, 13 in. × 15 in. (motor board).
2 pieces, 15 in. × 2 in. (lid).
2 pieces, 12¾ in. × 2 in. (lid).
(All wood ⅜ in.)
4 blocks, 1¾-in. cubes.
Flex, screws, nails, etc.

"At Less Cost"

An automatic record changer was one solution to the trouble, but I thought I could do something at less cost than that. And so the "Handibox" was devised and constructed.

The actual form of the box is a matter of taste. Being no good at woodwork, like perhaps many of my readers are, I chose a form that would allow of straight cutting everywhere, no mitreing or dovetailing, but just plain nails and hammer or screws and screwdriver.

What It Does

The idea of the "Handibox" is to provide an electric turntable (obviously a clockwork one can be substituted if desired), complete with pick-up and volume control, *and a small cupboard to contain records* in the form of a stool or cabinet suitable for placing alongside an easy chair, enabling the records to be changed, played, and replaced in their cupboard without the repeated journey to the radiogramophone every three or four minutes.

The cost is small, being mainly that of the motor and pick-up and volume control, which are all incorporated in one neat unit. With alterations in size other motor units and pick-ups could be used, but the Peto-Scott "Univolt" is ideal for the purpose and was employed in the construction of the cabinet. Incidentally it precludes the necessity for cutting large holes in the wooden motor board (a job I hate), for the "Univolt" merely rests on its rubber feet inside the cabinet—on the motor board—being fixed by a couple of long screws.

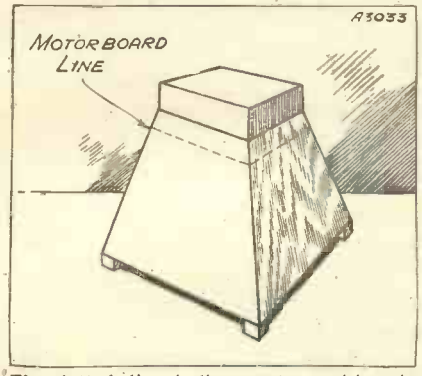
Underneath this is the record compartment which houses 30 or 40 records with ease, while thanks to the thinness of the "Univolt" the overall height of the cabinet is one of convenient measurement. The records are stored edgeways and not lying flat.

The wood used is ordinary ⅜-in. plywood, which can have, if desired, an oak or other ply surface, or it can be covered with some material such as chintz or leatherette in accordance with taste, to tone with the furniture in the room. Those who want it plain can use white plywood and merely stain and polish (or varnish-polish) the surfaces when complete.

Easily Elaborated

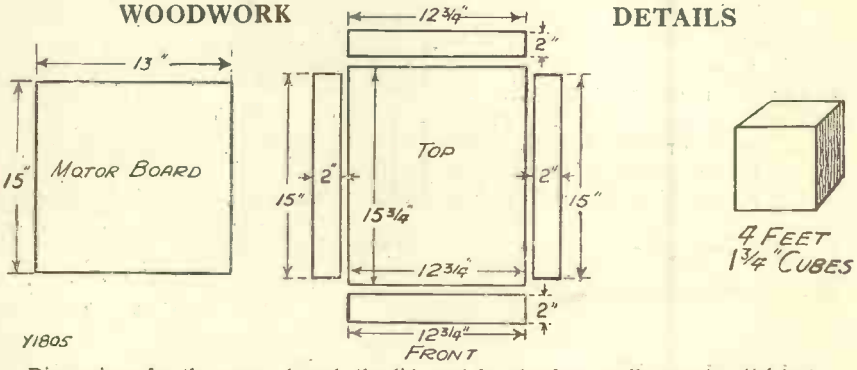
The shape is very plain, but as I remarked before, this can easily be elaborated and altered if desired, while the necessary dimensions of the sides, top, motor board bottom, and so forth are given in the sketches.

FOR THE TURNTABLE



The dotted line indicates the position in which the motor board will be mounted, and further details will be found on a following page.

WOODWORK DETAILS



Dimensions for the motor board, the lid, and for the four easily-constructed feet.

It Converts Your Set Into a First-Class Radiogram

The photos of the completed cabinet are a little misleading, for they give the impression that all four sides are cut with the top ends narrower than the bottom ones.

Sloping Sides

Actually this is not the case, and is only a trick of perspective. The sides are cut rectangular, but the back and front are slope-edged. When assembled this makes everything work out all right, it being remembered that all four sides are mounted on the base, the front and back vertically, and the sides with a slight inward slope towards the top.

Naturally the top and bottom edges require careful trimming, so that they fit flush against the lid sides and the bottom of the cabinet, but this is quite a simple thing to do.

The lid is mounted squarely on the sides, its 2-in. deep supports being perpendicular and not continuing the slope of the cabinet to the very top. This again simplifies the construction, and you will see from the diagrams that the whole process of preparation of the wood is one that could hardly be simpler, requiring the most primitive of tools, or enabling the constructor to have the whole lot cut by the wood merchant without any difficulty.

Fitting the Hinges

In the diagram showing the various pieces of wood it will be noticed that there is a cut across some three inches from the top. This is the point at which the door top comes, the whole of the back of the cabinet opening with the exception of the top three inches.

It will be seen that this cut comes just below the motor board, the underside of which forms the roof of the record compartment.

A few words about the fitting of the hinges may be useful. In the case of the door at the back, the hinges should be sunk into the sides of the cabinet and the door to allow the latter to shut flush, but in the case of the lid no cutting away of the wood should be done to make flush fittings of the hinges. This is because the edge of the top of the cabinet is to be covered with felt, and the non-sinking of the hinge mounting will give room for the felt, which will provide flush closing of the lid.

The felt is the usual draught material that is sold for use round house doors and contains rubber covered with felt. The feet of the cabinet are ordinary square blocks of wood as shown, and the whole can be stained and polished or covered with American cloth if desired.

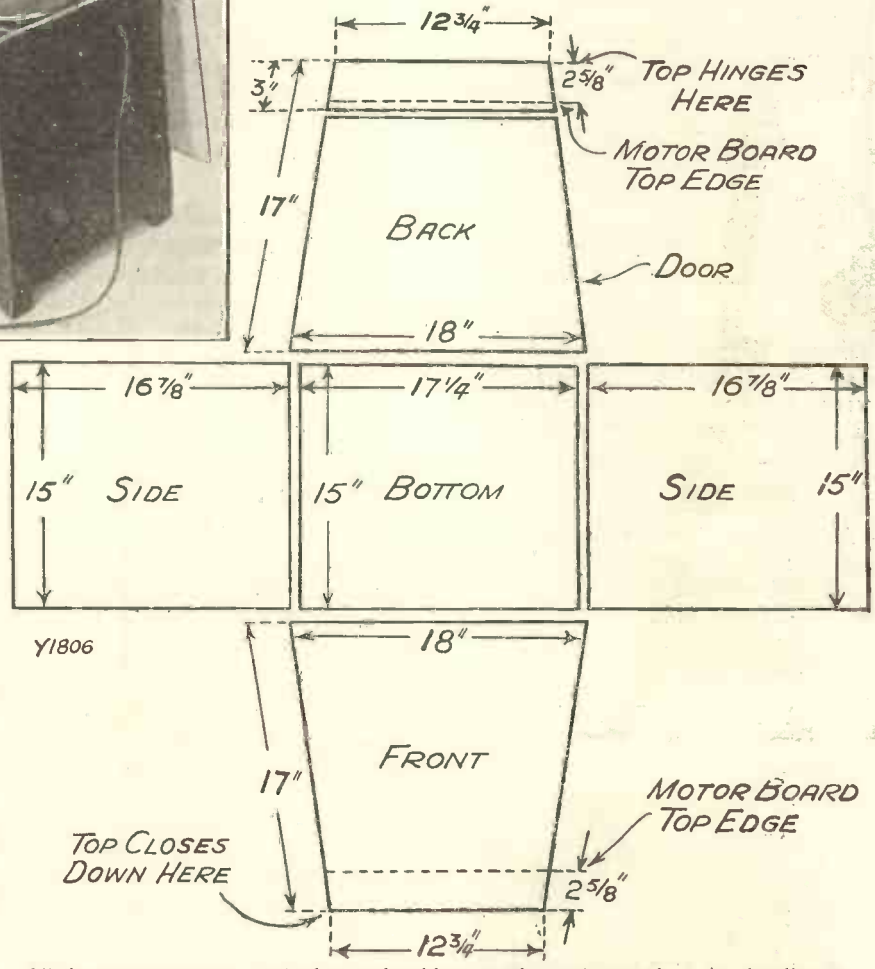
One of the standard types of lid restraining hinge is employed on one side of the lid, any type being used. Some may prefer the friction type, others the automatic catch variety—it obviously does not matter which.

For Moving About

If desired it would be a simple job to fit small castors or domes of silence so that the cabinet could be pushed away into a corner when not in use. Although not heavy in itself, the weight is considerably increased when a good stock of records is on board.

The "Univolt" motor unit is dropped into the cabinet on the motor board and screwed into place. The terminals on the unit for connection to the set are used for a long length of metallised pick-up flex, the metal covering of the flex being earthed at the set end. A plug into the mains completes the connections from the cabinet, and the outfit is ready for working.

STAND IT BESIDE YOUR ARMCHAIR



All the measurements required to make this attractive unit are given in the diagrams. You can stain and polish it so that it will tone with almost any type of furniture.

The WORLD'S PROGRAMMES

HOW, WHEN AND WHERE TO HEAR THOSE FOREIGNERS—

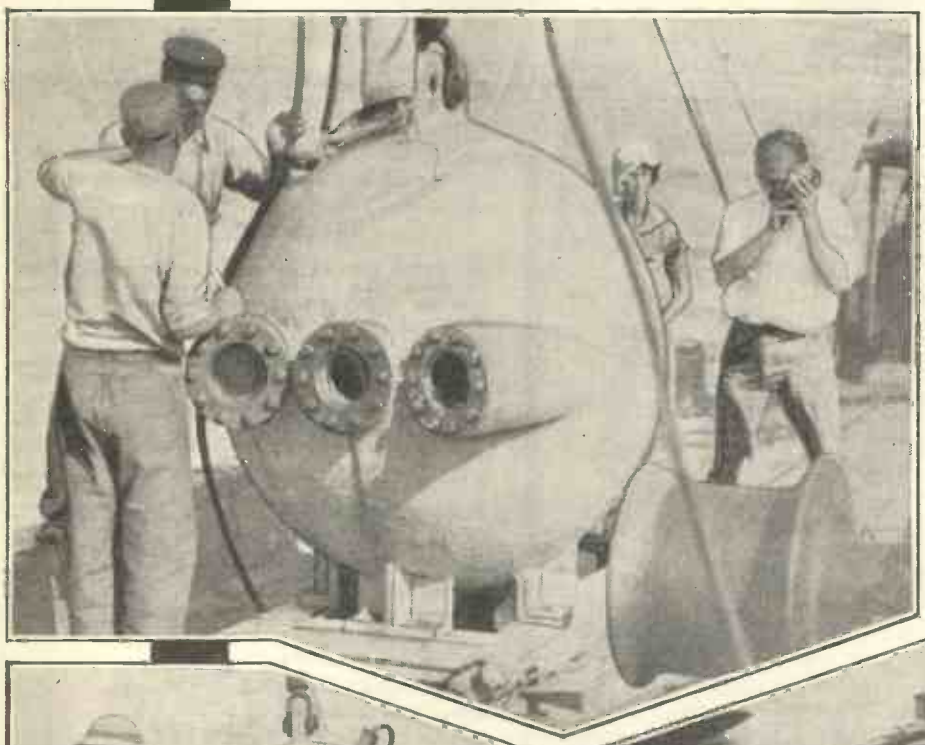
DR. ERNST HARDT, on whose shoulders rests the responsibility for the programmes sent out from the Westdeutscher Rundfunk station at Cologne.

CONTENTS OF THIS SPECIAL SUPPLEMENT

A TRIP TO THE OCEAN BED!

"I wonder what it's like at the bottom of the ocean," said Dr. William Beebe of Bermuda one morning. And so being of a curious turn of mind, Dr. Beebe determined to find out for himself—with the aid of a bathysphere having glass windows. A commentary on the adventurous doctor's experience was broadcast by American stations.

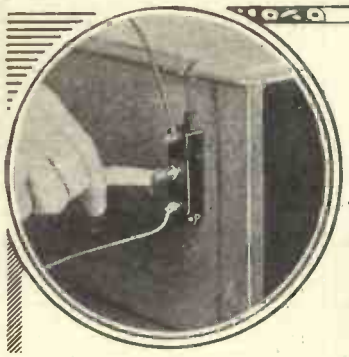
At 2,000 feet below the surface even the stout fastenings of the bathysphere could not withstand the pressure, and Dr. Beebe found himself sitting in icy-cold water which had leaked through the bolts. Back on the surface again, he was quick to bale it out with a bucket!



All ready to start (left) on this epoch-making trip to the ocean bed. The telephone and an alarm clock are being attached to the bathysphere, and then away we go.

Below is the gear on the deck of the "Freedom" which provided Dr. Beebe with a telephone through which he could talk to his friends on deck.

The picture in the bottom left-hand corner of the page snows Dr. Beebe undoing the last turn of the main bolt after the bathysphere had been tested on the sea bed.
The internal pressure blew this bolt 30 ft. across the deck.



SITTING UP FOR AMERICA

The medium waves have been most interesting recently, in that transatlantic reception has been excellent.

This and all other medium-wave news is gathered here for listeners.

QUITE the most interesting thing about medium waves during the past few weeks has been the continued excellence of transatlantic reception. Scores of surprised set-owners, hearing that American stations sometimes come over after the Europeans, have closed down at midnight, or thereabouts, have turned the dials and received a strong programme which they thought must be Rome or Barcelona, or some old favourite like that.

And then an unmistakable American has come on and clearly announced himself, and the set-owner either goes to bed astonished—or sits up and tries for more!

* * * *

For the benefit of those who have ambitions in the way of picking up America direct, here are some important hints on the subject. First, listen with your watch in front of you, and expect the station's call-sign at the even fifteen minutes.

Have a pencil and paper ready, or you may forget the letters. Sometimes they are given briefly, such as "You are listening to K G O" broadcasting from so and so; and sometimes they are accompanied by a slogan like "W I O D—Wonderful Island of Dreams," which distracts attention from the call-sign unless your pencil is ready for it.

* * * *

Most of the American call-letter groups begin with W, but some of the K's are getting over well. And don't be too surprised if you hear an L—not from the U.S.A., but from the Argentine, for the Buenos Aires stations, L R 3 and L R 4 have been widely successful of late.

* * * *

Finally, remember "Z." In the U.S.A. they don't pronounce it "Zed," but they always say "Zee" instead, so the call letters "W J Z," for instance, sounds to us like W J B or W J C or W J D—not a bit like W J "*Zed*."

* * * *

On our own side of the Atlantic we have the new and much-talked of Athlone station, which has taken over Dublin's duties on 413 metres. It seems to be likely to give us excellent strength and quality, but there has been some disappointment over the programmes, as such. And, generally, the more one listens to other stations, the greater becomes one's regard for B.B.C. methods!

* * * *

Another interesting new-comer to watch has been the new Toulouse, on test, while on 210 metres we now have the Hungarian Magyarovar. (For long this wavelength was somewhat impolitely known as "Cess-pool's," that being the usual rendering of the Hungarian name Csepel.)

* * * *

The daylight strength of many of the Continentals is something to marvel at. We have become so accustomed to the association of long-distance with darkness that many set-owners have no idea of what their sets can do before the light fails, or after sunrise, and as the longer days will mitigate against this class of reception, now is the time to try, if you are interested.

* *

Listeners who are finding that Dublin tends to wipe out clear reception from Berlin Witzleben, on 419·5 metres, will watch with interest for further news of the latter's new station, which is to be another step in Germany's radio reorganisation.

Katowice, too, about one degree on the dial below Dublin, has been somewhat overshadowed by him—much to the regret of the "Letter Box" listeners, who enjoy the answers to correspondents which are a regular feature from the Polish station.

* * * *

One particularly interesting feature of daylight reception which will appeal to the keen foreign station-finder is that quite a number of the really low-powered stations can now be heard. The best time for this freak distance-spanning is the afternoon, from about 3 p.m. onwards.

The Swedish relays just above 200 metres appear to be unusually adapted to set up records of this kind, although a power of only about a quarter of a kilowatt is employed!

"Huomio, huomio! Lahti-Helsinki." Do you recognise this announcement? Then what about accompanying Our Special Correspondent on a visit to Finland to make the further acquaintance of the long-waver on 1,796 metres?

ALTHOUGH I had a French-speaking friend who had promised to take me to the Lahti wireless station, I made a valiant effort several days before to add to my smatterings of European tongues by mastering conversational Finnish.

Language Difficulties

Never again! I am sure that the pronunciation is above the average Briton. I tried my Finnish on a man I met near the station, when I wasn't quite sure which was the shortest cut to take.

"*Hyvaa paivaa, mita tieta paasen Radio Lahti?*" I asked in the manner born, but he just looked at me, smiled, said "*Kiitos*," and passed on. As *Kiitos* is simply the Finnish equivalent of "Thanks muchly," I'm still wondering what he really thought I had asked him!

"*Viides katu vasemmalle ja sitten kuudes oikealle . . . .*" started a postman on a glorious flow of language when I tried the question on him, but when paper and pencil were produced he proved that he was only trying to be helpful in directing me "fifth to the right and sixth to the left," which I duly followed and so arrived at the studios of the Lahti station.

A Consolation

There I was met by my French radio engineer friend, who, before we started talking about radio, entirely removed any likelihood of my ever speaking Finnish by explaining that all words, nouns, adjectives and numerals are declined, and that there are no less than fifteen cases.

I don't want to bore you with Finnish grammar, but it is interesting, as my friend pointed out, that in Estonian (which is similar) the fifteen cases take the place of our prepositions. Therefore, there is no such broadcaster as Radio Tallina—the name which most people give to the well-known station. *Tallin* is the name of the place. *Tallina* means "to Tallin."

British tourists, seeing the word Tallina on signposts have supposed that the radio station itself should be called Tallina, and not Tallin! A little knowledge . . .!

My only consolation at Lahti was that in Finnish most of the radio and electrical terms are the same as in English, and so the station engineers were able to give me a good idea of the plant without my French friend having to interpret everything.

Dignified Studio

Swedish is also used in Finland, and so here and there, where pidgin-English broke down, a few words of Swedish came to the rescue. Such are the trials of a British radio "fan" abroad!

Well, they took me first into the announcer's studio, a most dignified place quite unlike any studio of the B.B.C. There is just a faint resemblance to the old Savoy Hill studios in the shape of the sound-damping curtains hiding the roof, but that is all.

The announcer has a desk of his own, with a carbon microphone standing on it, and at the side a keyboard controlling signal lights. There is another tall desk in the room, topped with a resilient pad so that the announcer doesn't get his papers rustling. The main "mike" of this studio is on a stand. It has to be shifted about, because this is the room from which they give the very occasional radio plays.

Heavily Draped

They use the Reisz-type of carbon microphone, which is now standard at most foreign stations (except the Germans, who favour condenser microphones), and coloured indicator lights on the doors, *à la* B.B.C. in the pre-Broadcasting House days! It is a lofty, dignified studio, and is used much by the programme staff during the day for rehearsals and the more important interviews.

Then there is the big concert studio, a spacious carpeted room some fifty feet long. They turned two smaller rooms into one in order to get the length, and so it is rather spoiled by pillars which had to be put up to keep the roof in place! But these are covered in curtaining to match the material on the walls.

The roof and door and window openings are heavily draped with curtains, but the walls are covered with a colour-harmonising material pasted on to hide the felt, or whatever it is behind the decoration, to damp out echo.

Morning Music

A station orchestra broadcasts from this room nearly every night. I saw a group of about a dozen rehearsing, but the studio would hold an orchestra of fifty. There are two microphones.

Before I was taken over to the Lahti transmitter, one of the studio staff told me how their programmes are arranged. They have music at about half-past six in the morning—gramophone music, and then a short talk. Sunday morning is the particular time for early starting. On the "late" mornings the Lahti programme starts at 10 a.m.

Lady Announcer

The station orchestra gives its turn between six and seven, and between eight and ten. A news agency supplies Lahti with a special bulletin at about half-past seven every night, and the announcer gives this out in Finnish and Swedish. Before leaving for the transmitter, I met the charming lady announcer who sometimes gives an affectionate "*Huomio, huomio! Lahti-Helsinki*" through the Lahti "mike."

IN THE CONCERT ROOM

The orchestral arrangements at Lahti seem most homelike, with warm carpets and heavy curtains surrounding a grand piano and a few music stands. Actually the room has received very careful acoustic treatment.

One of the most important parts of the transmitter is the landline panel for the cables through from the studios and going out to the relays of the Lahti programmes: Helsingfors (Helsinki, as they call it) and so on.

Maybe you remember the time when Helsingfors was the main station, and there was only a small relay transmitter at Lahti. My knowledge of the history of this time of broadcasting was soon brushed up by our guide, who drew out a pencil scheme showing how the studios, relays and Lahti are now interconnected.

Remote Control

The Lahti station chief told me that it is a sixty-kilowatter. I was a little surprised. It didn't look so big as all that. After a while I found that he meant total input; according to our rating we should call Lahti a 40-kilowatter. But that still entitles it to be called a long-wave giant!

Right in the centre of the transmitting room is a big white control panel with small aluminium buttons which work through relays. They control the power circuits, and the tuning is done with remote controls ending in car-type wheels.

The white panel is connected with the valve cooling pumps. I have an idea that British-made water-cooled valves are being used. It was not tactful to ask, for, judging by the rest of the station, they should have been German!

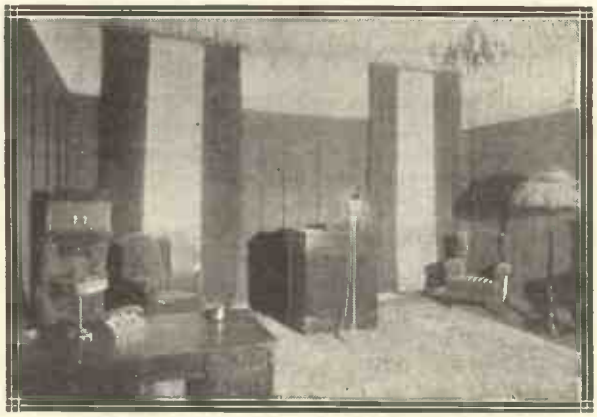
Quality Check

In one corner of the room are two speech amplifiers on the sort of trolleys that are used for operating tables in hospitals! Just why, I didn't fathom. There is no real need for these amplifiers to be moved, for they are the main modulation stages. The valves are hidden in crystalline metal boxes fitted with meters on top, which tell the whole story. A most elaborate multi-cable links these boxes with the transmitter proper. The speech cables coming in to the amplifier boxes are shielded.

In quite a number of the transmitters I have visited there has been no indication of what is being broadcast. At Lahti it is different. A big cone loudspeaker in the actual transmitter room can be connected at the touch of a switch either to a check receiver or to the landline amplifier. The result is that all the time the transmitter is going the room is flooded with the Lahti-Helsinki programme.

By being able to connect the loudspeaker either to the check receiver or to the landline amplifier in quick succession, it is possible for the engineers to keep a constant watch on the actual performance of the transmitter.

There should, of course, be no aurally discernible difference between the quality of reproduction in either case



REMINISCENT OF SAVOY HILL

The sound-damping curtains on the ceiling of the announcer's room at Lahti are faintly reminiscent of the old Savoy Hill. A Reisz-type carbon microphone is used at the announcer's desk.

LISTENING FROM KAUNAS TO KIEV

What to look out for on the waveband between 2,000 and 1,000 metres, and some interesting notes on the stations themselves.

NEAR the lower end of the long-wave dial the U.S.S.R. stations are still somewhat unsettled, but some very good programmes have been heard from the Moscow station on 1,000 metres.

Moscow Popoff has, at the time of writing, taken up a position, with Reykjavik and Istanbul, on 1,200 metres.

* * *

Despite the first reports to the contrary, the U.S.S.R. representatives undoubtedly did "sign on the dotted line" at the Madrid Conference, so we may hope that one cause of congestion in the European wavelength jam is now to be removed by co-operation.

* * *

Roumania is the source of a somewhat startling rumour to the effect that a super-power station is under construction, to work on 1,980 metres. The power to be assigned to this newcomer—if he ever materialises—is said to be no less than 150 kilowatts, thus threatening Warsaw's pride of place as the most powerful long-wave broadcaster in the world.

* * *

Another report of interest to long-wave listeners is to the effect that Russia is contemplating the world's biggest station to work on 500 kilowatts, probably on a long wavelength. This is admittedly only in the possibility stage as yet, but in view of the present success of the Soviet programmes in reaching this country it is noteworthy.

* * *

There was not much in the way of novelty to record on long waves during the past few weeks, but for form's sake it may be mentioned that Hilversum is now announcing on the Huizen wavelength, the long-waver having made the usual exchange with the 296·1-metre station on January 1st. The next change-over will therefore be on March 31st, after which Huizen becomes Huizen again, on 1,875 metres—until mid-summer!

* * *

A question which has recently been cropping up quite frequently concerning long-wave reception is that of the chances of receiving American stations after the European transmitters have closed. It is curious that such an idea should have got about, because there are *no* truly long-wave broadcasting stations in the U.S.A., so it is quite obviously hopeless to talk of such a possibility.

* * *

Apparently the fact that the *medium* waves—with wavelengths anywhere between 200 and 600 metres—have been so successful in this respect, has caused people to refer to them—*medium* waves—as "long," to distinguish such reception from the really short-wave stuff below 100 metres.

Anyhow, the facts are plain enough. There are no stations in the U.S.A. on 1,000 metres or above, but the medium-wavers, as recounted on another page, have been doing the transatlantic crossing frequently and well.

* * *

In view of the general excellence of long-wave reception during the past few weeks, there is little point in mentioning the performance of the usual and favourite stations, all of which have lived up to their reputations. Perhaps a special word is due to Warsaw, however, for the excellence of its music, but it is difficult to select one station where all have justified the hopes of the distant listener.

* * *

We can only hope that nothing will delay the much hoped for new Daventry long-waver, because with the first-class representation of other countries on the higher wavelengths it is time that the B.B.C. was adequately represented there by a quality station of reasonably high power.

FRAMES FOR FOREIGNERS

Quite apart from the satisfaction of telling your neighbour that without an outside aerial you can get all the stations he can, the frame aerial has distinct and valuable properties which you cannot afford to neglect.

IT is generally accepted, or perhaps I had better say it *was* generally accepted, that the higher and larger the aerial the better for long-distance work. And although this is sometimes assumed still to apply to-day, the tremendous amplification obtainable from the S.G. valves has really altered things.

Selectivity Paramount

As a matter of fact, with some modern sets little seems to be gained in increasing the size of the aerial beyond a quite small optimum size. On the contrary, to do so often results in an undesirable loss of selectivity.

This quality of selectivity is the biggest problem in long-distance reception at the present, and rather pushes the question of power into the background. And that is why I would suggest that the possibilities of frame-aerial reception for distance work are worth consideration.

THE POST OFFICE AERIAL

The Post Office officials make full use of the directional properties of frame aerials in their detector vans.

Directional Properties

Quite apart from anything else, there is an added thrill to receiving some far-off station on the speaker when the sole means of pick-up is a frame aerial. And when you compare logs with a friend, what a feeling of superiority it gives to be able to inform him that you received them all on a frame!

Still, that aspect may not carry much weight with you personally, so let's get along with some more practical advantages. The chief advantage of a frame aerial is its directional selectivity.

An Explanation

I expect you will understand just what is meant by that. Anyway, for those who are quite new to frame-aerial theory, let me explain.

The direction in which a frame aerial is pointing governs which stations it will bring in. A station will be best received when the aerial is pointing directly towards it, and hardly heard (if heard at all) when the frame is at right angles to its direction.

Thus you see that if two stations adjacent in wavelength tend to interfere badly on an ordinary set, and if their directions from the receiving station form approximately a right angle, the use of a frame for reception will enable them to be completely separated. Of course, the directions do not have to be completely at right angles for the effect to take place, but the nearer the approach to a right angle, the greater the separating effect will be.

Connecting Up

The following frame connections will be found to apply to most sets. First of all disconnect all wires (except the lead to the tuning condensers), from the grid of the valve holder that takes the first S.G. valve.

This grid terminal is then joined to one end of the frame aerial winding, and the other end is joined to L.T. negative or some point connected up with this. That is all, but a slight variation from this will be needed in the case of a ganged receiver.

With such a set the tuning condenser should be disconnected from the grid terminal as well, and an external ·0005-mfd. variable condenser wired across the frame. In sets where the coils and condensers are not completely screened from one another, the frame and its condenser, if an external one is used, should be kept a foot or two from the receiver.

Constructional Details

And now a few words about suggested frames.

But it is an easy job to make up a frame to take the winding at home. I suggest that it should be arranged so that the winding has 2-ft. sides and is square.

Suitable wire is easily provided, as anything except very fine stuff will serve O.K., particularly in the case of a long-wave frame. By the way, so far as home-wound frames are concerned, I advise you to have separate ones for the two bands, as an ordinary shorting wavechange switch is not satisfactory, although a tapping will often serve the purpose.

Guiding Figures

For medium waves use about 11 turns spaced about $\frac{1}{4}$ in., and for long waves two to three times this number spaced considerably closer. These figures will serve as a guide, and you can put on a few more or take one or two off according to the wave-range you achieve in practice.

A. S. C.

Photos by courtesy of "Radio-Journal," Prague

OTHER PEOPLE'S PROGRAMMES

No. 3.—CZECHOSLOVAKIA

Though Czechoslovakia is only a post-war State it has a broadcasting service of which any ancient country might well be proud. This month we discuss the programmes which come from Prague, Brno, and the other famous Czechoslovakian stations.

"CZECHOSLOVAKIA?" you say. "What do I want to know about their programmes for?" But if I were to mention Prague, Brno, Bratislava, or perhaps Moravska-Ostrava, you will probably begin to sit up and take notice, for it is not always realised that five of Europe's most interesting broadcasters belong to that little country—and it is not so little, either—which separates Austria from Poland.

Quality Programmes

There is much that is of interest in these Czechoslovak programmes, which can boast a period of service not very much less than that of our own B.B.C. For it was in May, 1923, that Prague first began to broadcast, to be followed only a year later with a new transmitter under the control of "Radio-Journal," then a private company.

"Radio-Journal" still has charge of the programmes, but the company has been reorganised since those earlier days, and is now a semi-government concern. But the tradition of those days still remains, and the Czechoslovak programmes must be placed very high up in the list when one comes to estimate the entertainment value of European broadcasting.

Permanent Orchestra

Just as the technical side of Czechoslovak broadcasting has shown progress and development equal to any in the world since those first days when a 5-kilowatt transmitter was considered a real luxury, so the artistic and cultural level of the broadcast has shown a parallel development. As an example, the permanent Prague orchestra was enlarged, so that it now consists of 46 picked instrumentalists and holds a prominent position beside those international orchestras which also have a place in the programmes.

For the musical development Professor Jirak and Herrn Jeremias must be given the credit, for they have not rested until they have provided permanent studio orchestras and quartets which are the equals of the world-famous National Czech orchestras.

A FAMOUS ORCHESTRA

The Prague studio orchestra which, from small beginnings, has grown, under the able leadership of O. Jeremias, into one of the most popular of European orchestras.

Frequent Opera Relays

Very popular with foreign listeners, too, are the military band concerts which are frequently given from the Prague or Brno studios. Nor must we forget the frequent relays from the Smetana Hall of Opera, a type of programme which commands more respect and interest in continental cities than it does on this side of the Channel.

All this proves that Prague has rightly been called a leading town in the musical world—a reputation which the programme directors of "Radio-Journal" guard most jealously.

Dr. Kares is in charge of what are called the "literary programmes" of Czech broadcasting. These include not only the talks, which are varied and interesting enough to please the most fastidious listener, but also an excellent selection of radio plays.

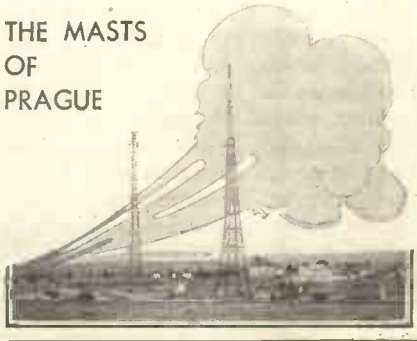
One of these plays, which had a sensational success recently and of which Dr. Kares is justly proud, was a new version of the ever-popular theme of "Faust." This was written by Dr. Kares himself, with musical accompaniment by Herrn Jeremias. Prague listeners haven't stopped talking about it yet.

Diverse Talks

Talks have improved recently and have been extended to include lectures by the most prominent scientists and thinkers in the country. Technical lectures on industry, commerce, trade and economics have a big following; lectures for women and children are as much enjoyed; while courses in German and other languages have their place in the week's programme.

An address by the Archbishop of Prague, news of new books, "How a Film is Made," a lady doctor talks to a mother, "My Theatre Reminiscences," by a blind actor—these talk

THE MASTS OF PRAGUE



titles taken at random from a recent issue of "Europa Stunde" (Prague's equivalent of "World Radio") give an idea of the varied nature of the Czech programmes, which begin at 6.15 a.m. with the crowing of a cock and a gymnastic lesson from Prague, and which end at about 11 p.m.

The officials at Prague will always point out to foreign friends that they

"PRAGUE CALLING"

Pour Ferdinand whose genial voice is well known to listeners on 488·6 metres.

were responsible for one of the very first running commentaries on a football match. This followed another notable outside broadcast—a relay of the Sokol festivities and gymnastic performances in the early part of 1926. To-day there is not one important event in the realm of culture or sport which is not broadcast from one or other of the Czech stations.

Lady Announcer

The first broadcast from Prague in the German language took place in October, 1925. To-day German transmissions are sent out regularly every evening, weekdays and Sundays. In addition, the ordinary programmes contain both German lessons for Czech listeners and Czech lessons for German listeners.

The studios at Prague and Brno have managed to gather together a staff of announcers who are as remarkable for their many talents as they are efficient at their work.

Maria Tomanova, for instance, whose photograph is on this page, is famed for her knowledge of languages. As a result of her school-days she can speak German, French, English, Italian, and Russian, as well as her own language, while she has found it necessary also to learn Serbo-Croat since the Prague programme is so often relayed to Yugoslavia.

Incidentally, Frau Tomanova, before joining the Prague studio in 1929, was in great demand in various embassies both in Czechoslovakia and abroad on account of her remarkable abilities as a shorthand-typist!

Then there is Jan Liska, who started life as a very successful merchant. During the war Jan served as a wireless operator. In 1925 he deserted the export trade and returned to wireless—this time as announcer at Brno.

A Fine Tribute

The "father" of them all, of course, is the genial Adolf Dobrovolny, who might have been excused for thinking his career ended before he took up announcing! After an exciting career as an actor and theatrical manager, he became managing director of the first National Playhouse in Brno and afterwards of the Czechoslovak National Theatre in Prague. In 1924, after he had retired from active work, the "Radio-Journal" company persuaded him to announce for them, and no finer

AN EDITOR-COMMENTATOR

Josef Laufer, sports editor of a famous Prague newspaper, who undertakes all the sporting commentaries which are relayed by Czechoslovak stations. His first football commentary was in 1926.

tribute to his work could be paid than this sentence which I saw only the other day in a Prague newspaper:

"We must tell Mr. Dobrovolny that a weather report given by him is much more pleasant than a recitation of 'Hamlet' by many a prominent actor."

Last But Not Least

And I have kept to the last the charming Margarete Hoffman, who when I asked her for some particulars of herself sent me the most delightful letter, which makes me wonder whether Signora Boncompagni of Rome has not another serious rival!

Fraulein Hoffman, who is 24, is an orphan and, after promising to make a brilliant musical career for herself, she was compelled through necessity to take a job just as she was working for her degree as professor of music.

"My first job," so her letter runs, "was that of a correspondent in a publishing firm. Then I worked in a wholesale business and became well acquainted with this work. My only joy after a long, hard day's work was a four-valve set in my landlord's house. There I could forget my troubles and imagine myself again in touch with my beloved music.

Talented Staff

"One day I am told that the radio company wants someone who knows at least three languages. Of course I went there—and passed the exam. I was accepted as second announcer.

"I was not a bit nervous, as I knew that the first announcer would introduce me to the art of announcing. But fate willed otherwise. On the day when I was to begin my job, he died from appendicitis. So I had to rely on my own capabilities."

With such a delightful and talented staff, and with Herrn Josef Laufer, the well-known sports journalist, in charge of the running commentaries, it is little wonder that Czechoslovak broadcasting is a friendly, family affair.

Satisfied Listeners

Though the Czechoslovak listener wants to enjoy life as much as he can, the point of view that radio only serves for amusement is now quite out of date. The Czech listener wants to be amused, but he is just as keen on studying languages and on listening to good music and literature, and he appreciates the facility for getting these in his home.

The increasing number of listeners is proof that the tendencies and the contents of the Prague and the other programmes have been well chosen.

SHE KNOWS SIX LANGUAGES

Maria Tomanova was taken on to the announcing staff at Prague on the strength of her linguistic abilities. Since then she has added Croat to her "bag" of languages.

The German Point of View

A. A. Gulliland raises an interesting and controversial point with regard to announcements from British stations during international relays.

THE B.B.C. has a wonderful motto: "Nation shall speak peace unto Nation." But the worst about it is, we outside the B.B.C. seem to be the only people who realise that this motto exists.

Have a look at the frequent cases when German stations take programmes from London studios. (I only refer to Anglo-German relays because I have full data on them, for all I know the same thing may be the case when French or Italian or other stations are relaying B.B.C. programmes.)

A Case in Point

A short while ago a number of German stations relayed a programme of English and Scottish student songs from the London studio. Later on in the evening a programme of dance music by Henry Hall was taken from London by Berlin.

LADY OF LANGENBERG

A photograph taken in the Westdeutscher Rundfunk studios at Cologne during the performance of a radio play.

I was listening-in to the Witzleben station, my local station, at the time. Witzleben, as very often happens when it is relaying programmes, was about five minutes late, so they just switched over to London after a short German announcement and got in bang in the middle of a song.

Usual Rapid English

Now, this was Witzleben's fault, not the B.B.C.'s. But throughout that programme the B.B.C. announcer spoke his usual rapid English, made no reference to the millions of Germans listening-in for the first time to British student songs from a British studio, and did not even attempt to say a word to those foreign listeners at the close of the programme. Instead, after the last song there was silence and then the Berlin announcer said that we had just heard student songs from London.

Some time later, when Berlin went over to Henry Hall, the preliminary announcement was again in German by the Berlin announcer, who said: "We are now going over to London for dance music" much as he would say, "We are now going over to the Eden Hotel for dance music."

The German Verdict

The effect was strictly the same as after his words we heard Henry Hall, heard the usual English announcements and the programme closed without one word from the B.B.C. announcer to his foreign listeners.

I thought that perhaps these two occasions were just a fluke. Perhaps for this light entertainment programme it had been arranged that the B.B.C. were not going to take any notice of the millions of German listeners.

But on other occasions I have found the procedure repeated.

Talking to German friends I found that they missed some sort of greeting from London; "but, then, of course, who could expect anybody to speak German over there?" was *their* general verdict.

What Does the B.B.C. Do?

Speaking to an R.R.G. official about the matter he said that at present there were no hard and fast rules as to the exchange of programmes between the two countries, but it was the general practice for each country to do its own announcing.

Now, I fully realise that announcements in several languages take up a certain amount of time, but on the other hand if I have a German to dinner, and I know he does not understand English, I do my best to translate or speak his language, or I do not invite him. But the B.B.C., when it has millions of foreign listeners officially listening, and not just eavesdropping by means of powerful receivers, what does the B.B.C. do?

Nothing. It wraps itself in silence, and Berlin, therefore, goes over to London for its dance music just as if it were switching over to the Kaffee Vaterland. The only difference is that the items are announced in English.

Impersonal and Cold

The present method is impersonal and cold in the extreme.

A REAL PIONEER

Zeesen's engineer-in-charge, E. Schwartzkopf, was responsible for organising the first concerts from Königs Wusterhausen in 1919.

If things go on as they are at present, both foreign and home listeners will wonder at the lack of understanding on behalf of the other man, and then I, for one, would vote for economy in landlines.

EDITOR'S NOTE:—Since this article was printed it has been noticed that, on one occasion at least, an announcement in German was made from the London studio in connection with a dance band relay.

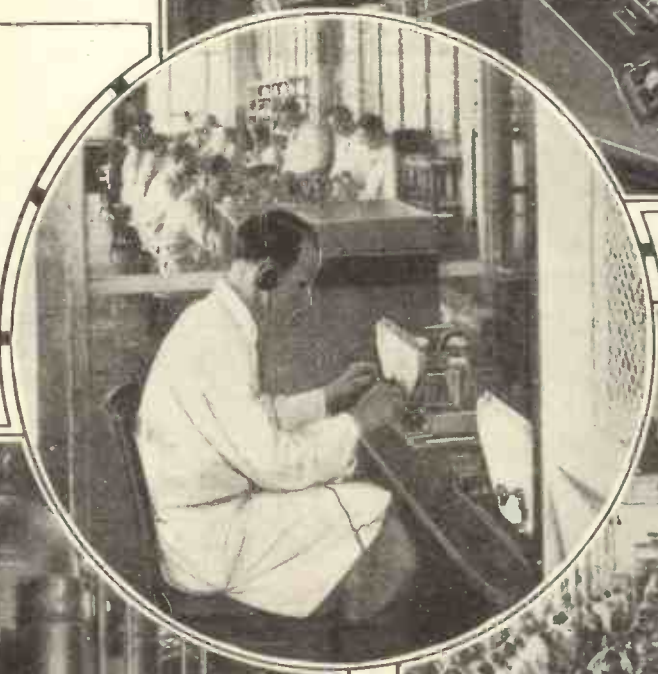
SET MAKING AND SET TESTING

Pictures from Germany which show the stages in the assembly of radio receivers.

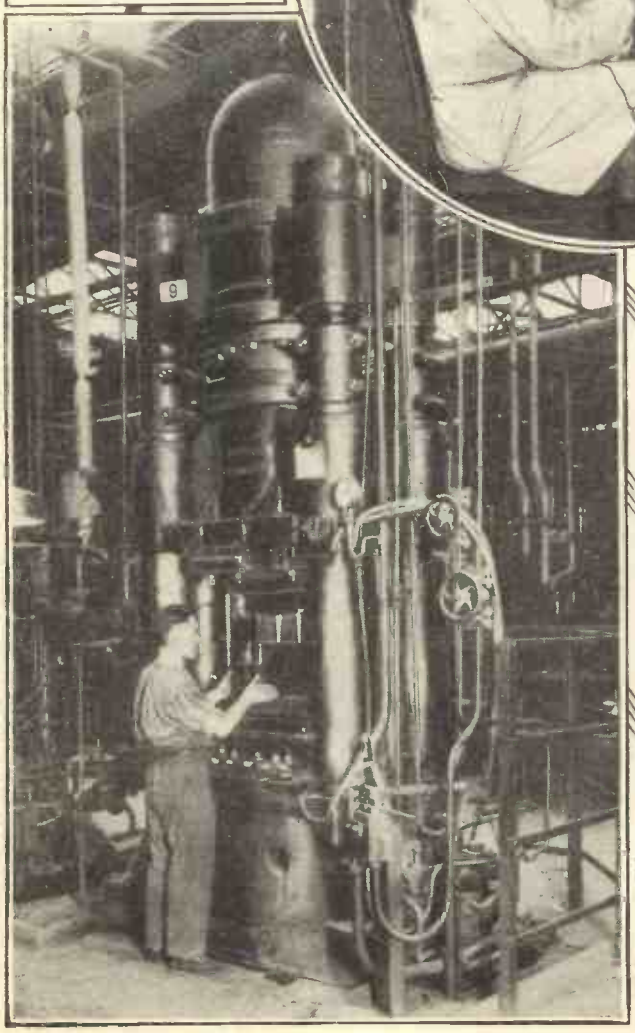
(Below) Every transformer must pass stringent tests as to its electrical qualities before being mounted in a receiver.

LIKE A BIRD IN A CAGE

is this engineer, who is responsible for the very important tests of selectivity. As in every up-to-date radio construction factory, this stage of the tests is made in a wire-screened cage, so that the operator is shielded from any outside influences or interference which might upset his minute calculations. Selectivity tests assume an even greater importance to-day with the increase in numbers and power of European broadcasters.

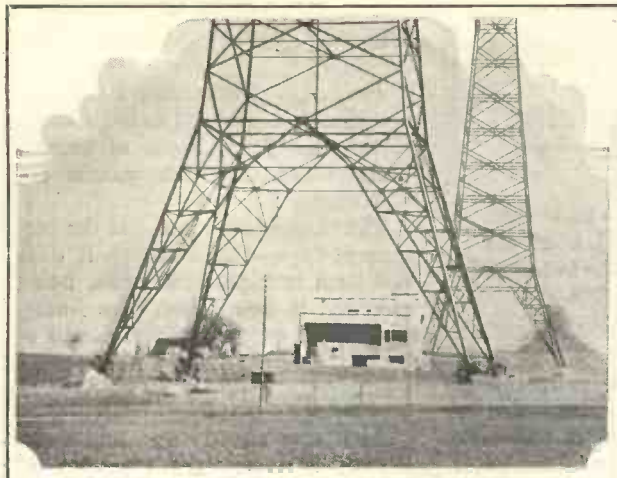


(Below) A section of a big German radio factory showing constructors working in front of a slow-moving conveyor band which facilitates their work.



SETS AND SPEAKERS HYDRAULICALLY BUILT

The casings of up-to-date wireless sets and loudspeakers are made from compressed materials under pressures of 400–500 atmospheres, as produced by huge hydraulic presses, one of which is seen on the left. The steam-heated moulds in this connection have to be made with the greatest accuracy from the hardest steel.



OTHER STATIONS' AFFAIRS

The latest news—flashed from all over the world—concerning broadcasting stations, their wavelengths, their power and their situation.

SAN JUAN, PORTO RICO. By some strange freak the Porto Rico station has frequently been picked up late at night in this country, although its power is only 1 kw. (Wavelength, 242·2 metres.)

* * *

ATHLONE, IRISH FREE STATE. The first tests with the new Dublin station at Athlone were all on half-power, 40 kilowatts or less, but the engineers are increasing power until the station works "all out."

* * *

MONTE CENERE, ITALY. The new Italian regional station being built at Monte Cenere, Tessin, will use a wavelength of 750 metres.

* * *

453·2 METRES. This is one of Europe's most crowded wavelengths, it being occupied by all the following stations: San Sebastian, Salamanca, Odessa, Danzig, Klagenfurt, Porsgrund, Tromsö, Bödo and Uppsala.

* * *

LJUBLJANA, YUGOSLAVIA. The object of this station (575 metres) is religious, and its station director is a priest.

* * *

LEIPZIG, GERMANY. The new Leipzig transmitter has had the effect of sending up the German licence figures to the original level from which they dropped a few months ago—nearly 5,000,000.

* * *

MADRID, SPAIN. The B.B.C. thinks it is possible that a new wavelength plan will be in operation next season as a result of the Madrid Conference.

* * *

GRAHAMSTOWN, SOUTH AFRICA. When Cape Town gets its new station the old one will probably serve as a relay for the Grahamstown district.

* *

S.S. BELGENLAND. During her recent world tour this vessel transmitted periodically on 7 and 4·5 metres, to determine whether reception was possible at the Slough Research station, but at no time was contact made on these wavelengths.

* * *

REYKJAVIK, ICELAND. This station (1,200 metres) claims the youngest regular announcer in Europe, Miss Sigrun Oegmund, aged 20.

* * *

HAVANA, CUBA. The new station that has recently been erected at Havana is operating on the same wavelength as that employed by Rome (441 metres).

* * *

SALISBURY, RHODESIA. The experimental broadcasts to decide which is the most suitable wavelength to serve local listeners will probably continue until next month.

* * *

BERLIN WITZLEBEN, GERMANY. This station is due for overhaul under the German Regional scheme and may be working on high power (120 kilowatts, like Leipzig) within the next few months.

* * *

MILNERTON, SOUTH AFRICA. The site for Cape Town's new station is about four miles from the city, near the Cape Flats. Its power will be about twenty times that of the present Cape Town station.

* * *

SAN ANTONIO, TEX. This low-powered station modestly announces itself as "K T A P—The World's Biggest Little Station."

* * *

MAGYAROVAR, HUNGARY. Budapest's programmes are now being relayed by Magyarovar on 210 metres.

* * *

NEW YORK, U.S.A. Recent estimates of the total number of wireless sets in use in the U.S.A. agree on an approximate figure of eighteen millions.

* * *

SLOUGH, BUCKS. Recent successes in the development of constant frequencies give rise to the probability of achieving a permanent standard which is accurate to within one part in a hundred millions!

* * *

DAYEUHKOLOT, JAVA. A new station is to be erected at Dayeuhkolot, near Bandoeng, at a cost of £13,700.

* * *

BISAMBERG, AUSTRIA. News from this, the site of Vienna's new high-power transmitter, indicates that work may be completed next month—or by Whitsun!

* * *

LOS ANGELES, CALIFORNIA. Even the Los Angeles station, K F I, which is about 6,000 miles from this country, has been heard after midnight by listeners here on ordinary good long-distance receivers. The wavelength is 468 metres.

* * *

SCHWEIZERISCHER LANDESSENDER, SWITZERLAND. This station generally broadcasts a selection of newly released gramophone records on Tuesdays at 8.30 p.m.

* * *

DUBLIN, IRISH FREE STATE. A proposal to institute an official short-wave station for the I.F.S. has been turned down on account of the expense involved.

* * *

WYCHBOLD, WORCS. This is the name of the village near Droitwich where the B.C.C. engineers, at work on the site for the new "Daventry," are concentrated.

The station that replaces 5 G B will use 60 to 70 kilowatts, while that which takes over the duties of 5 X X will probably use 100 kilowatts.

* * *

RADIO NORMANDIE, FRANCE. The Director of this station recently outlined a scheme for running a second station—a 60-kilowatter—close to the existing one at Fécamp, but on a widely-different wavelength.

* * *

SWITZERLAND. The Swiss Telegraph Department—always to the fore in international communication good offices—has proposed a European wavelength conference, to take place in June.

* * *

RADIO ALGIERS, N. AFRICA. When the post of lady announcer recently became vacant more than fifty applications were received. (Men were not eligible.)

* *

LILLE, FRANCE. A large mansion in the heart of Lille is to be converted by the municipality into France's first Broadcasting House, at a cost of over £8,000.

BROADCASTING THE WISDOM OF W I L L !

Quite a number of American universities and colleges have their own experimental wireless stations. But station W I L L of the University of Illinois—which becomes a broadcaster in the evenings—is the most interesting of them all.

You will have to go right back to the beginnings of radio in America if you want to dig up the origins of W I L L, the radio broadcaster owned and operated by the University of Illinois, U.S.A.

Quite a number of American universities and university colleges run radio stations as a sort of side-line. W I L L, the station run by the Electrical Engineering Department of the University of Illinois, is probably the most important of the stations of its kind.

Located at Urbana, in the American State of Illinois, the station, under the long-experienced guidance of its director, Dr. Joseph F. Wright, jogs happily and contentedly along on a 500-watt aerial input power and a 273-metre wavelength.

Modest Claims

It is doubtful whether you will ever have included W I L L in your bag of American stations, for this particular broadcaster has apparently little taste for a long-distance reputation, and its claims in that direction are, to say the least, modest.

At one time, W I L L was an experimental station, pure and simple. Now, however, it serves a considerable section of the Illinois community. Its activities are increasing monthly in this direction.

For the last two or three years station W I L L has broadcast regularly, and on an average thrice weekly, the actual class lectures which are attended by the students of the University.

Lectures for Listeners

A good deal of real and serious knowledge in literature, history and science has thus been disseminated, and, judging from the ever-widening activities of the University and station authorities in this matter of study broadcasting, W I L L has flung out its wisdom through radio channels with enormous success.

Naturally enough, the station has its own little studio in which the characteristic and accredited high-brow touch may be disregarded for the passing hour, and in which the more usual forms of broadcast entertainment and amusement may be conducted.

A Nightly Change-Over

Hence it is, therefore, that when the day's study broadcasts are over, W I L L metamorphoses itself into an ordinary radio broadcaster, and thus the happy game goes on.

And, strange as it may seem, W I L L accomplishes all its work with the aid of the simplest of radio apparatus, so far as broadcasting equipment goes these days. The entire transmitting equipment—power house, control rooms; everything, in fact—is contained within a small but modern building erected apart from the University buildings.

Two 200-ft. steel lattice masts support the aerial of the station, the earthing system being constructed immediately below the aerial structure.

Inside the transmitter house the equipment is arranged so as to afford it the maximum degree of accessibility consistent with satisfactory efficiency.

The transmitter itself is of the permanent type—that is to say, it does not form transportable units, being mounted in heavy iron pipe framework fixed securely on base slabs of cement.

For Practical Training

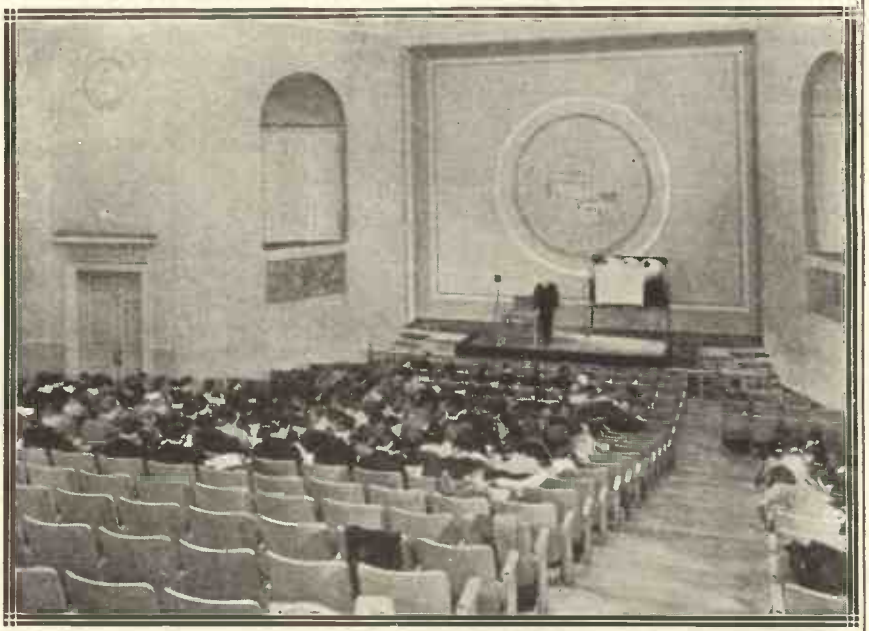
As I have already mentioned, the station is under the direction of Dr. Joseph F. Wright, Professor of Electrical Engineering in the University. Under the supervision of the Director, however, senior students are allowed to take increasing control and responsibility of the actual routine working of the transmitter.

On top of all this, the station experts find time to carry on original research in radio.

Where there's a W I L L there's a way!

Then, again, station W I L L maintains a purely experimental department and a radio laboratory in which a good deal of research work having a practical bearing on the many problems of radio is carried out. The radio laboratory, or a portion of it, at least, also serves as a training ground in radio technique for the more elementary students.

UNIVERSITY STUDY AT THE FIRESIDE



While Professor Lybyer, expert on history, lectures to the students in the University, outside listeners are enabled to eavesdrop through the microphone and transmitter of W I L L. This regular double-audience arrangement is probably unique in broadcast education.

An "ETHER COP" IN THE PRAIRIE

The "Constant Frequency Monitoring Station of the United States Government" is the full title of the ether policeman in Nebraska—the station which checks the wavelengths of the broadcasters of the world. Incidentally this station has one of the biggest vertical receiving aerials in the world.

EVERY few months I get a news bulletin from a radio friend in the U.S. Bureau of Standards. I had not heard from him for some weeks, and when at last he did write it appears that he had left his home at Washington and gone out to Nebraska—not leading a gay cowboy life, but on a visit to what he claims is the biggest ether-policing station in the world.

Official Title

It is officially known as the Grand Island station—a little group of buildings seven miles or so out from the railway halt which gives the radio station its name.

The official title of this ether policeman is the "Constant Frequency Monitoring Station of the United States Government," but American radio fans know it, says my friend, simply as the "ether cop," which is succinct and expressive.

Works Day and Night

Unlike the B.B.C. Tatsfield station, or the European wavelength-checking station at Brussels, the Grand Island station works day and night. It does not officially check up B.B.C. wavelengths, but it works in conjunction with the chief Governments of the world and keeps a watchful eye on commercial stations.

Therefore, this tiny station, far out on the Nebraska prairie, forms a link with our slice of the ether.

The land—it is almost a garden—on which the station stands was given to the Government by the local authorities, and they have put up two bungalow-type buildings which are really quite good to look upon. There is a bevy of aerial masts, and of long trailing poles for the aerials. They are all painted white, so the station looks neat. There are eleven aerials altogether, four being short-wavers.

The short-wave aerials are directional. One points towards London, another towards the North of Rio de Janeiro, and so on. What looks like an extra stout aerial mast is in reality a long brass tube, about 65 ft. high, mounted against one of the aerial masts.

It is one of the biggest vertical receiving aerials in the world, and can be divided electrically for reception on a good many wavebands. There is an ordinary broadcast band aerial and a long, single-wire aerial running out nearly a quarter of a mile from the station. This is used for checking up the wavelengths of radio beacons.

Just inside the Grand Island station is a room where the aerial wires are connected to lightning gaps, and some of them pass through special filters to prevent interference between the lines. Then they are taken up to the roof of the main building and come down through shielded conduits to the checking receivers.

Separate Units

The rooms are spacious. In a room measuring about 40 ft. by 50 ft. there are only four receivers. They look very much like the superhet receivers which the British Post Office uses for transatlantic telephony; that is, they are built on panels with each receiver unit separate.

As rough weather is sometimes experienced on the prairie, each of the check receivers has an indoor frame aerial, so that if any of the outdoor wires get blown down, emergency reception can still be carried out with a frame.

Three Main Sets

There are three main sets, one tuning from about 10 metres to 200 (covering all the short waves), another from 200 to 3,000, and a special long-wave set which goes up to about 30,000 metres.

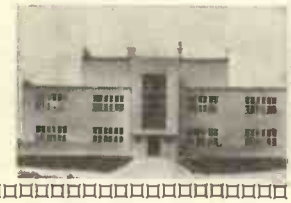
They are unit-construction jobs, and an interesting fact to a set designer is that the 10-metre sets have *three tuned high-frequency stages.*

THE STATION THEY CAUGHT AT LAST

Unauthorised and unlicensed transmitters are given short shift when detected. What do you think of this short-wave transmitter, with a range of 5,000 miles, which was discovered, after a two years' search, directing "rum-running" operations from Alaska to Central America.

CHAOS!

The Madrid Conference on wavelengths is over. What has it settled? How will listeners benefit?



By Our Special Correspondent.

THAT famous conference every single listener has been eagerly awaiting, the conference whose decisions were to set Europe's ether aright, the Madrid Conference—it closed in December.

The broadcasters set out full of hope; they had carefully considered every aspect and demanded some twenty new waves. And what have they got? Forty-one kc. on the long waves and ten kc. on the medium waveband! Not over twenty waves as they had hoped, but just five and a half whole waves providing for the usual 9 kc. separation.

One Long Fight

Madrid was one long fight. One suggestion after the other was brought forward and rejected. Broadcasting has not been able to obtain more wave space, and the decisions of Madrid will rule the next five years till the next conference. So broadcasters and listeners will have to find other ways and means of getting clear from mutual interference of stations. Listeners by getting more selective sets, and broadcasters by completely revising the Prague wavelength plan.

This is to be done at the invitation of the Swiss postal administration. Every government in Europe will be requested to present suggestions regarding a new wave-plan for European broadcasting, and after these suggestions have been received and duly circulated the new wave conference, the second of its kind, is to take place somewhere in Switzerland not later than June 1st, 1933.

Europe's Ether

I have superscribed this article with one word: "Chaos." This was not just a word to catch the eye, it means something; it represents the present condition of Europe's ether. The European Union of Broadcasters publishes through its technical committee a large graph every month showing the result of measurements effected at the Brussels wave-check station of the U.I.R.

Taking the graph for November, 1932, I counted the number of stations checked. I also counted the wave channels laying down 9 kc. as the normal distance from wave to wave, and the result exemplifies to the eye what the ear hears on turning the tuning-dial of a broadcast receiver for distant reception. During the count I was unable to register all those very small stations working on single wavelengths or on common waves, so that quite possibly the number is actually greater.

During the month of November the Brussels check station measured about 210 stations. Of these 40 worked on waves above 600 metres, and 170 stations below 600 metres.

The telegraphy stations are not included. Now if you take the wavebands 200–577 metres and 630 metres to 2,000 metres—the waves actually used by broadcasting stations in Europe at present—there is only space for 145 stations. Now if we cut out the waves not belonging to the broadcast waveband, as it is, only three stations (Geneva, the new Budapest station and Oslo) work there, besides the Russians, of course, i.e. if we cut out the waves from 630–1,154 metres, twenty-four in all, there remain 121 waves and 191 stations.

COLLECTING THE EVIDENCE

The wavelength checking station at Brussels, which provided a great percentage of the evidence of interfering stations and narrow separation for the Madrid conference.

Too Many Stations

Then, if we deduct the 16 waves or so which are used by several stations at once, there remain 105 waves and 151 stations. And these 105 wave channels are more than Madrid actually allows us by two or three! So that we have 50 stations too many, not counting those already sharing wavelengths with others.

Going over the graph a second time I found that actually only 42 stations in Europe have clear 9 kc. on each side of them, and of these stations six were Russians; thus only about 36 stations remain. Now this does not mean that there are only about 36 stations in Europe which work free from interference at present. There are more, as, of course, a station sharing a wavelength with another which is situated at a great distance from it will probably not find local reception very much impaired.

Interference

But in spite of this favourable factor, the fact remains that of 210 stations measured at Brussels during the month of November, hardly more than about 60 are free from interference of some sort caused by neighbouring transmitters. And this again greatly depends on where the distant listener happen to be. In Spain he will rope in stations clearly which he would be unable to hear in Russia, and in Italy he will get stations with no interference that are badly heterodyned in Sweden, although there is the case of Rome, which was interfered with by a small Swedish relay for many months. Even in the local reception zone round Rome the heterodyne whistle was clearly observed.

(*Continued on page* 144)

DISTANT STATIONS —AND HOW TO HEAR THEM

WHAT TO EXPECT DURING DAYLIGHT

DURING the evenings we expect to receive foreign stations at good strength, and if we do not we immediately begin to wonder what has happened to the receiver, and soon after that we are either pulling the set to bits in an endeavour to discover the reason for lack of signals or, depending upon whether we are a technical listener or not, 'phoning the service man to pull the set to pieces for us.

TRIUMPHANT OPENING

And yet those who cannot receive at least half a dozen foreign stations at good strength during daylight should most certainly look into the matter, for they are either situated in a bad locality so far as radio is concerned, or else something is wrong with their set.

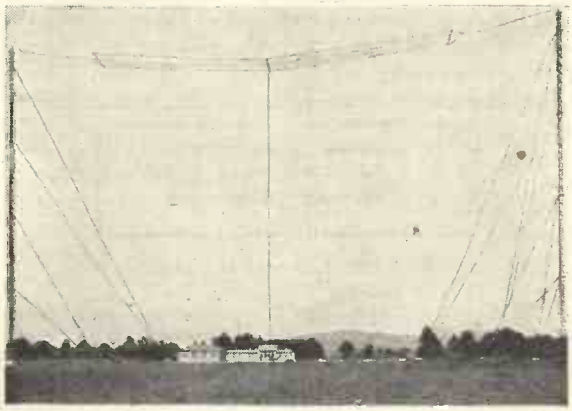
Throughout the day Hilversum upon 296·1 metres provides a good signal and is well worth listening to, for it "puts over" exceptionally fine and well-balanced programmes. Then at 12 noon you should most certainly spare a moment to hear the triumphant opening of the well-known Fécamp station upon 223 metres (or thereabouts, depending upon the station operator's ideas). The chimes of a church bell are heard, and then what at first sight might be mistaken for a frequency checking record is heard. It is in reality the "buzzer" or "siren" (which ever you prefer) of a Normandy factory. After this amazing entrance, the well-known Normandy folk song ("Normandy") is played. Then follows a programme of gramophone records.

DAYLIGHT DX

Far away Budapest also provides a good—if not so spectacular a commencement as Fécamp—programme, and this station generally provides a good signal from 1 p.m. onwards. Even farther afield Ljubljana, the Yugo- (or is it "Jugo"? No one seems quite certain) Slavian station, provided a signal audible in this country during daylight.

POWERFUL RUSSIANS

Russian transmitters are also heard on many occasions. Turn to 424·3 metres. In all probability you will find a quite powerful station operating. Moscow-Stalin, in all probability. Astrakan (R V 35) is another amazing Russian station, for although situated upon the shores of the Caspian Sea, and employing, so I understand, merely 10 kw., this station frequently provides quite a powerful signal during daylight. This station operates upon a wavelength so near that of Brussels (No. 1), that when both stations are operating a severe heterodyne results.



"Even farther afield, Ljubljana, the Yugoslavian station, provides a signal audible in this country during daylight."

If you are lucky you may also hear Samara (R V 16) upon 575 metres, and Oufa (R V 22), besides many other DX stations.

SHORT-WAVE NEWS

The usual changes in conditions have been responsible for a number of alterations in the list of "Best Stations to Listen For" that everyone compiles mentally, and the following are some of the more uncommon stations that have been received very well during the last month.

Nairobi (V Q 7 L O) on 49·5 metres comes over well almost every evening between 6.30 and 7.30 p.m. There is usually no fading, the modulation is high and the quality excellent.

Pittsburgh (W 8 X K) on 48·86 metres is one of the best and most reliable "Yanks," although he is now being run pretty close by Philadelphia (W 3 X A U) on 49·5.

EASY TO RECEIVE

Another station in the same wave-band that is also extremely easy to receive at times is Miami (W 4 X B) on 49·67 metres. Although not so consistent as the nearer Americans, Miami simply pours in on a good night.

Bound Brook (W 3 X A L) on 49·18 comes in the same category as Miami—strength rather than consistency is his good point.

Another station worth mentioning in the 49-metre group is Johannesburg on 49·2. If you ever hear Nairobi you should be fairly sure of finding Jo'burg just below him and slightly weaker.

TREMENDOUS STRENGTH

Coming down to the 31-metre band, we find several stations worthy of mention for their consistency, and the absolute ease with which one can nearly always find them. Bandoeng (P L V), although not broadcasting at present, can be heard working telephony with Holland on 31·86 metres in the afternoons. His strength is tremendous—more reminiscent of a local medium-wave station than a distant short-waver.

Buenos Aires (L S X) on 28·98, and Cairo (S U V) on 29·84, come in the same category.

Madrid (E A Q) is a pukka broadcasting station on 30·4 metres, and probably needs no introduction to most of my readers. G S C, the Empire station on 31·3 metres, is now

PRACTICAL NOTES FOR THE "DX" MAN

in full swing and seems to provide good programme-value even in parts of Britain, although he is naturally not so strong at short distances as G S A on 49·6.

The station that everybody wants to hear, of course, is Sydney (V K 2 M E) on 31·28 metres. Just at present he can generally be heard between 1 and 5 p.m., and again between 6 and 9 a.m.

Zeesen (D J A) on 31·38 is another "local" that gives one no difficulty at all except from occasional bursts of fading.

At the time of writing, conditions are not too good for the 25- and 19-metre groups of stations, in this country at any rate.

From information received from abroad it seems that the Empire station on 19·8 is received at equal strength with Radio Colonial (F Y A) on 19·68 metres in most parts of the world, although he uses a beam directed towards Canada! Probably the B.B.C. have also had their "omni-directional" aerial in use on this wavelength.

IDENTIFYING GERMAN STATIONS

There are so many German stations on the air at the present time that many long-distance enthusiasts have difficulty in identifying them. Here are some hints which may make matters easier. The only German station on the long waves is Königs Wusterhausen (Zeesen), whose wavelength lies between those of Daventry and Radio-Paris. The medium-wave group consists of nine main stations with their relays. These are Hamburg (relayed by Bremen, Flensburg, Hanover and Kiel), Stuttgart (Freiburg), Leipzig (Dresden), Breslau (Gleiwitz), Frankfurt (Cassel) Heilsberg (Königsberg and Danzig), Langenberg, Munich (Nürnberg,

AERIAL AT W2XAF

The system used by this station for tests with Australia.

Augsburg and Kaiserslautern) and Berlin Witzleben. In all announcements the name of the main station is followed by those of the relays, but Langenberg announces "Westdeutscher Rundfunk." The only relays likely to be heard in the lower part of the medium waveband are Flensburg, Kiel, Nürnberg and Gleiwitz. At the top of the band are Kaiserslautern, Augsburg, Hanover and Freiburg. All of these can be identified from the call-signs, taken in connection with the wavelength.

CAREFUL TRIMMING PAYS

In the modern multi-valve set with two, three or more circuits tuned simultaneously by means of the ganged condenser, it pays handsomely to spend a little time over the trimming of the variable condenser units, for this may make all the difference to both the selectivity and the sensitiveness of the set.

A mistake often made is to trim only upon one transmission, choosing a station somewhere near the middle of the medium wave-band.

A better plan is first of all to trim closely on a transmission such as Heilsberg's in the lower half of the band, and then to turn to Langenberg or Prague near the other end. Re-trim, noticing just how much movement is required for each trimmer. Now set the trimmers to an intermediate position between the two and try first Heilsberg, then a "middle" station, such as Strasbourg, and lastly Langenberg or Prague. A little further fine adjustment will find a compromise which enables all of these stations to be brought in equally well.

CHAOS!

—continued from page 142

Now, stations working too close to each other are not the only cause of the present state of the European ether. I find a new-old factor: new because we all thought it had been got rid of; old because it used to be very frequent indeed—Harmonics! Moscow's third harmonic is perilously close to Stockholm, and Leningrad's second close to Belgrade. Daventry's 5 X X seventh harmonic was measured, so was Sottens' second on 1,485 kc.

Remodelling Needed

The Berne conference in June, 1933, will have to completely remodel the European wavelength plan and find space for the large number of stations which have cropped up since the Prague Plan of 1929.

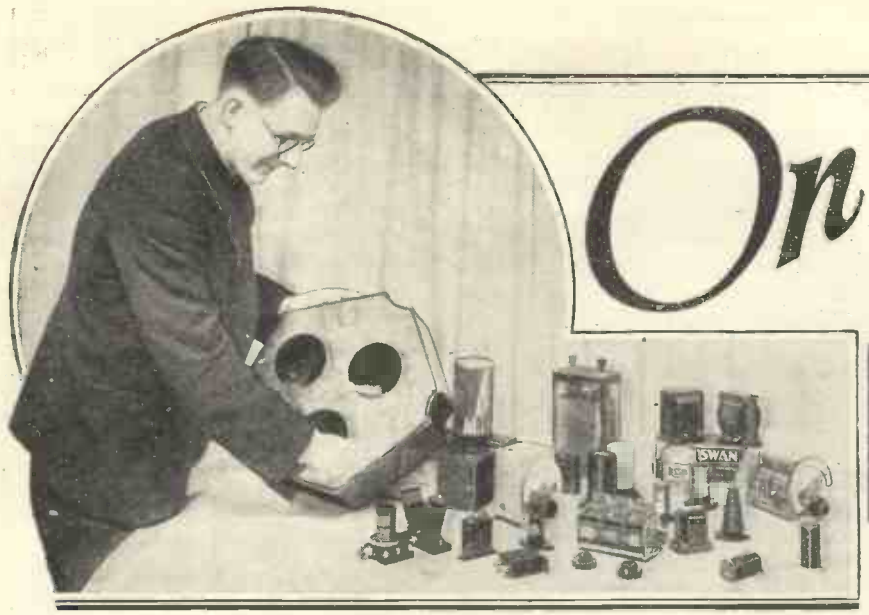
On the wave chart, stations operating according to the Prague Plan are shown with thick lines connecting the check points, the new-comers with a thin line. Of the 210 stations, or rather of the 210 waves checked at Prague during November, 1932, 107 operated according to the Prague Plan and 103 had thin lines. This one hundred and three includes four harmonics and 22 unknown signals which were checked more or less regularly.

As probably a number of the unknown stations are actually harmonics of other stations we can take it that there are about 90 stations which Brussels measures and checks every month that work outside the provisions of the Prague Plan.

Now the forthcoming conference at Berne is up against it. It has to find room for about ninety stations, and has only been given five and a half more channels to do it in. If we still deduct the Russian stations, which for the reason of the distance between them and our own stations are not always causes of interference, and as a number of them work outside our waveband, if we still deduct them and the four European stations at present working outside the band, there remain about 60–70 stations that will have to be provided for. Of these about 25–30 already share waves.

Question of Power

Then there is the question of power. Since the time of Prague the total power of the European stations has increased many times. We have close on thirty stations using more than 60 kw. in aerial. Even now, after the opening of Leipzig, Bucharest is complaining, and Poste Parisien has complained officially of Breslau, and in these cases it is impossible to move the waves by just one kc. like one did in the Mühlacker–London case. These are the problems the Berne conference is up against.



On the TEST BENCH

Our comments regarding some interesting new components.

Fine Moving-Coil Speaker

THE accompanying photograph very clearly illustrates the handsome appearance of the Minor R.K. Reproducer (Ediswan).

Complete in oak cabinet, it retails at the most attractive price of £2 17s. 6d.

THE MINOR R.K.

The permanent-magnet Minor R.K. Reproducer in an oak cabinet.

It is the permanent-magnet model, and is fitted with a multi-ratio input transformer for pentode or power valve matching.

Having a first-class magnetic system, it is a sensitive instrument able to give good results with the smaller types of sets.

And as it has a freely moving cone, it is capable of handling the heavier powers with complete satisfaction.

Both the unit itself and the cabinet have obviously been designed with thought and precision, which, in the circumstances, is not surprising.

There is good bass response, and throughout the register a clear-cut cleanness giving pleasing renderings of both speech and music.

Erie Resistors

These world-famous components have been manufactured in this country for some time now.

They are available in a very wide range of capacities suitable for all purposes. There are Erie grid leaks as well as resistances for intervalve coupling, decoupling, mains units, and such purposes.

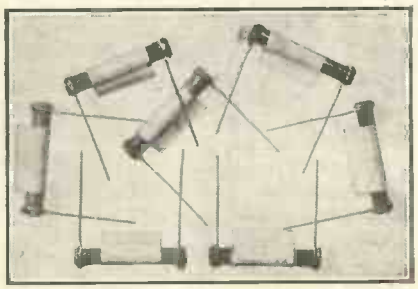
Our tests have shown them to be very close indeed to their published specifications, well inside the usually accepted tolerances, and moreover to be consistent and reliable when in use.

An ingenious colour code has been adopted, allowing one to determine their values at a glance. This is in addition to labels.

Electrolytic Condensers

We have had an opportunity of testing a number of Hellesen electrolytic condensers of both the wet and dry type.

IN CODE COLOURS



These components are coloured in accordance with an ingenious value-indicating code.

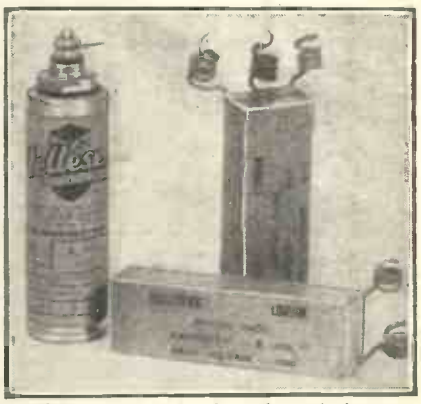
In regard to the latter the Hellesens are the first British dry types we have come across.

Their great attraction is that they can be mounted in any position instead of having to be kept vertical.

Constructors will also appreciate the greater ease with which they can be connected into circuit.

Multi-microfarads in a small space are now well within the scope of home set builders.

WET AND DRY TYPES



Hellesen wet and dry electrolytic condensers.

These Hellesens are obtainable in a very usefully comprehensive range, and our tests prove them to be good components in every way.

Set Switching

Listeners who have installed several loudspeakers in different rooms of their houses should be keenly interested in a new production of Messrs. Wates Radio.

It is the Distance Switch for switching off a set. It can be operated by " bell pushes " over practically any

Observations on Some Interesting Components

distance. Alternate operations of these " bell pushes " then switch the set on and off.

The device is applicable to both battery and mains sets, and there is even a model available which will deal with a set using an " eliminator."

WATES' DISTANCE SWITCH

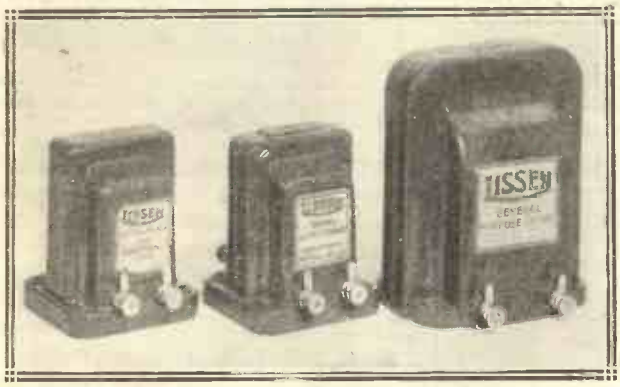
An interesting device for easy listening.

Its mechanism is simple and its action positive. In construction it is very robust, and we cannot visualise it letting its user down, however hard and long it was made to work.

Lissen Components

Among a large number of Lissen items recently received from that well-known firm, there are three L.F. chokes.

THREE DEPENDABLE L.F. CHOKES



The Lissen intervalve and sn oothing, tapped output, and general purpose chokes.

These are respectively an intervalve, a tapped output, and a general purpose type. The intervalve has an inductance of 80 henries, and its application is to L.F. interstage coupling of various forms.

The tapped output has 16 henries of inductance and can carry 20 milliamps., and the general purpose 25 henries at 20 milliamps. and 18 henries at 60 milliamps.

All three are undoubtedly good components, and within their specifications give full satisfaction.

A Fine Unit

The British Radiophone " Radiopak " comprises all the essential elements for band-passing an S.G.-det. type of set. And they are all built into the one compact unit.

The great advantages of this method for the constructor are obvious. If the design has been well carried out, there will be that perfect matching of parts so essential to successful band-passing and which is so difficult, if not impossible, to obtain with individually assembled parts.

Additionally, there will be a saving in connections and, incidentally, an economy in wiring which in itself will contribute in no small measure to the efficiency of the set.

And we can say that all the above is applicable to the " Radiopak." It is a first-class example of the most modern radio-engineering, and we advise all constructors to obtain the interesting and informative literature about it which is published by the makers.

New Accumulator

The Block Accumulator is quite revolutionary. Built into an artistic coloured case it has no interleaving plates to disintegrate or buckle, and has twice the capacity of an ordinary accumulator of similar size and weight.

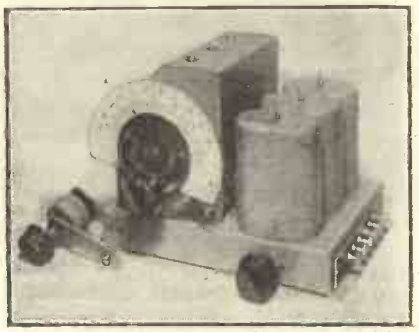
We have had a Block under test in the Research Dept. for the past two months or so and it has fully substantiated the capacity and reliability claims made for it.

There only remains the life test, and we do not doubt that that will be completely favourable to the Block in view of its present performances.

The Block accumulator is a very modern and notable development of the famous Fuller Block accumulator which served our armed forces so excellently during the Great War.

That it will attain considerable popularity is beyond doubt ; indeed, it will in all probability have done that before these words appear in print.

THE " RADIOPAK "



A first-class band-pass unit due to British Radiophone Ltd.

An accumulator of comely appearance deserves public approbation, but when it has the technical characteristics and working advantages of the Block, it becomes an achievement.

THE BLOCK

An accumulator which does not employ plates and is built into an attractive container.

A brief review of a typical selection of the latest gramophone records.

THE gloves are off in the world of discs, and the struggle for popular acclaim is getting harder and harder. Witness the latest move of the Crystalate Co. and of the Panachord makers.

Some time ago the Vocalion Co. developed the Broadcast long-playing record; we were provided with good quality reproduction at an inexpensive price, and the pitch of the grooves of the records was such that an 8-inch disc gave the playing time of a normal 10-inch, and the larger Broadcast provided between four and five minutes' entertainment per side.

Years went by and Vocalion linked up with the Crystalate Co., who now produce the popular Broadcast records. A few months ago the Durium Record Co. decided on their newsagent distributing scheme and also to have a single-sided record, but with two full-length items on the one side.

"FOUR-IN-ONE"

This was followed by Sterno with the "Four-in-One" record—a disc of normal size which gave choice of four tunes instead of the usual two.

Now Broadcast have taken the fight a step further with the production of a "four-tune" record, using a groove pitch that enables them to give about ten minutes of music on the one disc. And all at 1s. 6d.!

Moreover, the first two records show that the recording is quite up to the usual Broadcast standard, and the items chosen provide an extremely powerful team.

Thus Broadcast No. 501 gives on one side The Blue Mountaineers playing **Yes, Mr. Brown** and **Dreaming**, while on the other side are The Rhythm Rascals disporting themselves with **I Don't Want to Go to Bed** and that popular Continental success, **Lying in the Hay**.

The second "Four-Tune" disc (No. 502) contains The Blue Mountaineers playing **Old Mother Hubbard** and **Please**, while turning over we find **Mimi** and **My Romance** recorded by Al Benny's Broadway Boys.

Well done, Broadcast!

The second item of particular interest is the fact that Panachords are now reduced to 1s. 3d., which will surely add further to their increasing popularity.

As I said before, the gloves are off, and with a vengeance, too.

COLUMBIA

Those **Accordeon Nights** are still going strong. I refer to those played by Geraldo and His Accordeon Band, for the sixth record under this title has just been made, making a fine addition to the series. It includes such favourite numbers as "**Song of the Bells**," "**On a Dreamy Afternoon**," and "**Venetian Lady**," and will be very popular. (DX425.)

Another very good light record is that by Howard Jacobs, on which he plays **I Love the Moon** and **From the Land of the Sky Blue Water** on the saxophone. Jacobs is a member of the Savoy Hotel Orpheans band, and the sweet tone he gets out of his instrument is enhanced by the string quartet and harp accompaniment. (DB1005).

The Archibald Joyce **Waltzes'** disc by Debroy Somers and His Band will please a great many people, and is a tuneful reminder of the pre-war days. "Dreaming," "Passing of Salome," "Vision d'Amour," and so on, are titles of popular waltzes that remain unforgotten by many.

Heavier in style is the Grenadier Guards Ballet **Egyptien**, which they have re-recorded recently. It makes a really vivid disc, and is one of the finest ever produced by the famous band. (DX423.)

Rudy Vallee's popular "signature" tune, **Let's Put Out The Lights**, is one of the dance numbers that is sweeping Western civilisation; it has become a veritable craze in some parts. Now we have it recorded by Sydney Torch on the cinema organ of the Regal Cinema, Marble Arch.

He puts quite a different interpretation on the number, with his cuckoo clock background. On the other side is **Isn't It Romantic**, theme song of "Love Me To-night," also excellently played, though I cannot help feeling that we shall soon get tired of this particular number. As an organ recording of dance tunes this record is unsurpassed. (DB995).

We must not forget Henry Hall and the B.B.C. Dance Orchestra when discussing dance numbers. It is a very much improved band nowadays, and is worthy to take its place with those stage successes of the past (and present): Hylton, Payne, Whiteman, and so on.

The rearrangement of the brass section and the "hotting-up" of the orchestrations have done wonders. This month we have "canned" versions by H. H. of Wanderer (the latest Flanagan and Allen craze) and **Always in My Heart**. (CB538.) Henry has also done the other Flanagan and Allen success, **Dreaming**, with Ray Noble's composition, **Love is the Sweetest Thing**, on the other side. (CB530.)

A POPULAR RECORDER

Ray Noble, who is rapidly coming right to the fore among dance music orchestrators and band leaders. He records for H.M.V.

Brahms' Hungarian Dances (No. 5 in G minor and No. 6 in D) have been recorded by the Hallé Orchestra under the baton of Sir Hamilton Harty. This is on 5466.

Charles Kullman singing **Her Name is Mary**, a delightful ballad, with Lehar's **Only My Song**, on DB1006 is a piece of artistry that will find favour in a great many homes; in fact, all lovers of good tenor singing should hear this record.

Hubert Eisdell is another favourite of mine: I always enjoy his duets with Dora Labette, but here he is on his own singing **Looking For You** and **Love's Song is Sung**. His is a tenor voice of complete freedom in operation, with a clarity and diction that many of the famous would do well to copy. (DB996.)

Some of the best jazz music has to offer is contained in two Medleys of the most famous hits written by George Gershwin and Jerome Kern on a Columbia record played by Carroll Gibbons and the Savoy Hotel Orpheans.

In the Gershwin we have, as a fitting finale, the "Rhapsody in Blue," featuring Carroll Gibbons in some clever piano work. This is preceded by such well-remembered successes as "Lady, Be Good," "I'll Build a Stairway to Paradise," "The Man I Love," "S'Wonderful," and "I Got Rhythm." The big tune of the other side is "Old Man River" (from "Show Boat"), and this comes at the end of a brilliant series of numbers including "Who's Baby Are You?" "Why Do I Love You?" "Ka-lu-a," "Can't Help Lovin' Dat Man," "Look For The Silver Lining" and "Who?" The orchestration is very fine, especially in the grouping of various sections of the band. (DX424.)

A record that is a record in more ways than one is **Laughing Through**, just issued by Columbia. It is doubtful whether I have ever heard a record which was more certain to convulse its hearers, and I understand it is computed that this will during the present month set at least one million folk laughing.

If you attempted to count the actual laughs, individual and collective, in this record you would readily allow the justification of its description as the record of a thousand laughs. The record also was a record in speedy production, having actually been recorded, manufactured, and distributed nationally to gramophone dealers in three-and-a-half days.

"Laughing Through" is a record of sheer laughter, built up in snowball fashion. The chief laughter-maker, Charles Penrose, endeavours to let his friends know "What happened to Smith," but the telling of the story is lost in laughter. You should hear it. (DB1010.)

H.M.V.

The two outstanding features of the latest H.M.V. list of records are (1) that by the issue of twelve 10-inch records the gramophone now assumes the rôle of an astrologist, and (2) the release of the first records by the new dance band—Ray Noble whose picture you see on this page, and His Orchestra.

The astrological discs are by Robert H. Naylor, and will probably be much sought after by persons of either sex and all ages. It is a well-known astrological theory that the destinies of people are largely determined by the period of the year in which they are born, and each of the twelve H.M.V. records deals with sections of the year as determined by the signs of the Zodiac.

For instance, B4293 covers the period January 21st to February 19th inclusive, and so on. The records are called **What the Stars Foretell**.

Now let us pass to the records by a new star of a different firmament, Ray Noble, who is now featured with his new orchestra as one of the premier dance bands in the H.M.V. list. If he can maintain the same standard throughout the year that he has created by his first three discs, his records should be the most popular in the country.

He has written a very fine orchestration for the well-known Indian Love Lyrics, **Temple Bells** and **Less Than The Dust**, of which his orchestra gives a rhythmic interpretation on B6266. A new vocalist contributes to the success of these two songs in their new form.

Four popular hits of the moment, **Please**, **Here Lies Love**, **Yes, Mr. Brown**, and **Balloons**, show the calibre of this new band. It would be difficult to find a better version of these numbers, which will be best-sellers. The recording is perfect, and I strongly recommend them.

Once again England's greatest modern composer figures in the list, conducting his own composition. The first records of the overture **In the South**, composed and conducted by Sir Edward Elgar, are as great in conception and execution as his previous records. The work occupies five sides of three records, and on the sixth is Sir Edward's **Bavarian Dance No. 3**.

Of all Wagner's works, **Die Meistersinger** is the most favoured in popular acclaim and many will be interested to learn that a fantasia of the most familiar airs from this opera has been recorded at a popular price by Clemens Schmelstech's Symphony Orchestra. It is excellently done, and should be on your list of light classics—for no one can call "Die Meistersinger" heavy music.

There appears to be a good crop of piano records this month, for Mark Hambourg—now in India, I believe—has done a new record of Liszt's famous (sometimes too famous) **Hungarian Rhapsody No. 2**.

Recorded at the Central Hall, Westminster, and just released, are two of the late Arthur Meale's organ compositions, **Sicilian Mariners** and **The Magic Harp**, in which he demonstrates how justly famous he was. The organ records well and this disc is a fitting memory to a great artist.

Peter Dawson is still going strong and has made a 12-inch disc of two fine marching songs, **The Legion of the Lost** and **The Veteran's Song**. These tunes, by both soloist and chorus, are

(*Continued on page* 193)

"MODERN WIRELESS" TESTS

THE VARLEY "SQUARE PEAK" SUPER-HET

THE modern superhet, like that famous brand of petrol, is definitely plus a little something some of the others haven't got. It does not necessarily increase the "miles-per-valve" ratio of a set, nor yet does it eliminate "knocking" in the atmospheric sense.

But it does very definitely give a measure of selectivity commensurate with modern requirements, and that in itself means more stations.

Radio Perfection

Take, for instance, the Varley "Square Peak" Superhet, a model of which was recently subjected to "M.W.'s" tests. There are few sets for which, with our varied experiences, we should feel justified in advancing the claim of radio perfection, which, as we interpret it, would mean every station in Europe on almost equal status with the local.

Yet without a doubt this Varley instrument comes as near to that ideal as any set we have yet tested. It probably comes as near to radio perfection as we shall know it for many years to come, simply because the ideal can never be reached until the stations themselves adhere rigidly to their allotted wavelengths.

Fortunately, as things are at present, that reservation applies to the minority, and again, more by good luck than anything else, the stations that seem to revel in the "communal wavelength" idea are, with one or two exceptions, the ones that do not matter.

TECHNICAL SUMMARY

GENERAL DESCRIPTION: Five-valve superhet for A.C. mains with built-in moving-coil speaker.

CIRCUIT DETAILS: Five valves (excluding rectifier) arranged as follows: S.G., H.F stage (M.M.4V); combined oscillator and 1st detector (A.C./PEN.); one intermediate (M.M.4V.); 2nd detector (354V.); pentode output (A.C./PEN.); (Rectifier is a D.W.3).

CONTROL ARRANGEMENTS: Central knob is for tuning. Volume is regulated by knob on left. Right-hand knob is mains "on-off" switch. Wavechanging is effected by means of a sliding escutcheon plate which operates a switch.

SPECIAL FEATURES: (1) Simplicity of operation. (2) Provision for pick-up. (3) Sockets for external speaker. (4) Compactness. (5) Output of 1,600 milliwatts. (6) Power consumption of only 60 watts.

PRICE: 26 guineas including valves and royalties

MAKERS: Varley (Oliver Pell Control, Ltd.), 103 Kingsway, London, W.C.2

A modern dignified cabinet houses a receiver of exceptional efficiency and exemplary workmanship.

No Tedious Searching

So that here is a set that will receive if not all, at least the bulk of the European programmes just whenever you want to hear them. No waiting until conditions just happen to be favourable. No tedious searching with every control strained to the limit.

You just turn the control knob until the name of the required station appears centrally in the illuminated window, and providing you haven't picked one of the European "bad boys," the programme is there. Not only is it there, but it is at such strength and quality that it might easily be mistaken for the local station.

Is not that as near to perfection as one can possibly hope to get it for many years to come? Who is there that could possibly be dissatisfied with fifty—sixty—possibly even seventy guaranteed alternative programmes?

But that is only half the story.

Simplicity of Operation

To-day, more than ever before, the need for simplicity of operation is of paramount importance where commercial receivers are concerned.

Experience goes to show that the would-be purchaser of a commercial instrument more often than not attaches greater importance to its domestic application than to its ether-searching abilities. And that, frankly, is another very good argument in favour of the Varley "Square Peak" Superhet. Without a doubt, no set of its type could be more simple.

There is just the one tuning control, which is located immediately below the station-indicating dial, a volume control on the left and a mains on-off switch on the right. Wavechanging is effected by means of a sliding escutcheon plate which automatically hides from view that half of the tuning scale that is not in use.

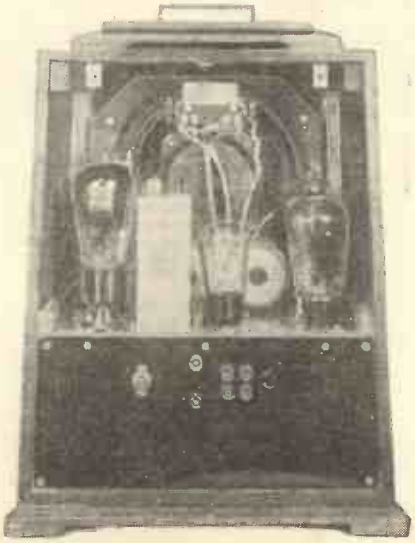
Low-Power Consumption

The set, with all its mains equipment and a particularly good moving-coil speaker, is housed in a beautifully finished cabinet of astonishingly small proportions. As you will gather from the technical specification, it is designed for use on A.C. mains, and according to our measurements its total consumption is in the region of 60 watts, a most economical figure.

Provision is made at the back for the connection of a pick-up, and

(*Continued on page* 196)

INSIDE THE CABINET



Remarkably simple for a big super, isn't it?

HOW TO OBTAIN BETTER RADIO

A LARGE number of readers have asked us to devote space to articles of an explanatory nature dealing particularly with the theory of radio.

While we freely admit that to know how a thing works puts one in a position more easily to keep that thing working to its best advantage, we fear we are not in a position to comply with these requests without in some measure departing from our originally defined aims.

Our purpose is to deal with the essentially practical side of radio reception, but as some measure of the "How it works" ingredient is obviously justified and is now demanded, we shall introduce it gradually and note the reactions of our friendly critics.

THE COMPILERS.

Whether you build your sets or buy them ready-made, you'll always find some query cropping up regarding maintenance, installation or modification. This special monthly feature solves all such problems for you in an attractive and entertaining manner.

SELECTING LOUDSPEAKERS

ACCORDING to our latest trade information there are about one hundred firms engaged in the manufacture of loudspeakers. As each firm will be making at least three different models, it means that there are some three hundred loudspeakers from which the potential purchaser can make his choice.

But the task is not so difficult as it might at first appear, so long as one has the main points of differentiation between the various types and models well in mind.

The Main Classes

First of all, loudspeakers in general can be divided into three main classes: electro-magnetic, inductor and moving coil.

The electro-magnetics almost invariably operate on the "balanced armature" principle and are mostly described as such.

They are usually very sensitive, and give first-class results, particularly in smaller sets. Their responses tend to excel on the higher frequencies, and they are free from the boom and absence of "attack" which mar some cheap moving-coils.

Certainly, it is a rare "electro-magnetic" which will give good bass, but good bass first of all demands a biggish set and plenty of volume. In quiet home-radio conditions these requirements are seldom encountered.

It is a vast mistake to regard any and every speaker made in accordance with the moving-coil principle as inevitably better than any other class of instrument.

It also frequently occurs that a listener would be better served by an electro-magnetic of a similar price rating quite apart from the indisputable fact that particular electro-magnetics have better all-round responses than certain of the cheaper moving-coils.

The "inductors" are very interesting propositions. In many ways they combine the virtues of the other two classes. And we are rather surprised that they have not come into greater prominence.

A good "inductor" is an instrument which can give very great satisfaction, and we would advise readers to listen to one working, without prejudice, if they get the opportunity.

But, of course, the moving-coil or "dynamic" loudspeaker is the peer, especially when big outputs have to be handled.

However, a small moving-coil with a cone that is stiffly anchored at its centre and edge, and which is buried in a cabinet of doubtful acoustic qualities, is not representative of the best that can be done with the principle.

The "coil" is fixed to the apex of the cone diaphragm and it is desirable that it should move freely within the poles of the magnet and not be liable to scrape or rub.

Our advice is that first and foremost the potential purchaser should allow himself no prejudices of an uninformed character, but that he should allow himself to be guided to some extent by the known representations of the manufacturers.

But even more important, he should make a very strong effort to hear a number of different loudspeakers on his own set in his own home.

Finally, it must not be forgotten apropos of this that it is important to match a loudspeaker with the output circuit of a set, but we shall have to postpone a detailed discussion of that until some future occasion.

TYPES TO CHOOSE FROM

Moving coil, inductor and "electro-magnetic" types of loudspeakers. They are all described in the accompanying article.

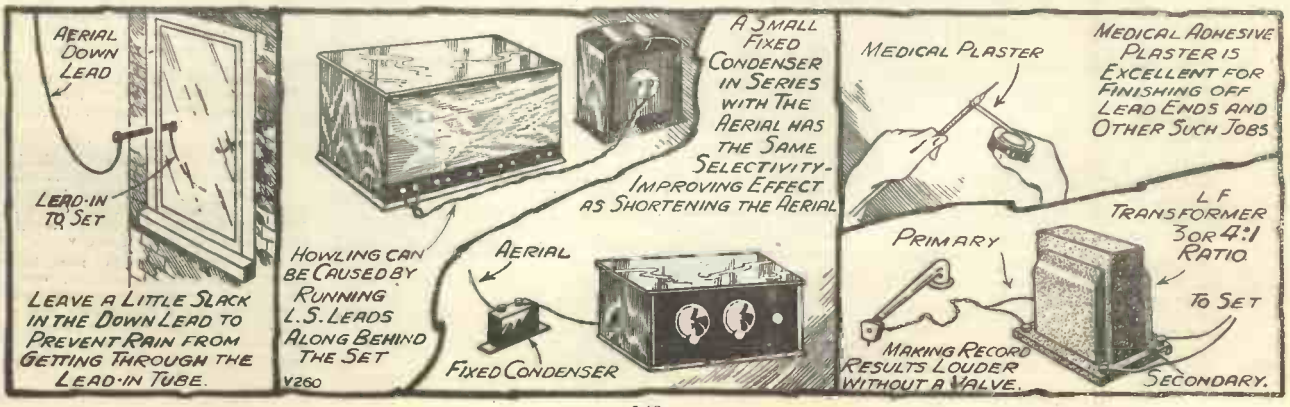
RAIN NOISES

A PECULIAR rustling sound in the loudspeaker may be due to rain. It may seem strange that rain should be able to cause such an effect in that there is no mechanical sound-channel between the aerial and the loudspeaker. But it is a fact that it happens quite frequently to the puzzlement of the listener.

Usually, the effect is produced by minute charges of electricity in the drops of rain.

As the drops strike the aerial their electrical charges are communicated

A SELECTION OF USEFUL HINTS IN PICTURES



Good Results From Old L.F. Transformers

to it and are passed to the receiver for amplification together with the electrical energy developed by the broadcasting station.

We fear there is nothing to be done about it except to change over to an indoor aerial, although the interference is seldom so serious as to render this necessary.

USING OLD TRANSFORMERS

WHAT was once regarded as one of the biggest bugbears in L.F. transformer design is nowadays accepted as a factor of little consequence in certain circumstances. We refer to core saturation.

The very poor results which early L.F. transformers gave were largely due to the fact that a serious loss of impedance was occasioned by even quite small H.T. current flow through the primary winding.

In the modern parallel-feed method of connecting up an L.F. transformer no H.T. current at all flows through the component. It passes to the anode of the valve through a fixed resistance, and the L.F. impulses are transmitted to the transformer via a fixed condenser.

Incidental to the advantage of H.T. diversion, the scheme has the merit that extremely good responses can be attained with transformers of inexpensive and compact construction.

Even with the greatly improved apparatus of the present day, a comparatively large and carefully manufactured transformer is needed to handle 3 or 4 milliamperes of H.T. current without frequency distortion.

By No Means Expensive

The main requirement is a core of substantial design. Of course, there are transformers having good performances available at reasonable prices; nevertheless, it is an indisputable fact that the parallel-feed type is able to accomplish equivalent results in respect of evenness, if not degree of amplification, with almost absurdly tiny cores of special material.

Of course, there are two extra components needed, the resistance and the fixed condenser, but these are by no means expensive items. Indeed, they are available in single unit form, together with the transformer, at prices of a distinctly competitive nature.

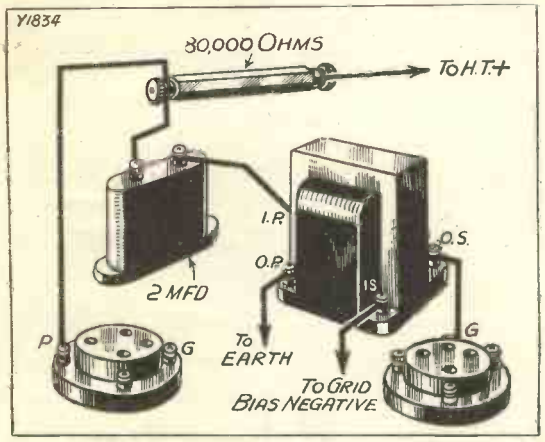
If an old transformer is used in accordance with the parallel-feed system, surprisingly good results can sometimes be obtained. Certainly, there is almost invariably a vast improvement over their use in a direct connection with the H.T. passing through them.

But they will not give performances equal to those obtainable with modern transformers designed especially for the task. For one thing, in all probability they will possess somewhat high self-capacities.

These have most detrimental effects on quality, especially in regard to high notes. The modern parallel-feed transformer, on the other hand, possesses almost negligible capacity, and it is largely due to this that it is able to set up an almost spectacular performance so far as quality is concerned.

However, a vast improvement can often be made to a four or five-year-old set by parallel-feeding its L.F. transformer; and if you go back further than that, and take a real old veteran in the way of an L.F. transformer, all the difference between unbearable and quite tolerable results can be made in this manner.

MAY BE A STRAIGHT LINE!



How an old L.F. transformer can be "parallel-fed" to give vastly better results.

SLOW-MOTION DIALS

FOR ordinary listening it is not advisable to have a slow-motion dial with a very high ratio. The ratio indicates the number of times the knob would have to be turned for every complete 360 degree rotation of the vanes.

In the case of a four to one ratio, four revolutions of the control knob would be needed. Actually, of course, the vanes can be turned only through 180 degrees.

Ratios of fifty to a hundred to one are needed only for short-wave reception, where it is almost essential to be able easily to make extremely fine adjustments of the tuning condensers. On the medium and long wave-bands a four or five to one ratio is quite big enough.

EXPLAINING "RATIO"

The bigger the ratio the more you must turn the control knob to obtain a given tuning variation.

SHOULD A SET HUM?

THIS is a question which seems to puzzle quite a number of readers, despite all the references we have made to it in the past.

The fact is that there are many very bad mains in the country.

SMOOTHING PROBLEMS

There is a lot of "smoothing" here, but the set might still hum!

and some of these mains are so troublesome that set manufacturers almost dread to supply sets to people using them.

Particularly does this apply to D.C. supplies. Despite the most expensive smoothing apparatus, some of these bad D.C. mains have almost completely defied the attempts of experts to make them "silent."

But there is one method not often tried which is full of promise, and that is to run a small rotary converter and thus turn the D.C. into A.C.

A rotary converter comprises a small electric motor permanently coupled to a small dynamo. In this present case the motor is driven by the D.C. mains supply, and the dynamo furnishes alternating current.

There is a great incidental advantage in that A.C. is much more flexible. If one has, for example, a D.C. supply of 220 volts, that 220 volts represents one's maximum; and if grid bias to the tune of 15 or so volts is taken off the mains the available maximum H.T. voltage is dropped by that amount.

Almost Any Voltage

But having transformed the current into A.C., almost any voltage can be obtained. The only limitation is the power limitation of the rotary converter, and we can say right away that this is no limitation at all in practice, for converters capable of doing anything necessary are freely obtainable.

It may be doubted whether a small dynamo outfit could operate without itself creating a considerable amount of mechanical noise, but the better makes are fitted with protective casings that muffle all the sounds generated. They don't make much noise, anyway, for modern precision methods of dynamo construction contribute wonderful armature balance and an almost uncanny absence of vibration.

A Raw Hand

Often one can hardly tell whether or not the outfit is in action. In any event, there is no reason why the converter should be in the same room as the set. It can be installed in another room and wires taken through.

As regards reliability, we have heard of a listener who had one of these converters running continuously for nine months. When it was first connected up by a local dealer, the dealer said nothing about switching it off when the set was not being used.

But the listener was a very raw hand at radio, and was frightened to touch anything, so he left the converter running. It did not stop of its own accord even after the nine months, and an examination failed to reveal any faults!

Returning again to the question which constitutes the title of this article, we can definitely repeat that hum is not inevitable, but that it is sometimes difficult and expensive to eliminate every vestige of it.

It often happens that the individual listener must ask himself how much hum he can tolerate. In many instances, on the other hand it should not be difficult to achieve perfect silence at little outlay.

RADIO IN DRY WEATHER

WIRELESS reception ought to be much better when it is wet. There seems to be a common belief that the reverse is what should be expected, and that dry conditions favour radio.

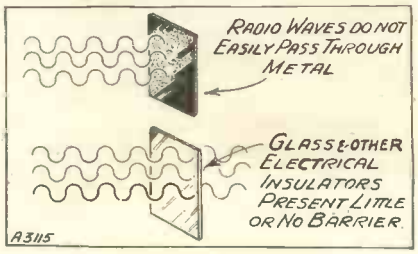
But it must be remembered that wireless waves do not conform to the same laws that govern electrical currents. These latter travel easily through such things as copper, iron and aluminium; all the metals, in fact. But these act as reflectors to wireless waves.

Wireless waves pass easily through substances such as glass, mica and wood, which are barriers to electrical currents.

When the ground is made wet by the rain it becomes electrically conductive, but—and here is the vital point—it will reflect wireless waves. Therefore these do not tend to become absorbed to the same extent as when it is dry.

Also, there is this important factor: the average outdoor earth connection encountered in broadcast reception is not a particularly deeply buried one. The moisture around it caused by the percolating rain is likely vastly to improve its efficiency, and thereby improve the listener's results.

THROUGH YOUR WINDOW



Arranging H.T. Tappings—Hints on Indoor Aerials

As an indication of how well a wet earth surface may be expected to favour radio reception, it may be mentioned that much greater ranges are covered with a given power over the sea.

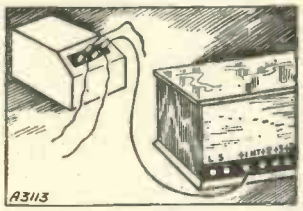
GROUPING H.T. TAPPINGS

MANY receivers have several H.T. positive terminals; in cases there are four or even five. On the other hand, the majority of inexpensive H.T. mains units provide for only three positive output connections.

An obvious way of overcoming the difficulty that arises when a listener endeavours to couple two such pieces of apparatus, is to join two of the H.T. positive terminals of the set together. Or couple up four of them in two pairs, should there be five or six to accommodate.

But this procedure is not necessarily always attended by success. Serious instability and howling may be caused.

CAUSES HOWLING



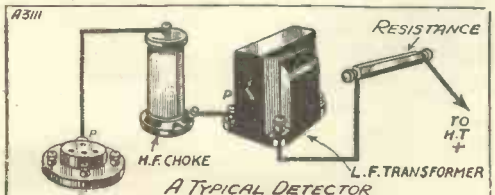
Sometimes an attempt to link H.T. plus terminals on a set leads to instability.

There are two reasons for the presence of a large number of H.T. positive connections on a set.

Firstly, the designer may have thought it desirable to build his design in that way in order to achieve greater flexibility.

Obviously, in the case of a four- of five-valve set it might happen that a perfect performance demands a close adjustment of H.T. for each valve.

THE PLATE MUST GO THERE!



There must be a metallic path from the plate terminal of every valve holder to H.T.

But usually this is a condition that a designer attempts to avoid.

A Bare Minimum

The most likely reason is that an attempt has been made to ensure greater stability either because the set is of a high efficiency and therefore somewhat temperamental, or because economies in components have been carried out.

Instead of lavish "decoupling," there is only a bare minimum or none at all.

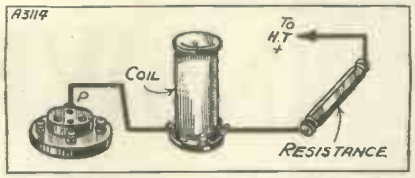
"Decoupling" is, of course, the H.F. and L.F. isolation of H.T. feeds by means of series resistances or chokes and by-pass condensers.

It is easy to determine whether or not there is decoupling in a set.

Between every H.T. positive terminal and the anode of the valve it serves, there must be a definite metallic path.

The path may comprise the windings of an L.F. transformer or a coil, and perhaps an H.F. choke. Also there may be a resistance. If there is the addition of this last, then it might well be a decoupling resistance.

AN H.F. ANODE "CHAIN"



The kind of path the H.T. travels in an H.F. stage.

It would be the first component to which the H.T. positive terminal is joined. And its other terminal would be connected to a fixed condenser.

No Difficult Task

The second terminal of the fixed condenser will be joined to L.T. or H.T. minus G.B. positive and any other point in direct contact with the earth terminal.

Failing the existence of adequate decoupling, and this evinces itself in instability, it is no difficult task to add it to a set, as we have shown in a previous issue.

WHAT IS BACKLASH?

BACKLASH was once a common ailment of variable condensers, particularly those having slow-motion movements. But it is only met with in cheap condensers of poor design these days.

It interferes seriously with tuning and makes close adjustments difficult, though seldom impossible, to get.

Instead of there being a perfect coupling between the initial driving element—this is the actual knob handled by the listener—and the spindle of the moving vanes of the condenser, there is a certain amount of looseness and play.

So although the vanes move in complete sympathy with the control knob in the one direction, on reversing the direction of rotation there is delay before the vanes begin to move.

A quite appreciable adjustment of the control knob may be followed by no movement of the vanes.

LOUDSPEAKER MICROPHONES

LOUDSPEAKERS are, in a sense, microphones working backwards. When suitable electrical energy is fed into them they produce sound waves.

When sound waves are directed at their diaphragms, they will generate tiny impulses of electricity.

But the ordinary loudspeaker does not make a particularly sensitive microphone. However, if you have a set using two stages of L.F. amplification, you can use a spare loudspeaker as a microphone and get pretty good results.

It should be connected up in exactly the same way as a gramophone pick-up.

If there are no pick-up terminals on the set, the easiest method is generally to connect the loudspeaker across the grid leak of the detector valve, taking care to de-tune the set or you will get broadcasting through as well.

Keep the two loudspeakers, the one in normal use on the set and the microphone loudspeaker, well apart, in different rooms if possible, or they may set up a "singing round the ring" howl.

FIXING INDOOR AERIALS

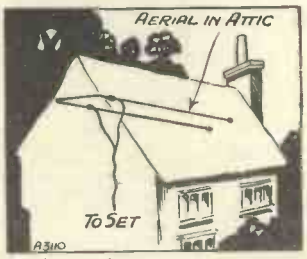
THE most convenient place for an indoor aerial is in the roof space just below the tiles if access can be made to it.

Many houses have quite a large amount of space under their tiles which is otherwise quite wasted.

If a length of twenty-five or more feet is available, don't run the aerial wire round but have just the one straight length.

Remember, too, that the down lead is also a part of the aerial system. If this runs down to a ground floor room, a distance of, say, twenty-five to thirty feet, the one straight wire along the roof space will suffice.

IN AN ATTIC



Straight wires are better than haphazard loops round all four walls.

With a shorter down lead it may be advisable to run two parallel wires, as shown in the sketch. These join at only the one end and should be about two feet apart.

Waste of Time

The lead down and indeed the horizontal wire, too, need to be carefully insulated from the walls. However, we cannot subscribe to the common view of experts that the wires must be kept some inches away.

We are convinced that it is a waste of time and trouble to go to such lengths. Unless a wall is actually damp inside, in which case it ought to be seen to anyway, it will not give you much of a capacity link to earth whatever its construction, so long as it is not a metal wall.

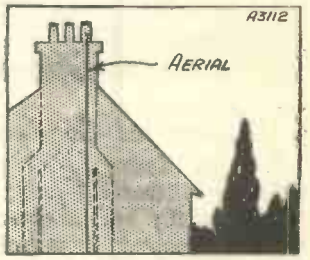
We believe that if the wire has a good insulating covering it can safely be run along walls, behind picture rails and so on. Undoubtedly it is an advantage to keep it as straight as possible and free from too many right-angle bends, but even these precautions may be carried to such an extent that they become a fetish.

Strict Rules

Take the straightest practical route from the set to the horizontal part of the aerial by all means, but a bit of wandering to the tune of a yard or two will make but little difference to your results.

Many of the strict aerial rules and regulations, as with many other laws which are regarded by many as inviolable, have been handed down to us from the early days of wireless and need to be re-examined now that broadcast reception has developed as a stable branch of a well-mapped out science.

UP THE CHIMNEY



An aerial can be accommodated in an unused chimney.

Magnificent Aerial

In very many houses there are fireplaces, in bedrooms, etc., which never, from one year's end to another, have fires lit in them.

But each fireplace has a chimney, and the inside of a chimney is a fine cavity for hiding away an aerial. The wire should be fixed at the top (a bar of metal simply laid across will provide anchorage) and dropped down.

Use an insulated wire, with a weatherprooof covering for the job. A twenty to thirty-foot length dropping to a lower room makes a quite magnificent aerial of the indoor type.

TOP UP THAT ACCUMULATOR

KEEP a specially watchful eye on your accumulator as soon as the warm weather sets in. (That will happen, we hope, in a month or two now!)

There is naturally a quicker evaporation of all fluids in the warm weather, and the acid solution of an accumulator is no exception to the rule.

The plates of the accumulator must be kept covered by acid or they will deteriorate. Distilled water should be used to keep the level at the desired height.

And while on the subject of accumulators, don't forget that frequent and regular tests will increase the life of your accumulator and cut out unnecessary replacement items from your maintenance charges.

A Rough Check

A test with a voltmeter made half an hour or so after the set has been switched on will give you a rough check as to whether recharging is necessary, but a hydrometer is the best way of getting accurate information about your accumulator.

Anyhow, a test of some sort should be made at least once a month.

QUESTIONS ANSWERED

Differential Condensers

S. B. C. (Ealing).—"I have just fitted a differential reaction condenser to my set in place of the existing reaction control. Upon testing out the receiver after the alteration was made I was surprised to find that the set oscillated when the reaction knob was rotated anti-clockwise. Surely this is wrong! Shouldn't the knob have to be turned in a clockwise direction in order to increase the reaction effect?"

In such a case it is only necessary to reverse the leads to the two sets of fixed vanes of your differential condenser, and the control should then work normally.

Adding an S.G. Stage

G. D. (Bromley).—"I have recently been experimenting with an S.G. valve which I added to my two-valve receiver in the form of a separate unit. The set in question was of the detector and low-frequency type and I was surprised to find that the S.G. stage oscillated directly the set was brought into tune with the local B.B.C. transmissions. Although the S.G. valve was metallised, I used unscreened coils, but placed an aluminium shield between the unit and the set."

The combination of metallised S.G. valve and vertical screen is not always sufficient, and instability may be caused by a bad layout or by the positioning of the grid and anode leads. Since your coils are not screened, they should be carefully placed with a view to minimising interaction.

The following points are of importance in the construction of high-frequency amplifiers.

(1) Coils of the "canned" type are advisable and the screens should be earthed.

(2) If unshielded coils are preferred, these should be placed at least six inches away from each other and a vertical screen is necessary between the aerial and detector circuits.

(3) It is an advantage to mount the S.G. valve horizontally through a circular hole in the vertical screen when the coils are not of the "canned" variety.

(4) Decoupling the screening-grid by inserting a 600-ohm resistance in series with the screening-grid H.T.+ lead is beneficial. A non-inductive condenser of 1 mfd. is then joined between the screening-grid terminal on the valve holder and L.T.— or the cathode.

(5) The metallic coating on the valve must go to the "earthed" side of the circuit. In a 2-volt battery valve this means that the L.T.— filament terminal on the valve holder should be the one to which the coating is joined.

(6) In "shunt" or parallel-feed circuits the H.F. choke in series with the anode of the S.G. valve should consist of a very large number of turns. An inductance valve of not less than 100,000 microhenries is desirable.

(7) The efficient working of an S.G. valve largely depends upon the values of the anode and screening-grid voltages, and the makers' instructions should be strictly adhered to.

Crackling Noises

T. S. (Kensington).—"For some weeks I have been getting loud crackling noises in my loud speaker. I am not sure whether these are due to external interference or to some defect in my set. Is there any way of finding and locating the cause?"

First of all remove the aerial and earth leads and note whether the crackling noises disappear.

If so the trouble is due to outside interference, possibly to X-ray or high-frequency apparatus in the vicinity. Such interference can only be remedied at the source, and the Post Office Engineering Dept., in co-operation with the owners of the interfering apparatus, are often able to effect a cure.

Should the noises persist even though the aerial and earth leads have been removed, you must carry out an examination of the receiver, bearing in mind that crackling may be the result of (a) loose connections; (b) faulty H.T. supply; (c) a defective transformer, choke, or loud-speaker winding; (d) a faulty resistance, particularly anode or decoupling resistance.

In the case of a bad connection, giving the parts a sharp tap will often accentuate the trouble and so reveal the source.

AT YOUR SERVICE

by OUR TRADE COMMISSIONER

Some trade news and views that are of interest to readers, whether or not they are connected with the radio industry.
Members of the trade are invited to send items of interest, or photographs, to be included under this heading.

The Atlas Programmes

IF you are a regular listener to Fécamp and Radio-Paris on Sundays you will have noticed recently that a new sponsored programme has been going on the air. This is organised by Clarke's Atlas who are at the time of writing taking up the half-hours of 5.30–6.0 and 10–10.30 p.m. each Sunday from Radio-Normandy (Fécamp) and from 3–3.30 p.m. on the same day from Radio-Paris.

This enterprising firm, noted for mains units and loudspeakers, besides other well-made radio gear, gives programmes that are well worth hearing and you should not miss them.

Empire Broadcasting

I have received news of a new short-wave coil that will interest readers at home and abroad. It is produced by J. J. Eastick and Sons, makers of the famous Eelex range of components and short-wave converters, and is intended to cover a waveband embracing all the broadcasts from the recently opened Empire station at Daventry. The coil is to retail at 5s. and fit into the eight-pin base similar to that used with other Eelex coils. It is reversible through 180 degrees in order to cover the waveband in two independent sections.

Belling and Lee Terminals

I am asked to bring to your notice the fact that from now on Belling-Lee type R and B terminals will be available in black and walnut colours. The prices will be as before, namely, 2½d. for the R and 6d. for the B terminals.

Over 1½ Million!

That is the vast figure given as the number of Rola loudspeakers in use, and forming part of the valuable information on the latest British Rola list. The Rola speaker is too well-known to need any introduction, but there must be many readers who would welcome further information and many will be amazed at the large variety of speaker models that are described in this list.

Naturally British Rola Co. Ltd., will be only too pleased to send you as many copies as you require if you will drop them a line at their Brondesbury works, 179, High Road, Kilburn, N.W.6, and you will find the details concerning the dual matched speakers of particular interest.

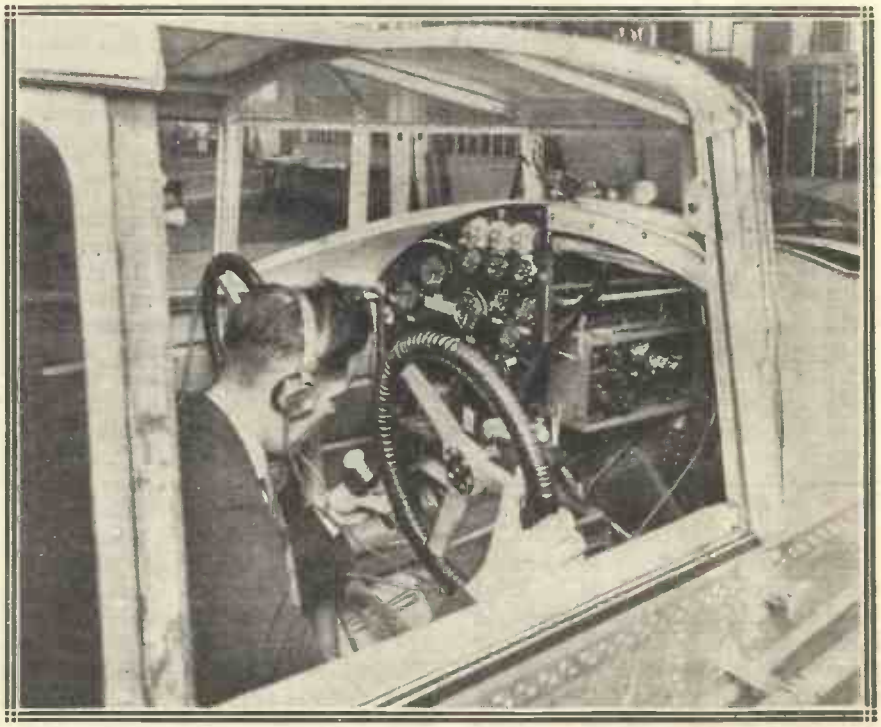
The Latest Transformers

A great deal of interest is being displayed in the anode bend or quiescent method of push-pull at the moment and a number of transformer manufacturers are bringing out components suitable for the operation of small consumption pentodes and triodes on this system.

The idea is not new, but special transformers for quiescent push-pull (sometimes termed push-push) in L.F. circuits have not up to now been available for the man in the street.

Experiments with sets incorporating this system are being carried out in our laboratory, and among the firms that have sent us transformers and output chokes in connection with the scheme are Radio Instruments, Sound Sales, and Multitone, the latter having

INCREASING SAFETY IN THE AIR



The special aircraft lightweight Marconi radio-telephone equipment that has been designed for use in large passenger-carrying machines. It was used by Mrs. Bruce during her attempt on the non-stop flying record.

A Valuable Book for Constructors

produced a tone control quiescent push-pull transformer which is particularly interesting.

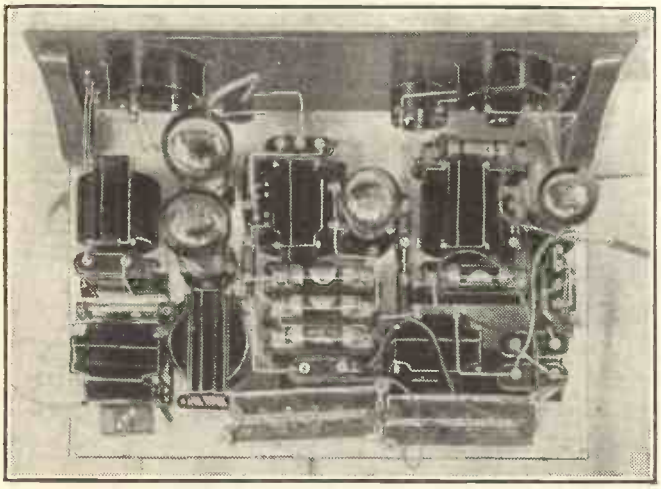
Whether the final form will result in the popularisation of pentode or triode "push-push" it is impossible to say at the moment, but the saving in H.T. wattage is a most valuable one as far as can be seen, though exhaustive tests have not yet been completed. However, you should look out for developments, for the system is well worth close attention.

Power Amplification

I have recently received a copy of the latest Ferranti home constructors' publication, List No. Wa513, which is sold at the low price of 6d. It contains a wealth of information in its 46 pages which will be of the greatest interest to all radiogram enthusiasts.

The details supplied concern a number of amplifiers and receivers which it is stated are capable of giving a reproduction "as good as is obtainable commercially within the limits of present-day knowledge." Exactly what is implied by that phrase I cannot state, but examination of the overall fidelity curves published in the book will show how excellent are the circuits described.

FOR D.C. MAINS USERS



One of the Ferranti D.C. amplifiers. It is designed to give 2,000 milliwatts A.C. output.

Here are some of the many fascinating sets and amplifiers included in the descriptions: Screened-grid battery four band-pass, and push-pull output; D.C. amplifier with 2,000 milliwatt A.C. output; A.C. amplifier with 6,250 milliwatt output; another A.C. amplifier with an output of some 12,500 milliwatts; and a band-pass receiver with the same output. Other interesting items are described, but the foregoing will give a good idea of the value of the book. I should advise all my readers to get it.

Interesting News from Hayes

The Gramophone Company has announced the release of a new "His Master's Voice" moving-coil loudspeaker, styled as the "Universal Super Model 177." The cabinet is of figured walnut specially designed for acoustic properties, and proportioned so that it may be placed on a mantelpiece.

The "His Master's Voice" permanent magnet moving-coil unit embodied in the instrument is extremely sensitive and is fitted with a universal transformer, allowing the model to be used in conjunction with practically any type of receiver or radio gramophone, whether it has a triode, pentode or push-pull output. The cobalt steel cross type magnet has a high flux density of 6,000 lines per square centimetre, and the pole pieces are copper-plated to eliminate rust.

The new loudspeaker is capable of handling up to four watts without difficulty, but is so sensitive that it will operate on two-valve receivers quite satisfactorily. The price of the Model 177 is £4 15s.

Also an announcement that the new price of "His Master's Voice" "Transportable Radiogram" is now 19 guineas will excite great interestamongst a large section of the public. This move by England's biggest radio-gramophone manufacturers will mean that an all-mains combined wireless receiver and electrical gramophone will now be available at a price under 20 pounds.

Discussing this development in the price of radio apparatus, Mr. Haigh, English manager of H.M.V., said: "During our peak month of last year, December, we received many letters from people who complained that none of the large manufacturers marketed an all-mains radiogramophone under 20 guineas. It was pointed out to us that if we could reduce the price of our cheapest radiogramophone members of the public who were only able to afford the price of a straight radio receiver would then be able to enjoy all the advantages of a combined instrument at practically no greater cost.

"We have carefully considered this proposal and have decided that in this case a reduction in price is justified in order to bring the pleasures of electrically amplified record reproduction to thousands more people."

"WATCHING" THE PROGRAMME

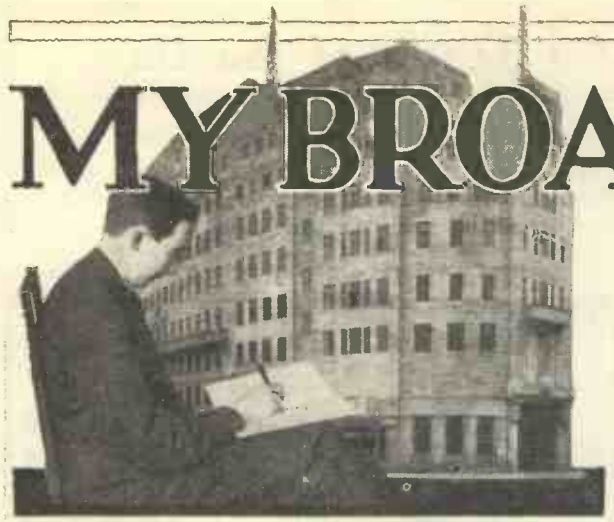
Mr. J. L. Baird "looking-in" on one of the latest televisors with Miss King, who was one of the earliest persons to be televised for broadcasting.

All Electric

The radiogramophone in question is an all-mains instrument incorporating an electric motor, thus dispensing with the need for winding up, and electrical pick-up and a four-valve radio receiver.

The whole instrument is of the very latest type and it has the great advantage of being able to be transferred easily from room to room, or taken round in a car to a friend's house for an evening.

In these hard times price reduction news is indeed good news.



MY BROADCASTING DIARY

Our own Broadcasting Correspondent keeps a critical eye on the affairs of the B.B.C., and each month, for the benefit of listeners, comments frankly and impartially on the policies and personalities controlling British broadcasting.

West Regional Hopes

As the date of the opening of the West Regional Transmitter draws near, expectations are naturally aroused. It is practically certain that the new station will be on the air in April.

Having gone into the matter carefully, I am prepared to prophesy that listeners in the West of England will be delighted with the new service. The B.B.C. has been wise in duplicating some Cardiff studios at Bristol, thus giving reality to the dual nature of the new service. On the other hand, listeners in North Wales will be disappointed, although I believe that a good many of them realise in advance that Watchett will not be for them.

It is all the more important for the B.B.C. to make certain that North Wales gets a better service than at present from Daventry National and North Regional.

Empire Service Finance

The inevitable development of the Empire Broadcasting Service after its wonderful inauguration is already creating a new financial problem. The original basis allowed for about £40,000 capital expenditure and the same amount for current annual expenditure.

These figures, however, were determined towards the end of 1931, when the financial crisis was most acute. They did not allow for the most modern equipment and service. Since then two things have happened to affect this problem.

First of all, the atmosphere of financial panic has gone. Secondly, the King's broadcast on Christmas Day to every corner of his Dominions has placed the Empire Broadcasting Service of the B.B.C. on an entirely new basis. Accordingly, more money has got to be spent; nor is there much likelihood of contribution from the recipients, at least for the present.

Within reason, I advise the B.B.C. to go on with this development; it would not be waste if £100,000 a year were allotted to current expenditure and an extra £50,000 for capital appropriation at Daventry.

Those Gaps

I am bound to confess sympathy with those elements of the wireless trade which are trying to induce the B.B.C. to fill in the gap in transmission between about 10.40 and 12 midday (except for the occasional talk). The absence of programmes during the best period for shop demonstration is not only a serious handicap to the trade, but also should be regarded as a disadvantage to the B.B.C.

There is no need to organise special programmes; gramophone records, appropriately presented, would suffice.

I know I shall be met with the customary two objections, the first that there is already too much broadcasting and to add to it would bring surfeit, the second that the technical apparatus of transmission needs overhauling, and this takes time. My reply is definitely that the B.B.C. should make up its mind to keep on the air all day, I do not ask them to transmit after midnight or very early in the morning, but I do suggest that it is definitely in their interests to avoid silence periods between 10.15 a.m. and midnight.

A BROADCAST BY MORSE

At a commemoration broadcast of the invention of the telegraph, William G. Morse, the only living son of the inventor, gave an address from the American station W O R. He is seen on the left, with his daughter, before the microphone.

Civil Service versus Business

The old controversy about whether the B.B.C. officials should be Civil servants has been revived in an acute form by a new move on the part of the Treasury. The official Treasury view appears to be that broadcasting is

Candid Comments on Radio Topics of the Day

bound to flourish in almost any circumstances, and that if the monopoly is perpetuated there is no reason why B.B.C. jobs, particularly on the administrative side, should not be filled from the ranks of successful candidates at Civil Service Examinations.

Also, there is the suggestion that the compulsory retirement of a large proportion of the present administrative staff of the B.B.C. in favour of young civil servants would effect a considerable saving in the salary bill.

Discovering New Talent

I am glad to hear that Dr. Adrian Boult and his able assistants are making progress in their effort to capture new music and new talent. Dr. Boult has always been keen on the executant side of music, and rightly so.

It was, I believe, most fortunate that Dr. Boult took over the Music Department of the B.B.C. at a time when it was still in doubt which way the B.B.C. would go in its attitude to executant effort. This remark is no reflection on Percy Pitt, Dr. Boult's predecessor. His career as opera conductor and his work at the B.B.C. were all for the happy reconciliation which it would not have been possible for him to organise.

Dr. Boult has taken on the job in a characteristically active and useful way, with the result that there is already substantial progress to report. The B.B.C., in effect, has not allowed itself to be a ready instrument of "technocracy" *qua* technocracy, at least in this respect.

Politics in Broadcasting

The intervention of politics in broadcasting is always a delicate subject both for Parliament and for Broadcasting House. The Polish "faux pas" drew attention to the problem rather acutely.

It is curious that over a period of ten years such a crisis had not occurred. I wonder whether some link in the list of people who "pass" things was omitted. Even so, however, Col. Moore Brabazon has given Sir John Reith full notice of a fight to the death on this and other issues.

Lady Snowden's Future

Although I, for one, regret the departure of Lady Snowden from the Board of Governors of the B.B.C., I am inclined to agree with a friend of mine who edits a national daily that Lady Snowden probably will do better work for the B.B.C. outside than inside.

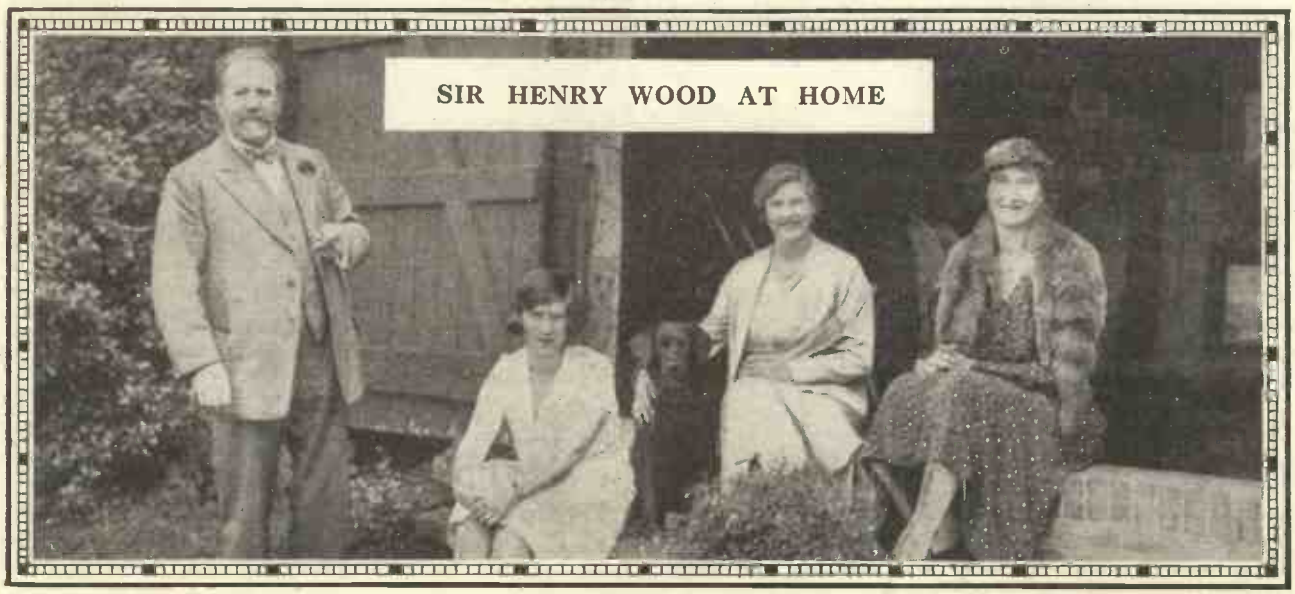
If the future were in my hands, I would hope the Prime Minister of the day would invite Lady Snowden to be Vice-Chairman in 1937.

Those Young Men

Here is a suggestion: let the B.B.C. establish a nucleus of young able men and women to be thrown into the line as needed. Mark you, I have heard this is going to happen, hence I am emulating a certain noble Lord in another sphere.

RADIO IN THE ALPS

The German-Austrian Alpine Club have obtained two portable combined transmitters and receivers to aid them when search parties have to be sent out. One set, shown in our photo, is left in the valley, while the other is taken along by the searchers.



The popular Promenade Concert conductor and his family. A photo taken at Appletree Farm.

VOLUME WITHOUT WATTS

"QUIESCENT" DEVELOPMENTS

Are we paying too much for our broadcast reception? A method of reducing the running costs of battery receivers is discussed below by the Chief of the "Modern Wireless" Research Department.

SOMETHING for nothing? No, not quite, but something that will be obtained with minimum wastage. Let me explain.

The average radio receiver—let us take a battery three-valver, for it is with battery sets I am concerned—the average radio receiver, then, delivers a certain maximum volume of output dependent on the valves used. That is well known.

It also "consumes" a certain amount of H.T. watts—say 14–25 milliamps at 120–150 volts. Again, this is dependent on the valves used, but roughly the amount of volume available from the set is dependent on the amount of H.T. energy we are prepared to put into it.

Wasted Power

Nobody grumbles much at the principle, though the dry H.T. battery user is apt to find his pocket somewhat strained by the process of keeping his set in good order, especially if he uses a large super-power valve or a pentode for output.

And the horrible part of the whole business is that *most of this power consumed is wasted.* Yes, utterly thrown away, just to keep the valves alive, as it were. It does not matter whether we are listening to a strong local station or a weak distant one, the power consumption of our set remains the same. *And we are still paying like this for our programmes, even when we are getting nothing,* during the intervals and while tuning-in.

"It's All Wrong"

"It's all wrong," as our early broadcast friend, John Henry, would say. And in many ways it is, for it can be avoided, though, it must be admitted, *at a greater initial cost for the set.*

And that is where each set owner will have to choose for himself, as you will see. Either he can pay more for his set and save on H.T. consumption, or he can reduce his "initial" payment as it were, and pay greater "instalments" in the form of more frequent renewals of H.T. batteries.

Pooled Outputs

He alone can choose which he will do when he has finished this article.

How can this waste be prevented? Let us see. Years ago—in 1915, I believe—a patent was taken out by the then Western Electric Co. (No. 275) for what was called push-pull L.F. amplification. In this patent it was stated that this was a system of using two valves, biassed to their bottom bend points, in such a way that they each amplified one half of the L.F. A.C. cycles, one valve lying quiescent while the other dealt with one half of the L.F. impulses. After the process the outputs of the valves were pooled in the now well-known way, through a push-pull output transformer or choke giving an A.C. output.

Obvious Advantages

The advantage of the scheme was that the anode wattage could be kept low while the output A.C. milliwattage could be high.

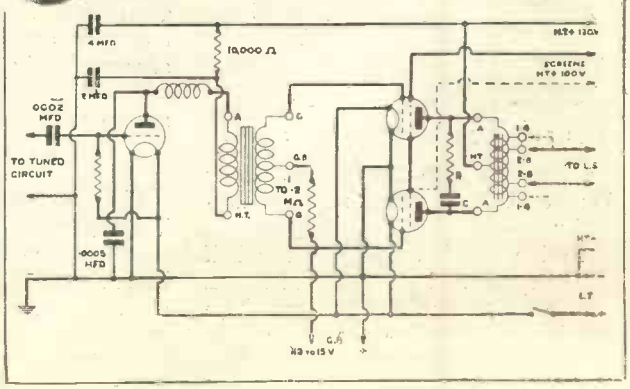
Since then many types of push-pull transformers and schemes have been tried, but the anode bend, or quiescent form, at first met with little use or success. Usually push-pull valves have been biassed at their mid-points and not the bottom bend.

Now, nearly eighteen years after, the whole question has been revised and

FOR PENTODES OR TRIODES

The quiescent push-pull system necessitates special input transformers of high ratio and many firms have been busy producing these. Above is the R.I. model output choke, with the theoretical circuit employed in pentode push-pull amplification.

IN PRACTICE AND THEORY



It Keeps the H.T. Battery Current Down

valve and transformer companies have got down to the problem anew, having in mind the use of the battery pentodes, which are capable of giving an undistorted output of some 1,000 milliwatts.

Good Work Done

Normally these valves take about 20 or more milliamps. total H.T. current at 120 volts for this output, and incidentally triodes would take more. So it was decided to make these high-efficiency pentodes operate in quiescent push-pull, or " push-push," as it is often called. By this means they could be prevailed upon to deliver their full output milliwattage at good quality with an anode current consumption of some mere 6 or 7 milliamps. instead of the steady current of 20–24 which would be needed in the ordinary scheme.

A lot of work was done on the subject. Special inter-valve transformers of high ratio had to be designed, giving each pentode a 4 or 5 to 1 step-up from the primary. This is essential if the valves are to be properly loaded, for it must not be forgotten that to get the full output we have to give the valves nearly double the grid swing required normally.

THE INPUT SIDE

The special high ratio input transformer for Q.P.P.

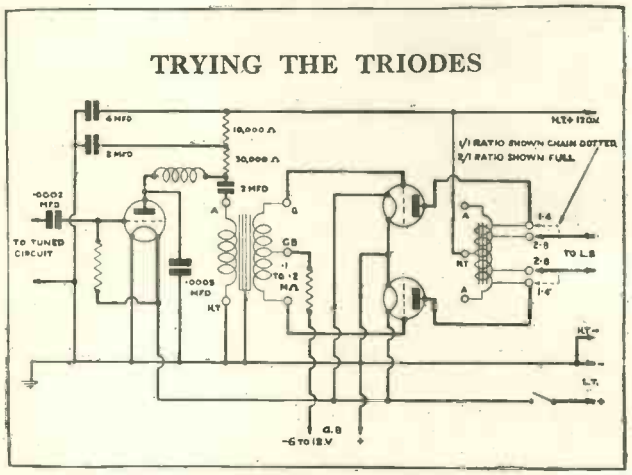
Each valve is amplifying one half of the cycle, and the full load means that we must run up the curve from the bottom bend to the end of the straight portion if we are to load the valve fully. There is no alternating above and below a mid point as there is in ordinary push-pull or straightforward output circuits.

The output transformer has to be properly designed to match the high impedance of the valves—some 18,000 ohms being necessary for the primary in the case of the pentodes.

An Ingenious Scheme

For triodes such a high value is not necessary, and as will be seen from the circuit diagrams, Radio Instruments Ltd., who are among the first in the field with transformers for quiescent push-pull, have ingeniously tapped one choke so that it can be used for pentode or triode.

TRYING THE TRIODES



A suitable circuit for quiescent push-pull with triode output valves of LP2 or P2 types.

Now let us see how the saving takes place. When no *modulation* is being received (for the carrier of a station has no effect on the L.F. valves), the two pentodes (or triodes) are both quiescent. They are biassed to or near their bottom bends and are passing some 3 milliamps. each. (I am assuming the use of valves such as the Osram P.T.2, Mazda Pen.220A, and so on; with smaller powered valves the current would be less.)

How It Operates

The station begins to modulate. L.F. is passed to the valves, and is split up into half cycles, the " top " half only takes effect on one valve, and the " bottom " on the other. So the two pentodes take it in turn to receive positive volts across their grids and filaments (the negative impulses are ineffective) and so alternately they begin to pass more anode current as their grids become more positive.

Very Fair!

Obviously the stronger the modulation (or the stronger the reception) the more positive will each grid become and the higher will the momentary rise of the anode currents be. So we " consume " anode current (save for the few milliamps.) only when modulation is present, and moreover we " consume " it in proportion to the strength of reception. A very fair arrangement!

All pauses in the programme result in the valves going quiescent, and the result of the scheme is that we are paying only for what we receive.

The Extra Parts

As I said before, the initial cost is higher than is the case with ordinary output schemes, for the two push-push pentodes will only give the same (or approximately the same) output power as will one when used in the ordinary way. So we have to buy an extra valve, a special input transformer (about 15s.) and an output transformer (12s. 6d.).

If we are building a set for the first time the input transformer can be reckoned as a very few shillings more (if any more) than we should usually pay, and if we are getting a new loudspeaker we can choose one with a suitable input transformer and so obviate the output transformer in the set. Or, alternatively, we can get a speaker without a transformer and use the output transformer (or choke) feeding direct into the moving-coil winding.

It is not advisable, as a rule, to use both the output transformer and the speaker transformer if this can be avoided, though for those who do not want to touch their speakers a suitable output push-push choke has been produced by R.I. Ltd.

There are one or two practical details about the circuits that should be brought forward. In the case of

(*Continued on page* 194)

SPOTLIGHTS ON THE PROGRAMMES

B.B.C. versus G.T.C.—A Successful Play—Quaint Announcement—"Hot" Orchestrations—Studio Audiences.

The B.B.C.'s Little "War"

THE excitement caused by the B.B.C. versus G.T.C. dispute is quite out of proportion to its importance so far as listeners are concerned.

So far as the director of B.B.C. vaudeville is involved, I should think the statement by Mr. Black of the Palladium caused no little pleasure in certain offices at Broadcasting House.

Mr. Black informed the world at large that the real reason for the ban on his variety "stars" was that the B.B.C. programmes had recently become so excellent as to constitute a serious menace to the music-halls. Probably the nicest remark the vaudeville people have had made about them for a long time!

An Easy Matter

Anyhow, the B.B.C. has made enough "stars" in the past to laugh at the ban. There is no doubt that recent programmes have proved that because an artiste is a success "on the halls," is no reason why he should shine in the studio.

A name isn't everything, and even if it were, the B.B.C. is in the position of being able to supply its own names.

It is high time it was realised that broadcasting requires quite a different technique from the stage, and the recent dispute should provide a big chance for "unknowns" to prove their worth.

Not What They Meant

"Don't buy a radio set that will be out of date to-morrow. Buy one of our . . . receivers, and you'll never come here again."

This notice in a provincial "cut price" store is surely worthy of being preserved among the classics of mistaken zeal in advertising. "Don't go elsewhere and be swindled—come here!" is, of course, the most quoted example, while "Don't let the washing kill your wife, we'll do your dirty work" runs it very close.

The Value of Publicity

John Tilley, radio comedian, certainly knows the value of keeping in the public eye.

Last month I told you how he became engaged in a taxi. Since then the marriage has taken place and Tilley added another leaf to his book of fame by going to the ceremony with a temperature of 101 and returning to bed afterwards!

Incidentally John Tilley is a very good example of an unknown comedian who sprang to fame in a night via the microphone. He is due for another appearance soon.

Plays Which Get Over

The B.B.C. Director of Productions, Val Gielgud, has placed another feather in the cap of his department by arranging for the first performance of a play based on a story by H. G. Wells.

"The Country of the Blind" was a great success and was marred only in one particular—the "dual-commentator" idea is not a success when carried out by a man and a woman. There is too much of a contrast between their voices to allow the narrative to run smoothly as it must do in such circumstances.

I Didn't Mean That

And while on the subject of radio plays, I have been getting into hot water with several readers who point out that my suggestion last month that Val Gielgud had mishandled the 1932 production of "Waterloo" was, to say the least of it, not consistent with my earlier remarks on this subject.

I am sorry that I expressed

PEER'S MUSICAL SON

John Weir, son of Lord and Lady Weir, of Renfrewshire, was invited to collaborate with C. Denis Freeman, of the B.B.C. staff, in the musical play, "Busman's Holiday." Mr. Weir (left) is here seen talking over his music with Mr. Freeman.

A Suggestion for the Television Director

myself so badly. I have so often said that Val Gielgud and Howard Rose are the only two B.B.C. producers on whom listeners can always rely for a good production under any circumstances, that I should never think of imputing faulty production to Mr. Gielgud!

Personally, I considered this experiment in presenting historical events as radio drama so successful that I have never ceased to urge both the authors and the B.B.C. to let us have more of the same thing.

At the same time it was a general criticism that certain of the "effects" in this play missed fire (this very point was brought out in the very amusing burlesque which the B.B.C. produced a few days after), and it was to this criticism that I was referring in my remarks about the production.

Treats in Store

Incidentally, Val Gielgud—who is our Programme Personality for this month—has some fine treats in store for radio play enthusiasts.

The first of these is a revival of Flecker's play "Hassan," which has not been heard for, I believe, nearly six years. This famous drama has in its time aroused no little controversy, but it seems likely that the broadcast arrangement will please the majority of listeners.

"We hope," says Val Gielgud, "that broadcasting will simplify Hassan as it has simplified Shakespeare."

Dear Mr. Hoffman

The prize for announcers this month must go to the gentleman who looks after most of the sponsored programmes from Radio-Paris.

He had recently to announce an item in the programme which read as follows:

"Auf wiedersehen, my dear"—(Hoffman). The announcement sounded like this: "Auf wiedersehen, my dear Hoffman."

Perhaps "my dear Hoffman" will soon rank with the popular Messrs. Brown and Hemingway of dance band fame.

Henry Hall Goes "Hot"

Henry Hall has apparently got tired of hearing that his music is too peaceful, for he has now made arrangements to receive from America the latest "hot" dance tunes as played by Duke Ellington and his compatriots.

While this innovation will no doubt be welcomed by certain listeners, I do hope that Henry Hall won't overdo it.

His present orchestrations have given his band a personality which is as clear cut as it is different from that of his predecessors. It would be a pity to lose this personality in a futile effort to try to please everyone.

A Programme Suggestion

Here's a suggestion for the Television Director, given free, gratis, and for nothing:

Why not a broadcast of Mr. Eric Gill at work on one of the B.B.C. groups of statuary?

Mr. Gill, complete with beret, beard and black bag, would make a picturesque broadcast.

This Applause Business

The discussion about studio applause during vaudeville broadcasts seems no nearer solution even now.

We have been given ordinary audiences who behaved properly; extraordinary audiences who laughed in all the wrong places; a regulated "claque" which sounded like a badly controlled gramophone record; and finally no applause at all.

It would seem that the obvious solution is to have applause (moderate applause, please) at the end of each turn, and silence for the rest of the time.

An awkward wait or a not-too-funny compère between turns have not proved a success, and at the same time laughter from the studio in the middle of an item gives listeners the impression that the artiste is playing solely for the audience in the studio—an impression which is often correct.

The Best of the Month

Congratulations this month must go to E. J. King Bull for an excellent adaptation of H. G. Wells' "Country of the Blind"—a really original play.

Also to Mr. Freeman and Miss Allen for a "Miscellany" programme which was thoroughly acceptable in every way except the musical interludes!

P. C.

In the Programmes

VAL GIELGUD

Val Gielgud, director of productions for the B.B.C., is a picturesque character who assumes at times the appearance of a stage hero, or, dare it be said, of a stage villain! His properties include black military cloak and sword-stick; also a black beard, which disappears at intervals.

On his father's side he is Polish, with a general as an ancestor, while he is also a grand-nephew of Ellen Terry.

Went to school at Rugby, and afterwards on to Oxford. Wrote three novels on contemporary life and manners, none of which was published. He was annoyed about it at the time—but is only too thankful now!

Val Gielgud is a great student of military history and has a comprehensive library of books on Napoleon. All his successful novels have dealt with historical subjects from Russia and Poland.

Four years ago he married Barbara Dillon, and they have one son named Adam.

He is extremely fond of cats, particularly Siamese. On one occasion he went over to Jethou—then the island home of Compton Mackenzie—to bring back a young lady by the name of Lulu. But immediately he landed Lulu disappeared, and only came home when he had returned to London!

Val Gielgud has written and produced numerous radio plays, the best known probably being "Exiles," which has been broadcast on several occasions.

He is a wonderful dancer of the old Viennese waltz, smokes incessantly, works best from midnight to dawn, hates oysters, and has a partiality for caviare and beer!

ON THE SHORT WAVES

by W.L.S.

No matter what branch of short-wave reception claims your special interest, you will find these pages by our popular contributor make uncommonly good reading.

"W. L. S." combines a ripe experience and knowledge of his subject with a special aptitude for clear writing on the technicalities and cheery comment on the S.W. topics of the moment.

ANY doubts that anyone might still have had about the importance of short waves must surely have been dispelled on Christmas Day, 1932. Sitting in comfortable armchairs round our Christmas fires in the "Home Country," we were conscious of a real thrill at being taken right round the Empire, and, as I mentioned once before, the annihilation of time seemed more impressive than that of space!

A Credit to the B.B.C.

Dare I mention that I had a vague suspicion that one or two of the "messages" received by the B.B.C. came from none other than our old friend, the "Blattnerphone"? I didn't think it was possible, at 2 p.m. G.M.T., to effect such reliable communication with all the different parts of the Empire, particularly two as far apart as Cape Town and Vancouver.

Be that as it may, that programme did great credit to the B.B.C. and, in a quiet way, gave the short waves the best "advertisement" they have ever had! I have not heard, as yet, how it was received in the Empire.

Surely Unbeatable

S. R., the President of the New Zealand DX Club, sends a very interesting letter. By way of a change, he has been trying to receive Europe on the medium broadcast band, and has succeeded in identifying *thirty-nine* stations on that band, mostly between 250 and 550 metres.

Not one British station figures in the list. Although this is not strictly "short waves," I mention it to stop some of the folk who brag about receiving America on the broadcast bands! For a feat of sheer "DX work" it is surely unbeatable.

By the way, Rome heads the list in N.Z., and is followed by Breslau and Turin.

POCKET PORTABLES

A view of the transmitter at Brighton for communication with police-constables on duty who are equipped with special receivers which fit into their pockets.

Substitute for Sydney

Short-wave listening has not produced very much to write about during the past month. The general rule has been, as usual, "poor below 30." Above 30 metres, the best group of stations seems to have been the 49-metre crowd of "Yanks." On the 32-metre band, Melbourne (VK3ME) has proved a very efficient substitute for Sydney (VK2ME), although the latter station should be in action again before these notes appear.

Letters concerning short-wave clubs and societies continue to pour in. Most of them, I regret to say, have no constructive suggestions to offer, and content themselves with, "How nice it would be if . . " etc. More practical is that from H. L. (Prestwick), mentioning the "Short-Wave Listening League," a British club whose title is self-explanatory.

Anyone interested is asked to get into touch with Mr. B. Dyson, 213, Green Lane, Rawmarsh, Rotherham, Yorks. Don't forget the stamped, addressed envelope, please!

Short-Wave Classification

In "Popular Wireless," I have been asking my readers to send in to me their complete lists of short-wave stations heard. Seventy or eighty really good lists are at present in my hands, together with others in the "not-so-good" category. It has been most interesting work to classify these lists, and to note that

A Set for Better Long-Distance Reception

" one man's meat is another man's poison."

All through I keep coming up against little deviations. A man in Warwick finds W 8 X K his best station, and has never heard W 2 X A D in his life; another, in Leamington, praises W 2 X A D up to the skies, and says he has " no use at all for W 8 X K." The most surprising variations take place in the course of a few miles.

Particulars, Please

For this reason, I am going to ask readers of " M.W." to do the same thing. Don't go to a lot of trouble on my account, but do please send me in the following particulars: Best short-wave station under 30 metres; best short-wave station between 30 and 80 metres; and details of your location—high, low, open, screened, or whatever it is.

If some of you are merely bored by short-wave broadcast, and would like to tell me a similar story about the amateur bands, please do. In that case I would like to know which part of the world you receive best on 20 and 40 metres, and, if you like, which individual stations head the list.

The amateur wave-bands, being filled with stations using relatively low power, and therefore even more dependent upon conditions than are the broadcasters, sometimes produce the most amazing freaks. I have just received a card from an American whom I worked with during November, and he mentions that his big transmitter was out of action; so he just " rigged up three watts of batteries." My log shows that he was just as strong as anyone else that afternoon.

I don't know whether I am entitled to claim a world's low-power record myself, but one American station that I worked recently told me that my " spacer-wave " was clearly audible. The " spacer " is, of course, the weak signal that is still radiated when the key is " up," and, in my case, is produced by a high resistance across the key, which is in the high-tension circuit.

I stopped and worked out the power going into the transmitter with the key " up," and found it to be about 1 milliamp. at 10 volts! ·01 watt for getting across the Atlantic doesn't seem much, but it certainly got there!

This sort of thing all goes to confirm that high power doesn't always produce loud signals, but it is necessary for the sake of consistency. I have often heard American amateurs using 100 watts on 'phone, and some of them have been far stronger than anything I have heard from W 2 X A D. That has always happened on a good day. On a bad day, " X A D " is there much the same as usual, while the " hams " have just quietly disappeared.

Feats of Reception

Low-power short-wave work will always be immensely interesting, since it is always so much easier to make a *really* efficient job of a very simple and small transmitter than of an elaborate high-powered affair. That, naturally, explains some of the amazing low-power freaks of which we hear from time to time.

Incidentally, I wonder whether the same reason applies to the wonderful feats of reception that readers often report to me with single-valvers? It must be possible to make a single-valve set with fewer flies in the ointment than would be the case with a more complex affair.

Elsewhere in this issue you will find a description of my five-valve superhet. You will notice that I do not make all sorts of claims to have received stations that no one has ever heard before. I still think that the good old single-valver is the only set for that particular job.

Absence of Noise

If, however, you want a set that will receive several of the distant stations rather *better* and more consistently than you have ever heard them before, *then* the superhet fills the bill.

I have been all over the question of " mush " and " background noise " in these columns before, but I must say here that I was very agreeably surprised by the absence of noise on this super. It uses only one L.F. stage and one note-mag., and is really a nice, quiet, well-behaved set compared with most of the superhets that I have met before (including, of course, my own efforts in that direction).

No one would describe it as a suitable set for headphone work, but it

ALPINE CLUB'S RADIO

One of the combined short-wave transmitters and receivers used by the German-Austrian Alpine Club. Its most important work is helping search-parties when some mountaineer is reported missing.

can be used in that way without the devastating results that one would expect from so large a set. With the volume control turned well down, and headphones balanced on one's cheek-bones, the effect is rather good.

I don't want to talk at length about superhets here, because plenty of space has already been devoted to that. One or two little experiments made since writing the article describing the " Empire Super," however, are rather interesting.

Test of Comparison

I have had the " super " and my usual " single " working side by side on the bench, with separate battery supplies, but with the same aerial, changed over by means of a switch. The " super " has been working into a loudspeaker, and the " single " into headphones.

Every station that I have found on the big set has also been found on the " little 'un "; and in three or four cases *very* weak stations have been picked out on the " single " that the other set has refused to find at all. This bears out in the most complete way my contention that for really weak DX signals one must have a

What to do When Conditions are Poor

small, "super-efficient" type of set. Don't think I am decrying the merits of my own superhet, or anyone else's! The single-valver is the sort of set that keeps me amused for hours, but it would be no use at all to some people.

The average reader abroad, I believe, would be willing to sacrifice the thrill of being the first to hear a new and incredibly weak station, could it be guaranteed that his set would give him the greatest possible degree of reliability and the best possible reception from most of the well-known stations.

I think the merits of the two types of set may be summed up in this way: "Superhet, programme-value and good loudspeaker reproduction; single-valver, DX and thrills, but only for the *patient* owner."

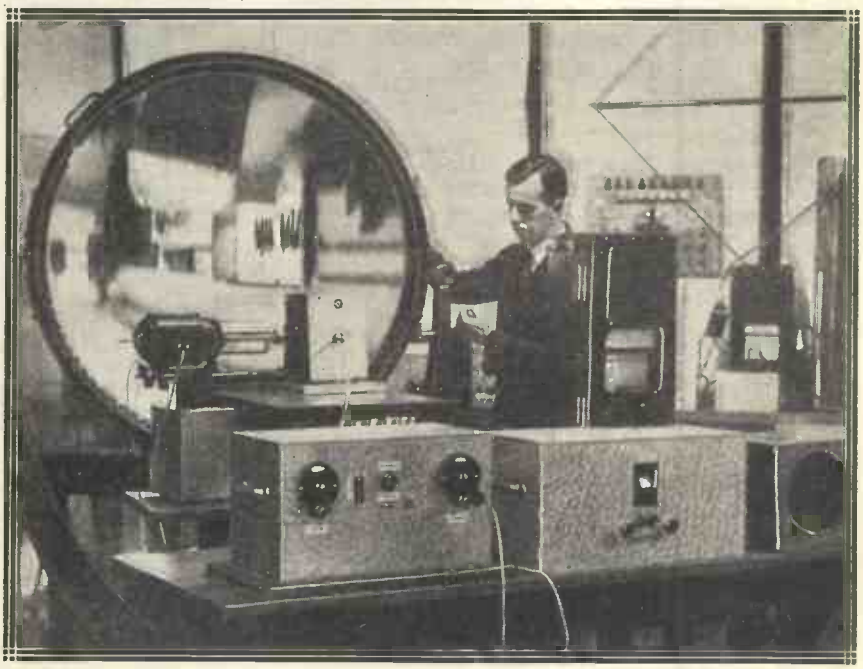
Caught Unawares

An impatient operator would probably go blue in the face before he had handled a single-valver for an hour, and yet the superhet would please him immensely.

It all comes back to the good old saying, that I have quoted more than once before, that "The big ones are larger than the small ones"!

I have not said much about conditions or stations on the air this time, because, for one thing, there is very little to add to my remarks for the past two months. While the short-wave ether is uneventful, we can best fill in the time by improving our receivers, to avoid being caught unawares with a "dud set" when the DX starts to pour in once more.

MEASURING INTENSITY OF NORTHERN LIGHTS



It is widely suspected that the Northern Lights have a big effect on short-wave conditions, so anything which increases our knowledge of these Lights is helpful towards finding out their significance. This apparatus is for measuring the Lights' intensity. The large mirror reflects on to a photo-electric cell which represents the Northern Lights as electric currents so that they may be recorded.

Conditions are not *bad*, but merely dull. New stations do not often crop up, and the old ones are becoming a little monotonous. There are two cures for this monotony; one is to learn Morse (a very good one, this), and the other is to settle down to one particular station that comes in consistently and to try and make an alteration for the better every day. This takes some doing, but it is the way to produce a really "hot" set.

SUPPORTING A MICROPHONE

A simple method to adopt

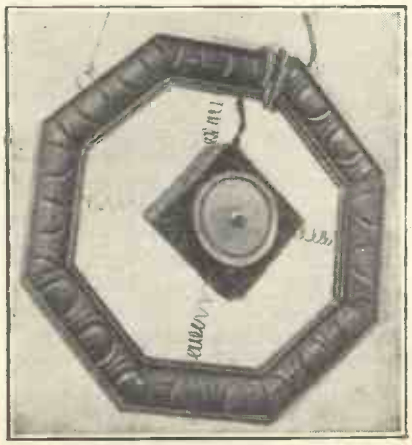
MICROPHONES are more in evidence among amateurs in these days of loudspeaking installations than they have been at former times. Nevertheless, it is not always the case that the microphone is properly supported when in use.

A microphone, for instance, which is merely placed upon the table or bench is always liable to become noisy owing to the numerous shocks and jars to which it may be subjected.

A very excellent and inexpensive method of adequately supporting a microphone is the one which is here seen illustrated.

How to Attach It

Obtain an old picture frame, and secure in the centre of it by means of four wire spirals or springs a square of spongy rubber of the type which is generally sold cheaply at most chemists' shops and stores.



An octagonal frame is used.

To this "rubber sponge," as we may term it, attach the microphone. The method of this attachment will probably vary according to the microphone in use.

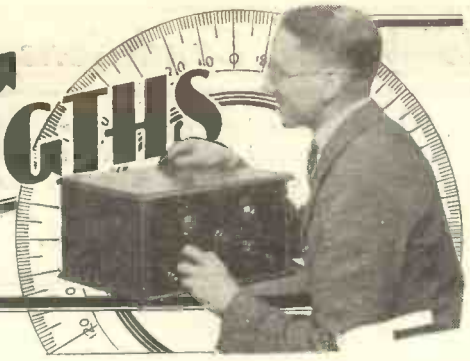
In the instance illustrated, the microphone is attached to its rubber sponge simply by its leads, which are well secured to the terminals at the back of the microphone case, being passed through the rubber sponge, and then held tightly at the back by means of wire staples pushed into the sponge.

Really Portable

A microphone supported in the manner illustrated forms a unit which is more or less portable in nature, and which may thus be carried about from place to place and used in almost any desired position.

J. F. C.

DIALLING WAVELENGTHS



When you have prepared a log for dial readings, why not transfer it to the panel so that the dial may be set direct without cross reference? It is easy to do in the way advocated.

By T. P. BLYTHMAN, B.Sc.

THERE is no reason now why the scales of tuning condensers should be marked in degrees. Years ago, when variable condensers were of the straight-line capacity type, with semi-circular moving vanes, the capacity in circuit was proportional to the scale reading, and therefore degrees were convenient. But with modern logarithmic and other type condensers a scale marked in degrees is only arbitrary.

It would be much better to graduate the scale in wavelengths, so that aided with a list of stations and wavelengths, it would be easier to tune to any station required.

Types of Scales

This is done in some commercial sets, but only when using a frame aerial can it be perfectly correct, as the ordinary aerials vary so much in characteristics that on a listener's own aerial the calibrations would have to be readjusted.

Let us now see how we can make a scale of wavelengths to fix to our condenser scales. Scales marked in degrees are of three types. The circular scale on the front of the panel, a similar scale behind the panel showing through a small window, and the scale on a drum-drive condenser which is really rectangular but is folded back on to a cylinder.

The method of making the scale is the same in all cases, but the shape of the latter one is different.

Dealing first of all with the circular scales, we require a piece of cardboard of the thickness of a postcard, and from this is cut out a circle with a diameter about half-inch greater than that of the dial. This is then cut across to form a semi-circle.

As this will be fastened behind a dial, a small semi-circular piece is cut out of the middle to clear the condenser spindle.

Fig. 1 shows the shape of this piece of card. It will be fastened to the back of the dial by glue or similar adhesive, and will be seen to project about $\frac{1}{4}$ inch from the edge of the scale. It is on this projection that the wavelengths will be marked.

Before doing this we must know the readings in degrees of about six stations. These can easily be found, and the table shows a sample of what we need.

From this table we make a graph as we want to find the readings corresponding to wavelengths of stations from 200 to 500 metres.

Making the Graph

On a small piece of graph paper we mark wavelengths along the bottom in steps of fifties from 200 to 500, and up the left-hand side dial readings in twenties from 0 to 180 (100 if we have a 100-degree scale). We then plot points corresponding to the readings we have and, joining these, obtain a graph.

From this the degree number corresponding to wavelengths of 200, 250, 300, up to 500 metres is found. Finding these numbers on the dial, we mark opposite them on the card the above wavelengths in figures.

The middle points between each fifty can then be found and marked with the twenty-fives, or by means of a scale we could divide each into five parts by a small line, thus marking every ten metres.

Tuning by Wavelengths

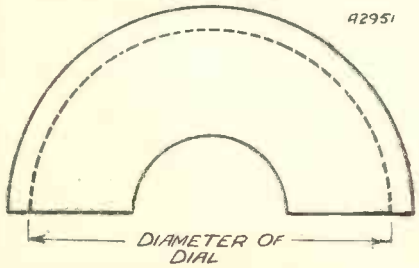
Fig. 3 showed the completed scale of wavelengths which will enable us to tune-in direct by wavelengths when we know the wavelength of any station.

In the case of the drum-dial type, we use a rectangular piece of thin card, the same size as that on the dial, and mark the wavelengths in steps of fifties as obtained from the graph at the proper places. In such a case the scale can generally be removed from the dial, and this will facilitate marking.

The celluloid-like substance called erinoid makes a more permanent job.

CUTTING OUT THE CARD

Fig. 1. The cardboard scale is cut a little larger in diameter than the size of the tuning dial itself.



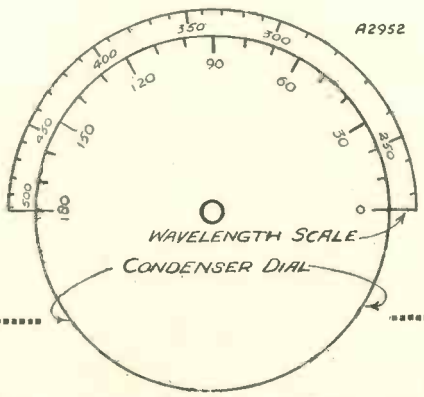


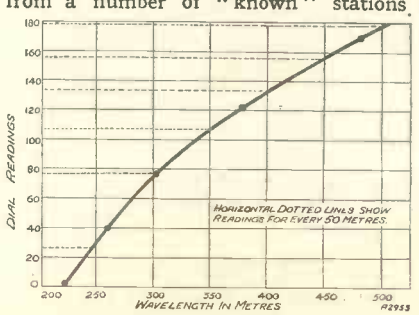
Fig. 3. How the dial and scale will appear when completed and calibrated directly in wavelengths.

TABLE TWO.

Reading	Station	Wavelength
2	Fécamp	223 m.
40	Lond. Nat.	261 m.
78	North Nat.	301 m.
110	Lond. Reg.	360 m.
122	Scot. Reg.	376 m.
170	North Reg.	480 m.

PLOT A CURVE FIRST

Quite an ordinary chart is first prepared from a number of "known" stations.



BATTERY VOLTS ARE NOT PLATE VOLTS

Don't assume that because you have a 120-volt H.T. battery you must necessarily be giving any of the valves in the set 120 volts also, for there are many forms of voltage loss between battery and valve. But it is easy to find what the actual plate voltages are by using the method explained.

By R. W. HALLOWS.

MANY people imagine that the voltages applied to the plates, screening grids or control grids of valves in their wireless sets are the same as those of the positive H.T. battery tappings from which the respective leads are taken. Actually, there is in many cases a vast amount of difference between battery volts and real volts.

A Typical Set

The purpose of this article is to show how the actual plate, screening grid and grid voltages may be found, and readers who care to carry these hints into practice may have some surprises in their own sets.

Let us deal with a typical set, such as the four-valver whose circuit is shown in simplified form in Fig. 1. We will go through it, valve by valve, and see just what the high-tension and grid-biassing voltages are.

Let us take it that the valves are 2-volters, and that the high-tension battery has a maximum E.M.F. of 120, a tapping being taken at 70 volts for the screening grid of V_1 and for the plate supply of V_2.

Decoupling is done in the plate and screening-grid circuits of V_1 by means of the resistances R_2 and R_3, and the condensers C_a and C_b; in the plate circuit of V_2 by means of the resistance R_4 and the condenser C_c; in the plate circuit of V_3 by means of R_7 and the condenser C_d.

First of all, what are the actual plate volts of V_1?

Plate Circuit Resistance

It is quite clear that they are *not* 120, since the plate circuit includes the 600 ohms of R_2 and the resistance of the windings of the high-frequency choke. High-frequency chokes vary a good deal in their D.C. resistance, but if we take the value of 300 ohms we shall not be far out in most cases. We have thus 600 + 300 = 900 ohms of resistance in the plate circuit of V_1.

Finding the Answer

You cannot measure the actual plate voltage by means of any ordinary voltmeter. The only instrument that would be at all suitable for the purpose would be one having a resistance of at least 1,000 ohms per volt, and even this would not give a completely reliable reading.

The sole way of finding the answer satisfactorily is to measure the plate current of V_1 by means of a milliammeter. From this the voltage is easily worked out.

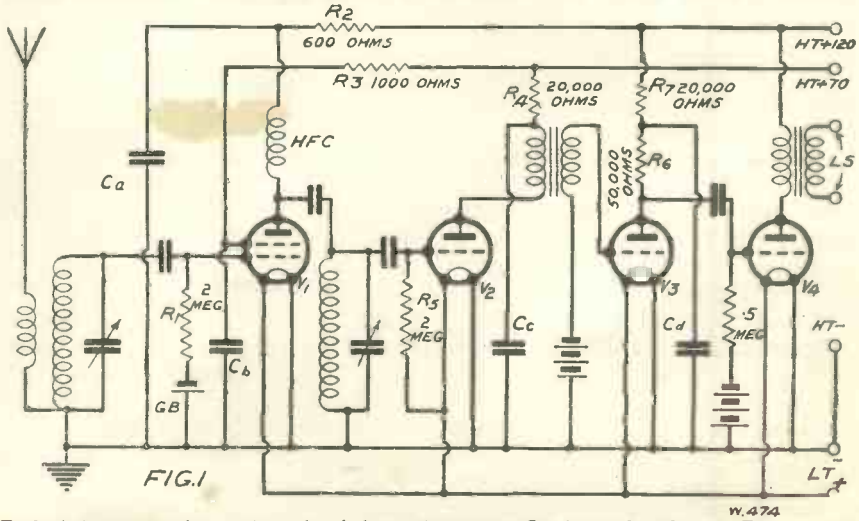
Working It Out

Let us suppose that we find 4 milliamperes passing in the plate circuit of V_1. Then, making use of Ohm's law, we can find the voltage drop across the high-frequency choke and R_2 by multiplying current in *amperes* and resistance in ohms. The sum is: 900 (ohms) × ·004 (ampere) = 3·6.

These volts are, therefore, lost in the plate circuit resistances, and the actual plate voltage is 120 — 3·6, or 116·4 volts.

Next the screening grid. Again we measure the current by means of the

MEASURING THE ANODE CURRENT IS THE FIRST STEP



To find the exact volts on the valves' plates, the current flowing is first found. The voltages lost in the anode circuits are then calculated and subtracted from the battery voltages.

One of the Prettiest Problems in Wireless

milliammeter, and this time we find it to be 1 milliampere.

Since R_3 is 1,000 ohms, the sum is $1,000 \times \cdot001 = 1$ volt. The actual screening-grid voltage is therefore 70–1 = 69 volts.

Easily Calculated

We see, then, that the valve is being operated with quite satisfactory plate and screening-grid potentials, though actually these are somewhat less than the battery terminal voltages. Why shouldn't we simplify the set by making one high-tension lead serve both plate and screening grid of V_1, and dropping the required amount of volts across the decoupling resistance of the screening-grid circuit?

This is very easily done, and we can soon calculate what the value of the decoupling resistance must be in this case.

The rule is: Divide the volts to be dropped in the resistance by the current flowing. We know that the current flowing when the screening grid has its proper positive potential is 1 milliampere, and the volts to be dropped are 120—70, equals 50. Dividing ·001 (ampere) into 50 (volts), we have 50,000, which is the required value for the decoupling resistance.

What of the bias on the control grid of V_1?

No Volts Dropped

This grid is insulated from earth by means of a grid condenser, and a negative bias is applied through the grid leak R_1, whose value is 2 megohms, by the biassing battery G.B.1, which consists of a single dry cell.

When the grid of an S.G. valve has a negative bias, no grid current whatever flows. The resistance between the control grid and the filament is therefore infinite, and the whole of the potential drop takes place between grid and filament. Irrespective, therefore, of the value of the grid leak, the negative bias on the control grid of V_1 is equal to the E.M.F. of the biassing battery.

So much for the high-frequency valve. We come next to the detector V_2, which provides some rather pretty problems.

To find the real positive plate potential is quite a simple matter now that we know the tip about using the milliammeter. We find, let us say, that the plate current is 2 milliamperes. The resistance in the plate circuit is supplied first of all by the decoupling resistance R_4, and secondly by the primary windings of the low-frequency transformer. The resistance value of the primary windings varies not a little according to the type of instrument in use, but 1,000 ohms is a good working value.

A Serious Loss

We have thus a total of 21,000 ohms in the plate circuit of V_2. The voltage dropped across this resistance is $21,000 \times \cdot002 = 42$ volts. Notice that V_2 is served by the 70-volt tapping of the high-tension battery. The actual plate volts are, therefore, 70 — 42 = 28.

THE LOAD LINE

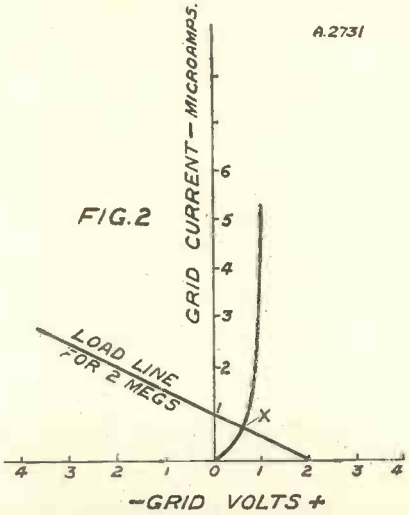


FIG.2

The grid potential of the detector is not always what it seems, but the grid-current curve will help you to find its real value.

This is far too low a plate voltage for good detection, but it is by no means unusual to find such a state of affairs, or even a considerably lower detector plate voltage, in receiving sets. I came across one the other day in which the detector was receiving under 20 real plate volts.

For Good Quality

It is outside the scope of this article to deal with distortion-free grid-leak-and-condenser detection, suffice it to say that if first-rate quality is desired it usually pays handsomely to work the detector so that it is passing at least 4 milliamperes of plate current.

How can this be done in the case of a set with a circuit like that seen in the diagram?

There are two possible methods. The first is to reduce the value of R_4. This can be done quite safely if it is remembered that the smaller the value of the decoupling resistance the greater must be the capacity of the by-pass to earth, C_c. We may find, however, that if we bring down R_4 to a value low enough to allow 4 milliamperes of current to pass, the capacity of C_c has to be made too large to be convenient.

Another Method

The other method is to supply the plate voltage of V_2 not from the 70-volt, but from the 120-volt tapping. The best way here is to make the connection as suggested, and then to try different resistance values for R_4 until one which gives complete stability is found.

The real grid-biassing voltage of V_2 provides one of the prettiest problems in wireless. Most people would say off-hand that the grid was 2 volts positive, since the grid-leak return is taken direct to the positive leg of the filament.

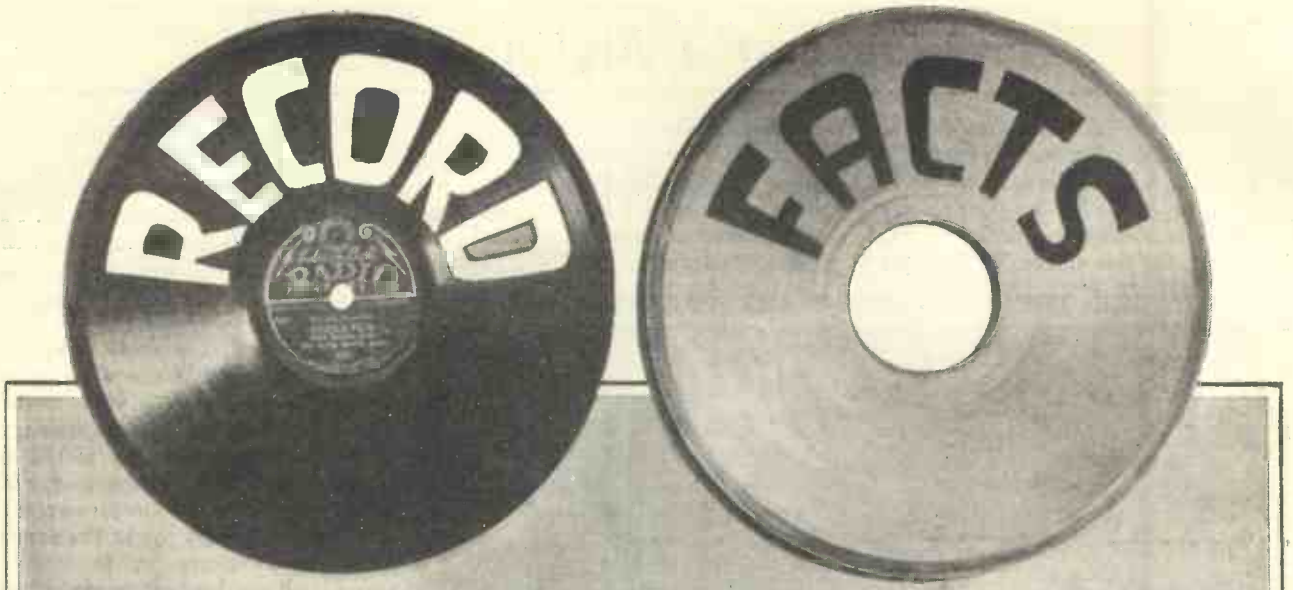
But the whole essence of this kind of detection is that grid current shall flow; current, that is to say, is actually passing from the negative leg of the filament to the grid and from the grid through the grid leak to the positive filament leg. Since there is a flow of current the whole potential drop does not take place across R_5. Part of it is across this resistance and part between the filament and the grid within the bulb of the valve.

Difficult to Measure

How are you to find just how much is dropped across each of these two resistances? You certainly cannot measure the grid current by means of a milliammeter, for grid current is always a matter of microamperes. Actually, even such a delicate instrument as a 0–100 microammeter is too coarse to make the measurement satisfactorily.

If you think it out you will see that even were there no resistance between filament and grid the current flowing through a 2-megohm grid leak and driven by an E.M.F. of 2 volts could not exceed 1 microampere. The actual current is a small fraction of a microampere, and no amateur

(*Continued on page* 196)



Masters—Mothers—& Workers!

How are the thousands and thousands of records that are sold of some renderings obtained from the original? This is one of the most intriguing aspects of modern mechanical music, and is interestingly dealt with

By F. N. GANDON.

IN a brief outline of the production of a gramophone record it would be as well to start in the recording room where the embryo disc first takes shape.

A "session" is about to commence. The orchestra, as seen through the recording-room window, is grouped round the microphones; not in a haphazard way, but each member in a selected position to obtain balance.

The First Cut

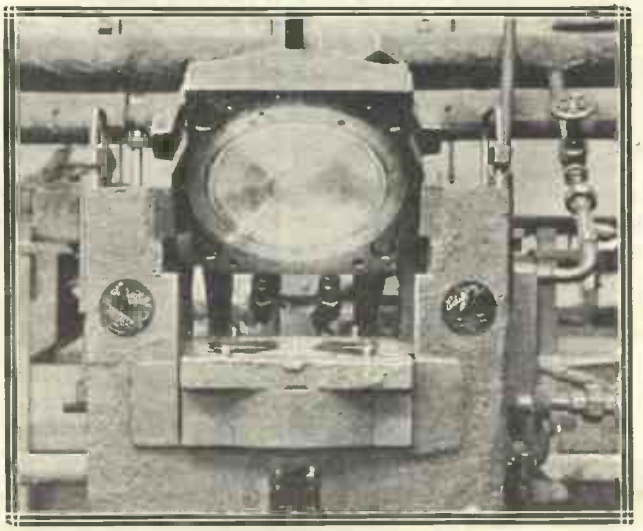
The turntable of the recording machine is revolving, and the engineers have placed on it a large wax disc, about an inch thick, fourteen inches in diameter and having a highly-polished surface. It has been heating in an electrically controlled oven for several hours to reduce it to the right degree of softness.

The cutter—rather like a large pick-up with a sapphire needle—is adjusted, and as a yellow light flashes in the studio, warning the orchestra to be ready, it begins to cut the familiar grooves on the surface of the wax.

Impressed Waves

If the first two or three grooves are examined with a magnifying glass it will be seen that they are quite regular, but on the instant that a red light flashes and the orchestra begins to play, they take on the familiar waviness of a finished record. The microphones are converting the sound waves into electrical impulses which are magnified by the valve amplifiers and passed on to the needle of the cutter. This vibrates with a side-to-side movement and impresses the sound wave-form on to the wax in wavy lines.

READY TO "BITE OUT" RECORDS



A metal press for making 10-in. records. Note the dies in the top and bottom jaws, and the pipes which are used for feeding in super-heated steam and cold water.

It is not difficult to appreciate that if the original sound produced these wavy lines, by means of a vibrating needle, then an ordinary needle and sound-box will re-create the sound waves if passed along the grooves.

There are many details in wax-cutting with which there is not space to deal, but it may be mentioned that the depth of the cut and the amplitude or side-to-side movement of the sapphire have to be adjusted very carefully.

Dealing with the Bass

If this is not done, a loud passage of music may cause the sapphire to move so violently that it breaks through the wall of an adjacent groove. To prevent this, the output of the amplifier has to be regulated and the bass notes are reduced in intensity by special filter-circuits.

Another interesting point is that a small suction fan is placed near the cutter to draw off the wax shavings before they can catch in the sapphire and damage the grooves.

Metal Records

It is possible to play a wax in the same way as a finished record provided that a light sound-box and a special needle are used, but being so soft it is practically ruined after one playing.

Pressure in the Region of a Ton

On the other hand, it is impossible to stamp out finished records from the wax, and so a metal die must be made for the purpose.

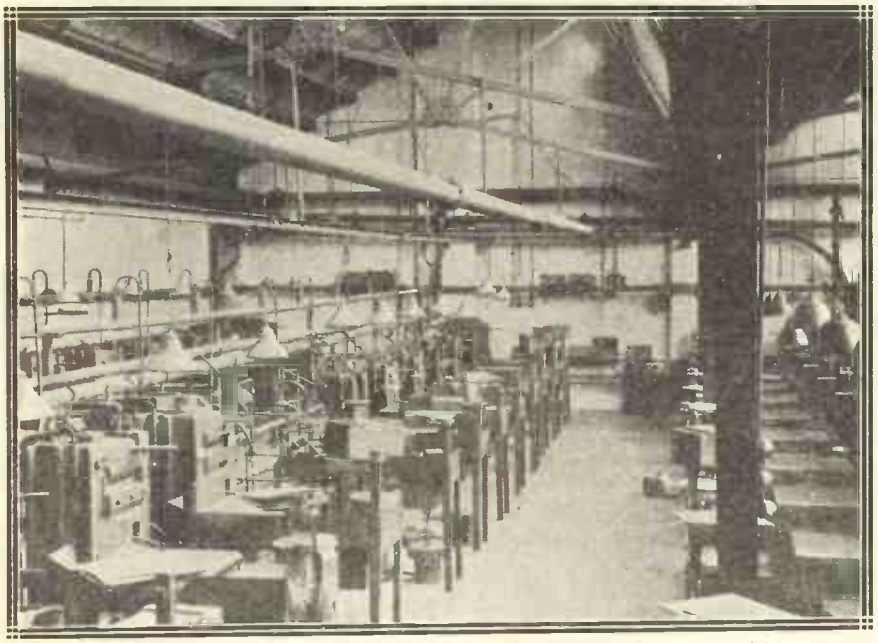
After it has been through the recording room, the cut surface of the wax is very carefully coated with a thin layer of graphite. This being a conductor of electricity, it is now possible to deposit on to it a layer of copper by electrolysis. The copper deposit is then stripped off and, after a coating of chromium for hardness, it is suitable for pressing records.

The first metal copy, which is given the name of "Master" by one manufacturer at least, is not used for pressing purposes. By the same process of electrolysis, copies of the "Master" are made which are called "Mothers," and from these in a like manner is produced a whole host of "Workers."

The latter are the dies actually used for pressing records as we know them.

The composition of records varies with the different manufacturers, but the dies and the presses are much the same.

WHERE THE "WORKERS" ARE PRESSED OUT



A row of 12-in. record presses. The flat tables to the right are heated with steam to soften the composition ready for use in making the "discs."

Hydraulic Press

In operation, the press is opened and two dies or "Workers" inserted —one for each side of the record. The title labels and the composition in a softened state are placed in position and the press closed. By hydraulic means the pressure exerted is in the region of a ton to the square inch, and to ensure that the composition shall reach every crevice of the die, it is made almost liquid by superheated steam.

After a few seconds it is solidified by the circulation of cold water through the jaws of the press, which, when opened, reveal a perfect record, except, perhaps, for a few jagged edges which are removed eventually in the finishing shop.

The Finished Product

It is a strange experience to stand by a press and to see in fifteen seconds a dirty piece of putty-like substance transformed into the "Rhapsody in Blue." And still more strange to find, on trying it over, that after all these processes—wax-cutting, die-making, pressing, etc.—the results are comparable to the original sound.

MAKING TERMINALS "STAY PUT"

A simple but very useful tip that will prevent loose terminals.

THE easiest way to mount terminals on an ebonite strip or panel is to drill a hole slightly larger than the terminal shank, pass it through the hole and tighten up the nut with a pair of pliers.

Unfortunately, however, this sometimes leads to trouble, for it is by no means uncommon to find a terminal mounted in this way that has worked loose.

Tapped Holes

Most set manufacturers tap terminal holes so that the nut on the back merely acts as a lock-nut, but it is not all amateur set-builders that possess a set of taps. The scheme that I often adopt in a case like this, and if there are no taps available, is to drill the hole slightly smaller than the terminal shank, and then gently but firmly screw the terminal into the hole.

It Cuts a Thread

The metal screw being considerably harder than the ebonite, makes its own thread in the latter, it being quite impossible to withdraw the terminal without unscrewing it. The nut on the back can then be used for connecting up without any fear of the terminal working loose.

Don't drill the hole of such a size that it is hard work to force the terminal shanks into place. Otherwise the very tight grip that you will have to take of them with pliers is likely to mark them and spoil their appearance.

THE "FIVE-GRID" FOUR

An appreciation from a Seafaring reader.

Sir,—I wish to show my appreciation for your description of your "Five-Grid" Four, published in your August number.

As an inexperienced hand I found the wiring easy, and followed your advice throughout in everything.

It is certainly a very good receiver; it has a wonderful daylight range, and will suit me admirably when we go to sea.

Yours faithfully,

L. H. NEWTON

(Chief Officer).

S.S. "New Brooklyn."

CAN WIRELESS WAVES BE PHOTOGRAPHED?

An interesting speculation on the possibilities of bridging the gap between those frequencies with which your receiver deals and those which your camera records.

By T. B. SANDERS.

"As every schoolboy knows," the transmission of broadcast programmes from sender to receiver is effected by disturbing the ether. All that is required to effect wireless communication is to cause the ether to vibrate a certain number of times per second at one point and a receiver will hear "signals" on a certain wavelength at a distant point.

There is, of course, a definite relationship between the frequency of the ether vibrations and the wavelength. A wave of 600 metres, for instance, is due to an ether frequency of 500 kilocycles.

Candle Radiations

Wireless transmitters are not, of course, the only means whereby ether disturbances may be caused. A modern transmitter is a very complicated piece of mechanism and creates relatively slow vibrations on one fixed frequency. A lighted candle, on the other hand, is quite a simple affair, but it disturbs the ether in the vicinity of its flame over a range of frequencies from roughly a hundred thousand million to (equally roughly) a million million *kilo*cycles per second.

From the point of view of the results achieved, the candle would appear to be a much more energetic worker than the Daventry National transmitter, which disturbs the ether fixedly at the paltry rate of a mere 193 kilocycles per second.

Actually, of course, the candle radiates both light and heat, both of which are transmitted by ether vibrations of much higher frequency than those created by a broadcast station.

The important point to bear in mind, however, is that the *only* differences between the candle's and Daventry's efforts are of frequency and strength. Both disturb the ether, the candle doing it a greater number of times per second but less violently.

The accompanying chart shows a range of frequencies from one thousand to ten million million kilocycles per second with corresponding wavelengths in metres and millimetres.

Various Bands

A very large part of this chart is concerned with what may truly be called "wireless" waves, since from 100 metres to 1 metre are the well-known short and ultra-short waves. From 1 metre down to 1 millimetre are waves admittedly not yet used for communication purposes, but nevertheless they can be produced in laboratories by electrical oscillators.

Then the chart shows a relatively small range of frequencies which are "put to no use at present."

Finally we come to heat and light waves.

The Camera

The art of photography is well established, and its present state of perfection is due to intensive research into the behaviour of certain chemicals which change their composition when exposed to light. By coating a glass plate or celluloid film with an emulsion of such chemicals suspended in gelatine a sensitive material is made which, by means of a camera, can be made to create a permanent pictorial record of an illuminated object.

Naturally, those responsible for the development of photo-chemical processes have devoted their energies chiefly to making materials which will be as sensitive as possible to visible light. The most faithful pictorial rendering of a subject is effected when the sensitive materials are only influenced by the light we see by.

If, however, reference is made to the chart, it will be seen that immediately adjacent to the frequencies which cause visible light are the infra-red and heat rays. Moreover, they border on visible light on that side which ultimately leads to wireless.

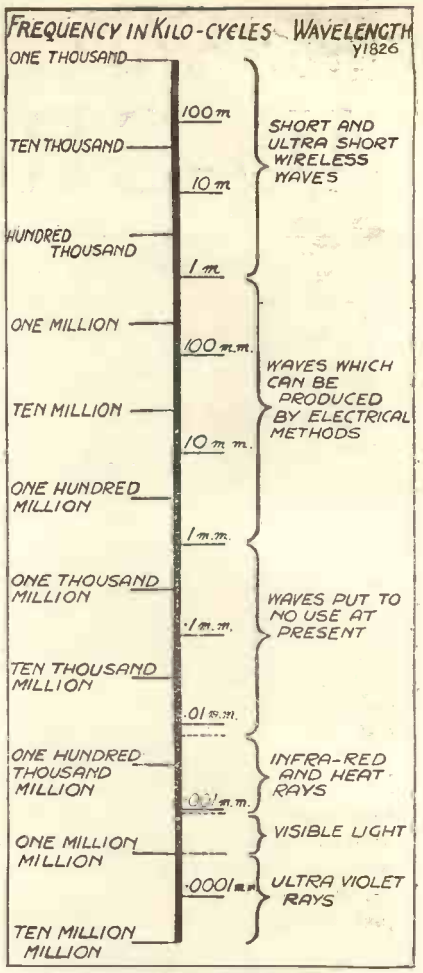
Recently a determined attempt has been made to increase the sensitivity of photographic emulsions so that they are influenced not only by white light, but by the infra-red rays which our eyes cannot see.

Unaffected by Haze

A large measure of success has attended these efforts and the production of infra-red plates has made possible long-distance photography and photography through haze. Haze and mist due to water vapour in the air do not impede the progress of infra-red rays as they do the rays of white light.

The modern scientist is never satisfied and experiments have been made to see if infra-red sensitive plates are influenced by heat rays

(*Continued on page* 194)



As can be seen from this frequency chart there is not, relatively speaking, an immense gap between light waves and waves produced electrically. In other respects, of course, they are alike.

PHOTOGRAPHY WITHOUT LIGHT

Photo by courtesy of Messrs. Ilford, Ltd.

Thanks to the untiring efforts of British research chemists, heat can be made to affect photographic plates so that such a picture as this may be recorded in total darkness.

Why RESISTANCE-FED UNITS?

By PAUL D. TYERS.

"Shunt-feed" or "parallel-feed" is now such a popular method of connecting L.F. transformers that the following summary of its features and advantages is of unusual interest to all who value life-like reproduction.

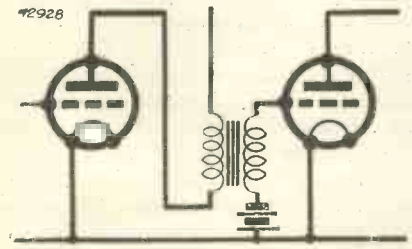
IF I were asked how long resistance-fed transformers had been in use I would make a guess at about ten or twelve years. There is nothing very new about the idea, although resistance-fed units have only been marketed here within the last year or two.

The day of stunts and freak devices is long past, and when anything obtains such importance as the resistance-fed unit we may rest assured that it offers some very decided advantages. Let us, therefore, examine just what it is, just what it does, and why it does it.

Definite Inductance

A resistance-fed transformer gives far more even amplification than an ordinary transformer, and, in particular, we lose practically no bass—hence the value and popularity of the resistance-fed unit. With a valve of any particular impedance the transformer primary must always have a definite inductance if there is to be no loss in the lower registers.

A PRIMARY CONSIDERATION



TRANSFORMER COUPLING FIG.1

With the original transformer-coupling methods the plate current was passed through the transformer's primary winding.

When the steady anode current of the valve flows through the primary winding of a transformer it has the effect of decreasing the inductance very considerably, and accordingly in a high quality receiver it is necessary to use a somewhat large and bulky transformer if there is to be no bass loss.

No Step-Up

There is a type of amplification which, when properly arranged, gives practically no bass loss whatever. This is known, of course, as resistance coupling. The great disadvantage of resistance coupling is the fact that there is no step-up between each valve, and accordingly the amplification is low, and a greater number of valves has to be used. A resistance-fed transformer arrangement can be considered very simply as a combination of resistance coupling and transformer coupling.

The illustrations show three simple circuits. The first is of an ordinary transformer connection, the second is a resistance-coupled connection, and the third a combination of the two. I must point out here that the coupling condenser used with a transformer is very much larger than that used with a resistance arrangement, and, therefore, we must not merely remove the grid leak in our resistance amplifier and substitute the transformer. Having shown that the resistance-feed connection is extremely simple, one immediately asks why are special transformers or units produced when apparently one requires nothing but a coupling resistance, a condenser, and an ordinary transformer.

Importance of Design

In the answer to this question lies the secret of the efficiency of the special resistance-fed unit, because a particular type of transformer is used, and the whole success of the unit depends practically entirely upon the design of this transformer.

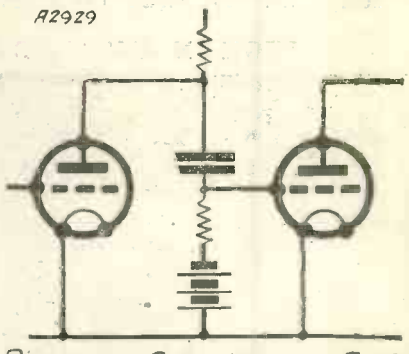
I have previously mentioned that loss of bass with transformer coupling is due to the anode current of the valve lowering the effective inductance of the primary.

In ordinary transformer design this effect is overcome by using a large iron core which requires a correspondingly large amount of wire. In a resistance-fed arrangement no direct anode current passes through the primary winding, and accordingly the effect of lowered inductance does not arise. This enables us to take advantage of a special type of alloy for the core.

High Permeability

Most transformers have cores made of a silicon iron alloy. There are other alloys, however, which contain a very high percentage of nickel, and these have various trade names, such as Mumetal and Permalloy. These alloys have what is known as very high magnetic permeability. This property in the core of a transformer controls the inductance, and accordingly with these special alloys we can obtain very high inductances with extremely small cores.

NO TRANSFORMER AT ALL



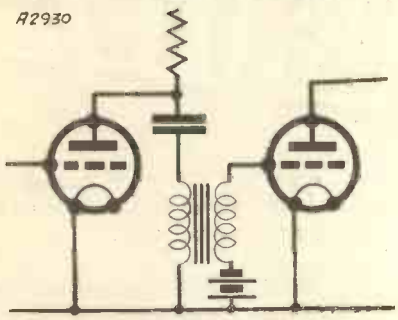
RESISTANCE COUPLING. FIG.2

The resistance method of low-frequency amplification was capable of better quality than that given by the earlier L.F. transformers.

Small in Size, But Capable of Great Fidelity

It may be imagined that apart from saving a certain amount of space and weight there is little to be gained by using such diminutive core stampings.

"BEST OF TWO WORLDS"



Nos 1 & 2 Combined Forming Resistance Feed Coupling. FIG. 3.

The transformer is now "shunted," or parallel-fed, and the advantages of both methods are retained in the circuit.

However, there is still much more in this than meets the eye.

It is well known that the ratio or effective step-up of a transformer is determined entirely by the number of turns on the primary and secondary windings. A 3–1 transformer, for example, has three times as many turns on the secondary as it has on the primary.

Shunt for High Notes

Now the more wire we put on the secondary the greater becomes what is known as the self-capacity of the winding, i.e. the small capacities existing between the turns and layers. I expect everyone knows the effect of placing a condenser across a loud-speaker or a transformer secondary. It acts as a shunt path to the high notes and makes the reproduction sound generally woolly. In other words, it cuts out the amplification of the high notes.

Going back then to the size of the core and the amount of wire, it is now obvious that if we can use this diminutive core with a small number of turns we are going to reduce our quantity of wire on the secondary very considerably, and as a result we reduce the self-capacity. In other words, we have lost no top-note response, which gives such brilliance to the reproduction.

There are still two further advantages, as we can almost "fake" our response at either end of the scale.

The value of the coupling condenser which is employed ranges, as a rule, from about ½ mfd. to 1 mfd. By careful arrangement of various values it is possible to introduce a slight low-note resonance, which has the effect of raising the lower end of the characteristic, and we can, in fact, actually control the point at which this slight resonance occurs.

Boosting Up Top

When I refer to a resonance I do not mean a very marked peak, I simply mean something which will give just a slight rise in the lower registers, and tend to compensate for the deficiencies in most loudspeakers at the lower end of the scale.

Similarly, we can tend to make the top part of the response rise, and it is quite possible to obtain greater amplification at 5,000 cycles, for example, than it is in the middle of the scale.

Again, we are boosting up the top response which gives brilliance to the reproduction just in the region where many of the popular loudspeakers begin to fall off rather badly. How this is accomplished is rather difficult to explain in a simple article, but it is done by means of what is known as controlled leakage.

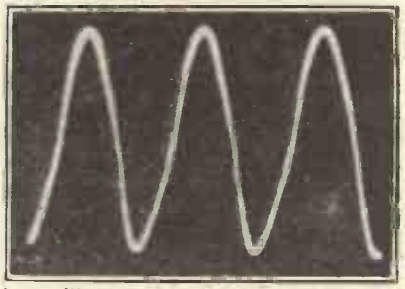
So far I have dealt merely with the aspect of frequency response, which is so important. I must now say something about the degree of amplification which we can obtain.

Lost Amplification

If we take a 3–1 transformer and measure the amplification, and if we then resistance-feed it, we shall find that we have lost a certain amount of amplification. This results from two causes.

In the first place we have connected a resistance of about 30,000 ohms in the anode circuit of the valve, which means that we have lowered the anode voltage because a certain amount of voltage is dropped across the resistance, and accordingly the output of the valve decreases slightly.

THE UPS AND DOWNS



An oscillogram showing part of a 50-cycle wave transmitted via a resistance-fed unit.

In the second place, the fixed resistance acts as a load across the primary circuit. Modern valves are so efficient, however, that the slight loss of amplification is of little importance, but there is still plenty which can be done to overcome what appears to be a slight drawback to the system.

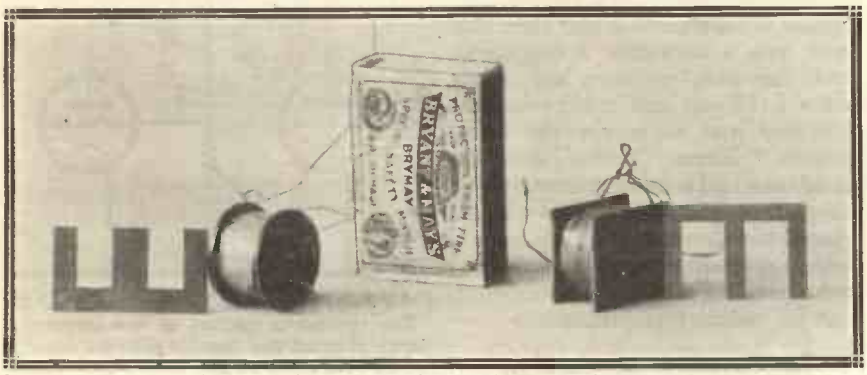
Large Amount of Wire

In the first place, we can actually make the ratio of our little transformer higher than usual, because one of the limiting factors in making a high-ratio transformer, which, of course, gives greater amplification, is the secondary self-capacity produced by the large amount of wire in the secondary winding.

We can therefore design quite a high-ratio transformer which still has a very high primary inductance and

(Continued on page 195)

HIGH INDUCTANCE IN SMALL DIMENSIONS



Compare the size of the match-box with that of the experimental bobbins and core stampings.

TROUBLE TRACKING

I HAVE just had a letter from a reader who is very puzzled. He tells me that he has been experimenting with an S.G. stage, using parallel-feed coupling.

You know the kind of circuit I am referring to. The anode of the S.G. valve is joined to an H.F. choke, and also to the grid end of the detector tuning coil via a fixed condenser. The other side of the choke goes to H.T.+ 120 volts.

Well, my correspondent's complaint is that he cannot stabilise his S.G. valve no matter how much screening he uses. In fact, he has apparently done everything he ought and yet the H.F. stage still oscillates.

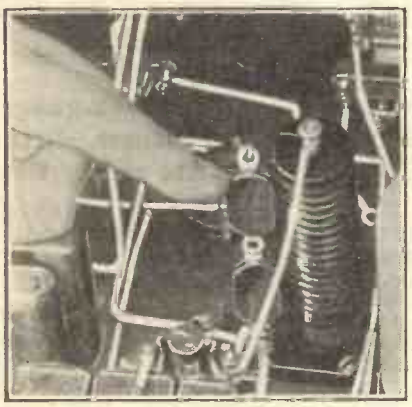
The Choke Clue

But luckily he gives me a clue when he describes his components. He expresses his doubts about the choke, which is of unknown vintage, although it is "a nice-looking job in a moulded case."

Yes, I feel somehow that the choke is responsible for the trouble and perhaps a few words about this inoffensive component may help other readers.

H.F. chokes can be divided into two types, viz., those intended for reaction purposes, and the others which are specially designed for S.G. circuits.

AN IMPORTANT POINT



The function of an H.F. choke is to act as a bar to high-frequency currents, and it is therefore essential for the choke winding to have a very large number of turns. This is specially true in the case of H.F. chokes which are used in parallel-feed circuits.

You will probably say, "But won't one choke function both for reaction and parallel-feed?"

Simply a Hank

As a matter of fact, it will. A reaction choke is merely a large number of turns of fine wire wound on a ribbed former or sometimes it is simply a "hank" winding.

The point is that reaction chokes are not particularly critical. They have to divert the H.F. in the anode circuit of the detector through the reaction condenser.

Every month the Chief of the "M.W." Query Department discusses some of the common difficulties which can often be so troublesome. This time he deals with the need for using a good H.F. choke.

If they fail to divert all the H.F. it doesn't usually matter much as far as reaction is concerned, because there is normally a pretty big margin of safety in the reaction condenser value. Moreover, the choke usually has an anode resistance or transformer primary in series with it and this helps considerably.

So long as there are enough turns on the choke to give adequate reaction on the medium and long waves, one doesn't worry much. I have known of several cases where sufficient reaction has been obtainable without the assistance of a choke at all.

H.F.C. Must Be Good

But a "dud" reaction choke can produce unpleasant reaction effects on certain wavelengths, and it pays to buy a decent article.

When we come to the S.G. stage it is a different story. For parallel-feed work the H.F. choke *must* be a good one, otherwise incurable oscillation or loss of volume may result.

An S.G. choke has to embody two essentials. These are high inductance and low self-capacity. If the D.C. resistance is also low so much the better.

When an S.G. stage oscillates violently at certain settings of the tuning controls it is quite possible that the anode circuit is being tuned by the choke itself.

For Shunt-Fed Circuits

A well-designed choke will not do this and readers need have no fear of any trouble of this nature occurring if they use any of the makes specified for "M.W." sets.

But in cases where the makers list two types, it is better to purchase the higher priced component, and upon inquiry it will usually be found that this is the one they recommend for shunt-feed S.G. circuits.

I have said nothing about superhet chokes. These are windings which have a high enough inductance to act as H.F. stoppers on wavelengths of 2,000 or 3,000 metres, but in design they are similar to the other types I have mentioned. The main difference is in the size of the winding.

Some Final Hints

Don't forget that an inefficient choke in an S.G. circuit may let enough H.F. past it to cause a big loss of efficiency in the detector grid circuit, so you see it must be a good choke or nothing.

I should also have mentioned that, although detector reaction chokes are not so critical as the "S.G." type, in some circuits any leakage of H.F. currents past the choke winding is liable to cause trouble.

Take, for example, an R.C.C. stage immediately following the detector. Once the high-frequency currents get past the reaction choke there is always the risk of their causing serious distortion through being amplified by the L.F. stages and finally appearing in the output circuit.

The RISTOW RADIO ALARM

Ever since the inception of wireless, attempts have been made to perfect an automatic radio-calling device. Following recent British successes in this field, a German invention has now been developed and is here described by

Dr. ALFRED GRADENWITZ.

A WIRELESS alarm designed by Dr. A. Ristow was recently demonstrated in operation at a popular garden restaurant on the Stoelpchensee Lake, near Berlin. This was in the present case mainly to serve as fire alarm, but was shown to be suitable for many other uses besides.

Entirely Automatic

Radio-telegraphy has so far been severely handicapped by the fact that no suitable radio alarm was available. In fact, the vast possibilities of wireless receivers for signalling purposes could not so far be made use of. This is where the new apparatus is coming in very handy.

The Ristow Wireless Alarm affords a means of calling up by radio any given receiving post from any other place, the same as a telephone subscriber is called up by another, either direct or through the intermediary of the exchange.

No permanent watching is required as heretofore, the operator being called to the receiver by an alarm signal given out from the calling radio post. Apart from this possibility of individual alarm, there is also the alternative possibility of calling up a whole group or all of the receiving posts at a time (collective calls).

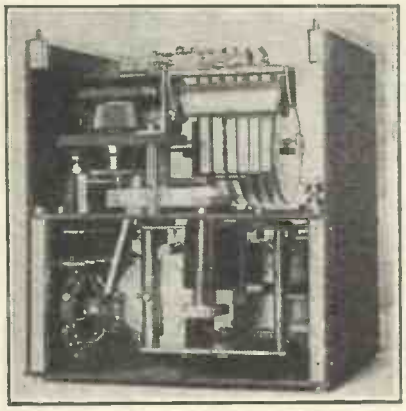
Mechanically Simple

The Wireless Alarm is accommodated in a case of very small dimensions, its compactness and simplicity warranting full reliability. There are two types of apparatus, for battery operation and connection up to the mains respectively.

The former is represented in the photograph, with the front wall and top of the casing removed; its weight being about 10 lb. Current is derived from a 4-volt battery.

The apparatus merely comprises a driving agent (motor or clockwork), cam discs, a small mechanic link between the two, an input relay and a drop indicator relay and alarm, and is connected up to a standard wireless set (or transmitter). When switching the lever over from "receiving" to "transmitting," call signals can be given out by means of the apparatus.

FOR BATTERY OPERATION



The newly invented Wireless Alarm can be mains operated, but where this is impracticable only a four-volt cell is required for the battery model.

The giving of three different signals has so far been provided for, though, of course, this number could be increased at will. Three signals will, however, be quite sufficient in the majority of cases, the more so as further differentiation can be obtained by other means—choice of other wavelengths, modulation, controlling energy of transmitter, etc.

When using the apparatus as receiver it is connected up to the loudspeaker on the one hand, and to the rectifier and receiving set on the other. As the alarm is switched off the loudspeaker is switched in automatically, and vice versa.

Constructional Features

The power consumption is about 2 watts, an ammeter indicating the receiving current. The upper compartment comprises the cam discs giving out the signals, which are screwed fast to the axis carrying the cam wheel of the receiving set, as well as the input relay, while the lower compartment accommodates the clockwork and releasing magnet.

All the various parts are readily accessible after removing the walls of the casing.

Operation has been found to be extremely trustworthy.

The main constructive feature is that all essential operations are released and actuated mechanically, and that all impelled organs are returned to their positions of rest simply by endowing the cam wheel with a centre of gravity causing it to drop back by its own weight.

The circuit of the drop indicator relay is closed as the contact set provided for it on the cam wheel is closed and as the armature of the input relay is dropping.

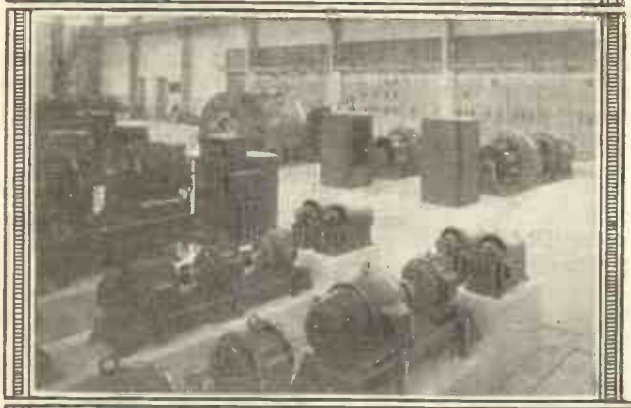
If this should not happen the cam wheel will slide over the contact block of the drop indicator relay. If the input relay should drop in advance, the making of contact as the cam disc is dropping into its position of rest will be of no effect.

Variety of Uses

The apparatus can be used to start any sort of signal—ordinary bells, sirens, chimes, optical signals, etc. These can be actuated either permanently until their being switched off mechanically, or only for a given period. The duration of signals can be controlled from the calling post as well, the signal being switched in to begin with, and switched off as desired, etc. In order to make sure of the fact that the signal has been started an automatic back signal can be provided for.

Finally, the current inserted by the drop indicator can be used to start —in the place of an alarm signal— any electrically controlled operation, e.g. the blasting of rocks, the switching in of substations, testing devices, etc.

HOW OUR STATIONS Get Their "Juice"



Do you ever compare your H.T. battery with the power plant of a B.B.C. station? It's not such a ridiculous comparison as you may think. The similarity is here explained by

A BROADCASTING ENGINEER.

LAST week I was at Brookmans Park, in the morning, when the station was being started up—a somewhat lengthy business. An engineer friend and I fell a-talking about this matter of switching on. I said, "It's a fair bit different from just flicking the 'eliminator' switch as I do with my mains-driven 'Comet.'"

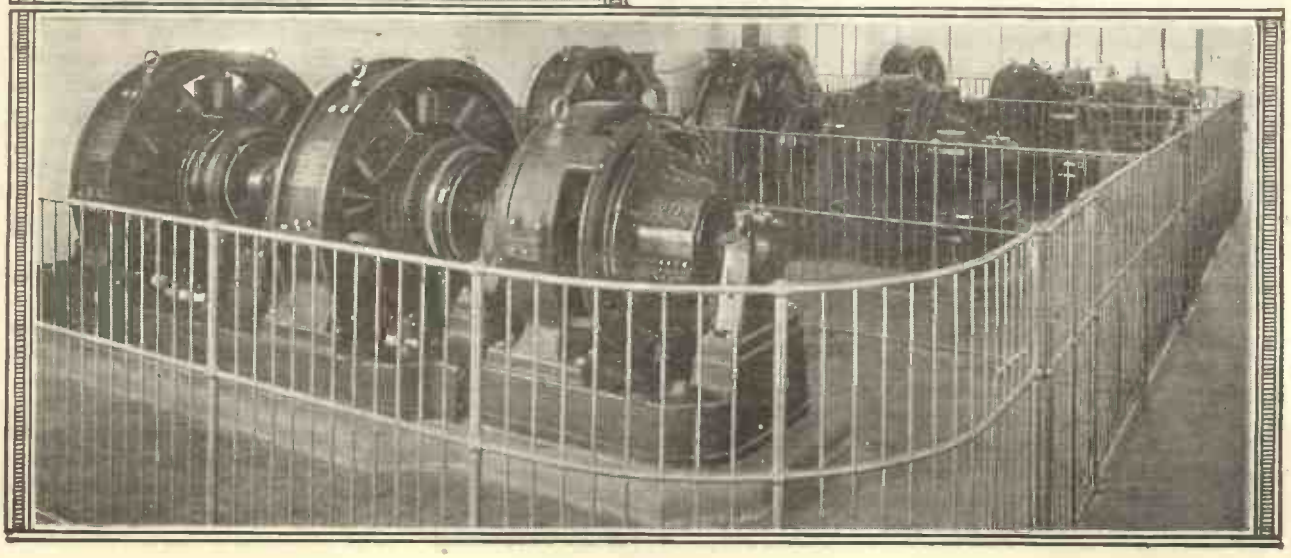
"Yes and—no!" replied the engineer, ever precise. "The mass is different, but the *matter* always the same. Most transmitters are mains-driven, too. It's like this——"

He waxed eloquent. I took out my pencil and notebook; and this is what he said.

From Mains or Generators

At every big transmitting station the power comes either from the mains, or is generated locally by meaus of dynamos which are driven usually by heavy-oil engines. In either case the power has to be steady D.C. current at a voltage of several thousands. Just whether the mains are used, or whether the current is generated on

Three typical sections of generating plant are illustrated here. Above, a group of experts is taking a look at part of the Moorside Edge machinery. On the left, Mühlacker's plant is shown (250 kw., 12,000 v.), while below are the 12,000-volt A.C. motor generators as used by the B.B.C. at Brookmans Park. Compare with these the 35-h.p. generator of 1906 illustrated on page 180.



Switching on the L.T. at the North Regional station of the B.B.C. is an operation which can only be done after the main power has been switched, the water pumps started, and the Diesel engines warmed up and working !

the spot, depends on the local conditions and the supply mains available.

At any Continental stations where the electricity is very cheap because of the plentiful supply of coal, or because use is made of natural waterfall resources, then the mains are used and an "eliminator," similar in principle to ordinary amateur gear, is used to convert the supply to direct current.

Nearly every big mains supply (particularly on the Continent) is alternating current, and as many transmitters need up to 10,000 volts high-tension, it is not always easy to convert this high voltage from alternating current to direct without losing a lot of power.

Capt. Eckersley's Estimate

Long before a station is built the engineers plan the amount of power which will be needed. Amateurs know that they need, say, 100 or 120 volts high-tension for their set and the total H.T. consumption will be in the nature of 20 milliamperes.

In just the same way the broadcasting engineers know the voltage required for all the valves in the transmitting gear, and the current consumed. From these two figures they can easily work out the high-tension power required.

That is not all. Out of a 30-kilowatt transmitter, the big water-cooled valves of which would take a filament current of 50 amperes, the total power taken by the L.T. side of the circuit would be 3 kilowatts. In addition, there are the little generators which supply grid bias, and the motors which pump the cooling water.

Capt. Eckersley, who has been in intimate touch with this aspect of station design, estimates that for an ordinary 30*-kilowatt station you have to take* 180 *kilowatts from the mains.*

Capable of 18,000 Volts

At stations which take their power direct from the A.C. mains and have no power generator of their own, special cables are installed from the power station, and these are put underground, if possible, so that the cables do not interfere with the counterpoise earth wires.

Big valve rectifiers turn the power from A.C. to D.C. in nearly every Continental station, but there are one or two stations where they use A.C. motors driving D.C. generators, because this saves the possibility of rectifier valves burning out; and also when you are dealing with voltages of 10,000 or so it is more economical to have D.C. generators.

The B.B.C. uses motor generators, and in the Post Office station at Rugby there are D.C. generators capable of giving 18,000 volts if necessary. At Carnarvon there are two 10,000-volt generators giving 150 kilowatts output. In comparison, our 150-volt mains units seem very feeble !

All the power that a receiver takes from the mains is consumed in a useful way, but with a transmitter there is a great deal which appears to be waste.

Now, to prove this, just take a typical B.B.C. type transmitter working on low-power choke modulation. If this were a 40-kilowatt job the final power amplifier stage of several valves will take 31·3 kilowatts. That is the power which appears as signal energy, and is, of course, useful.

On the "waste" side we have 2·5 kilowatts taken by the first power amplifier, ·1 kilowatt taken by the modulation amplifier, 4 taken by the modulators, 3 kilowatts taken by the filaments of all the power amplifiers, and ·4 kilowatt consumed in various non-signal productive ways.

Home-Made Power from Oil

This, you must remember, is typical of the most efficient type of transmitter. With the old high-power arrangement, out of a 40-kilowatt transmitter *the main valves took only* 14 *kilowatts, and more than this—actually* 16·8 *kilowatts—was taken by the control stage.*

If the " juice " does not come from the mains, or if the mains are used only as a standby, then a generator is used. In all the new stations, at Brookmans Park, Slaithwaite and Westerglen, the B.B.C. uses four six-cylinder Diesel engines, which run on heavy oil.

These are directly coupled up to big dynamos, giving 200 kilowatts each. Three engines run the station at full power, and the fourth is kept as a reserve.

There are 2,000-amp. hour accumulators which can run the whole plant in case of a breakdown. The " juice " comes from the power-house at 220 volts, and in the motor-generator room this is stepped-up or down as required. Three huge converters turn this 220-volt supply to direct current at 11,000 volts for the high tension.

L.T. comes from another bank of three machines, which seem small in comparison because they only generate 23 volts; but they are not really small, because they generate this 23 volts at 1,300 amperes. This is enough power for the filaments of all the valves, except the master-oscillator valve, which has its own accumulator.

Machine-Made Grid Bias

It is rather surprising that nine further generators are needed for a big B.B.C. transmitter in order to give grid bias and H.T. current for the smaller valves in the first stages.

We connect eliminator or batteries to the set by flex leads or battery cords, but a transmitter gets its power *via* lead-covered leads passing through earthenware ducts from the motor generators to the switchboard and thence to the actual transmitter panels.

Switchboards are sometimes straightforward as they are at B.B.C. stations, or they may be extremely complicated, interlocked affairs as they are, for instance, at Rome. It is B.B.C. practice to put meters in every circuit and to have plain switches subcontrolled from the control desks, one of which faces each transmitter, as you know.

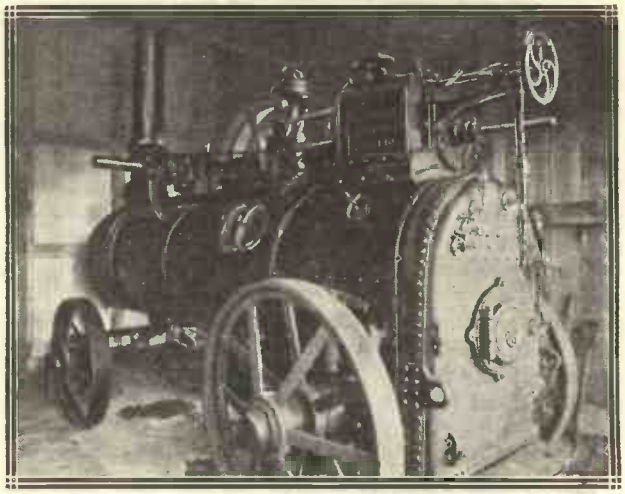
At Rome, Mühlacker and a few other stations, nearly every circuit can be controlled from the switchboard by means of little relays which also have red, yellow and green indicator lights. By simply pressing a button one can switch on the 10,000-volt rectifiers.

At one of our Regional stations, as a contrast, you don't just switch on the mains. It is rather a more lengthy business than that. The main power is first switched on to the station and the water pumps are set running.

Then the Diesel engines are started, and when they are warmed up and safely chuffing, then the low-tension, grid bias and high-tension (in that order) are switched on for the first stages. One of the control engineers also goes round and switches on the battery supplies for the master oscillator. If it were a crystal-controlled station, then the crystal oven would also have to be warmed up and the power switched on.

Then, after perhaps five minutes, the " big guns " (in the shape of the 10,000-volt generators) are set running—and the station is " on the air."

TWENTY-SEVEN YEARS AGO



In contrast with the most modern power generating apparatus illustrated on the preceding pages, this prime-mover for the 35-h.p. generator which supplied the energy for the Nauen station in 1906 appears almost prehistoric !

A HANDY SOLDERING IRON

This simply-made instrument is for dealing with extra fine work.

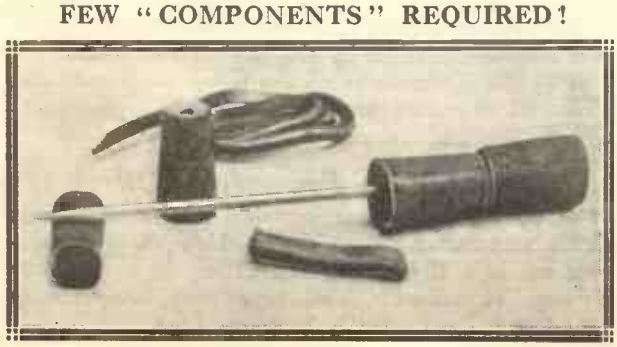
By J. F. CORRIGAN, M.Sc.

For fine and delicate soldering work there is nothing like an ordinary piece of copper rod, unless, of course, you are the fortunate possessor of one of those refined electrical soldering irons which are specially adapted for dealing with fine work.

An ordinary copper rod, however, pushed into a couple of corks, as illustrated, in order to provide a non-conducting handle, will provide a fine soldering tool fit for a king. It will give very satisfactory results.

The only bad point about it is that the rod will not hold much heat. Consequently it goes cold only too quickly. But, of course, against this disadvantage, you have the fact that if you used a soldering tool which would contain a good deal of heat, you would, no doubt, sooner or later, over-heat the instrument and burn all your fine soldering work away !

FEW " COMPONENTS " REQUIRED !



The simplest of materials are required to make this useful soldering iron. The iron itself is merely a short length of ordinary copper rod with a couple of corks for the handle. Another cork forms a neat stand.

Make One Yourself

So I am not envying any man his electrical solderers, although they may have gadgets for fine working. When I want to solder up a few strands of flex and similar things, out comes my cork-handled copper rod, together with a spirit lamp for heating it, and within a few minutes the job is done.

If, therefore, you have any similar " fine " soldering work to undertake, I should advise you to make the acquaintance of the little gadget herewith illustrated. It forms a handy little tool to keep in reserve.

What's Been Done about the ETHER?

Although you are always reading about it, could you say whether the ether has been proved to exist or not? The romantic story of the scientific search for proof is told

By T. B. SANDERS.

IF you go to your bookseller and purchase a sixpenny or a ten-and-sixpenny book on wireless, the chances are at least ten to one that you will find among the first chapters one entitled "Wave Motion," or words to that effect.

The Pond Analogy

Under this heading the author will proceed to embark upon a more or less convincing account of what consequences ensue when a stone is thrown into a pond. The effect of this puerile performance on a piece of floating wood near the edge of the pond is dwelt upon with relish.

The purport of the yarn is, of course, that a rough analogy is afforded of how a transmitter works. The idea being that the stone entering the water causes a disturbance, and water ripples are set up in ever-widening circles which make the floating piece of wood bob up and down in due course.

Hypothetical Medium

The author argues that a transmitter behaves in a similar manner by creating waves which spread outwards to influence a distant receiver. In this case, however, it is pointed out that ether waves and not water waves are under discussion.

On the subject of the ether the book is quite often curiously silent. At the most it will be described as "a hypothetical medium" possessing the curious property of being everywhere, but impeding the progress of no person or thing.

To people accustomed to do their thinking in terms of the square root of minus one, this may satisfactorily describe the existence of an entity capable of conveying programmes from Wilno to Wigan.

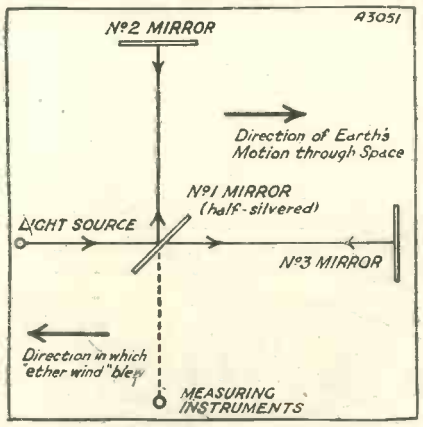
The man in the street, on the other hand, is frequently most disconcertingly inquisitive about anything "hypothetical" and the questions must have been asked many times since broadcasting began:

"What *is* this ether?" "Has it ever been proved not really to exist?"

If the present writer happens to number any such querists among his readers, they will welcome a short account of what science has done to prove or disprove the existence of the ether or space.

The notion that an ether of space must exist is almost as old as history,

INTERESTING EXPERIMENT



The No. 1 mirror was half-silvered so that a beam from the light source was reflected to the No. 2 mirror and also passed to No. 3. The measuring instruments recorded the time taken for them to receive reflections from both No. 2 and No. 3. These should not arrive simultaneously because of the "ether wind."

early Hindu mythological records containing references to it. With the advent of scientific methods of reasoning the postulation of a tenuous medium pervading the whole universe was put forward as early as 1671. The philosopher Kant published in 1755 a thesis proving by sort of circumstantial evidence that there was an ether connecting all matter.

As science advanced, phenomena began to be discovered which simply *had* to assume the presence of ether to account for their occurrence. Faraday's immortal researches into the induction effects which our present-day "straight" threes and our "super-tens" employ to such good effect, called loudly for a medium such as ether to explain their action.

Finally, belief in the ether became so firmly rooted in scientific circles that very few had the temerity to deny its existence. Lord Kelvin actually worked out its probable density, and stated that a thousand million cubic centimetres of ether would weigh just over a pound!

Not a Proof

It should be noted, though, that this did not *prove* the ether. The ether was very strongly *believed* to exist, but it was only a belief; no indisputable evidence of its existence ever having been forthcoming.

Scientists have, however, a rooted objection to *believing* in things. They want proof. Accordingly, late in the nineteenth century, two scientists initiated and gave their names to the famous "Michelson-Morley experiment," to prove once and for all whether or no there was any such thing as the ether.

The basis of this experiment can be roughly stated as follows: Ether exists everywhere. The earth is a big ball known to be travelling through space. Space contains ether. An "ether wind" must be created by the movement of the earth through the ether. Detect the wind and you've proved the ether!

"Blown Sideways"

Now the presence of an ether wind ought to influence a beam of light projected across it in the same way as does a fast-running stream affect the course of a boat which attempts to travel across to a point on the other bank directly opposite the point of departure. If it is directed straight at the object it will actually strike the other bank farther downstream.

Michelson and Morley accordingly set up, in 1881, the most elaborate apparatus to try to discover if a beam of light was actually "blown" to one side by the ether wind. But nothing of the sort was observed.

Six years later they greatly improved their apparatus and repeated the experiment with such delicacy and accuracy of measurement as to call forth the commendation of every

(*Continued on page* 196)

Using A Mile-Long Valve!

In measuring the speed of wireless and light waves a special "valve" a mile in length was used in laboratory tests. The fascinating details of the apparatus employed are entertainingly described below

By a

SPECIAL CORRESPONDENT

SCIENTISTS are never at rest, and some experts at the Mount Wilson Observatory have been having a jolly time with a special valve about a mile in length during recent tests to check up the speed of wireless and light waves!

A friend of mine, E. C. Nichols, of the Observatory, has given me an interesting eye-witness account of these tests. To satisfy curiosity, I must hasten to explain that the special valve is not in the usual glass bulb, but is made mainly of galvanised piping joined together with motor-car inner tubes!

Two Methods Used

First, a word about the tests which were made along two lines to find the speed of wireless waves. The first method, by distance, was done with the valve. The second, by time, was done with special clocks.

Two clocks were used in the time measurement. One was a ship's chronometer beating seconds on a relay and omitting every 59th second. The rate of the chronometer changed frequently, rarely remaining the same for 24 hours.

Quartz-Crystal Control

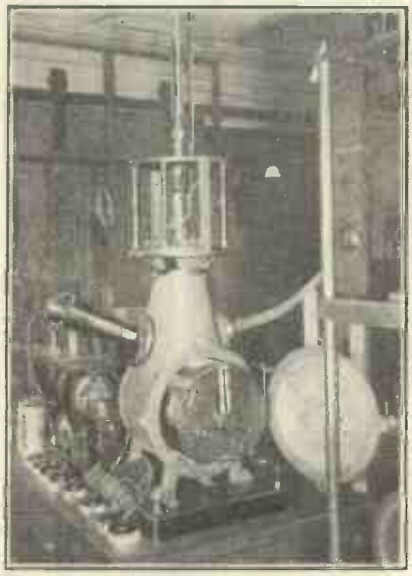
The other clock was a constant-frequency oscillator controlled by a quartz crystal, the period of which was increased by two multivibrators. The second relay and the syncro-clock were operated on a shaft driven by a unipolar motor. The motor was in turn operated by the multivibrators.

The rate of the oscillator was decidedly more constant than the ship's chronometer. Comparisons were made on a chronograph having two pens operated by relays.

The chronograph was driven by a synchronous motor and had a peripheral speed of one inch per second. Time-signals were also recorded on the chronograph. These signals were received four times a day on 1,700 metres.

The mile-long three-foot diameter "valve" consisted of 60-foot lengths

FOR WATCHING WAVES



The oscillograph is a very valuable tool in the hands of the research scientist. It is, to all intents and purposes, inertia-free, and can, therefore, be employed to record electrical vibrations of high frequency.

of rivetted and soldered corrugated galvanised pipe, No. 14 gauge, joined with rubber inner tubes cemented to the pipe ends with rubber cement. At each end two steel tanks were included in the tube to house the mirrors and their controls for the optical system.

These tanks were made of $\frac{3}{8}$-inch steel plate and welded. They rested on base plates of the same material, and were sealed with lead wire; no bolts were necessary.

No Machining Necessary

Not a single machined surface was necessary in the entire vacuum container, which had a volume of 40,000 cubic feet and resisted a total collapsing pressure of 53,000 tons!

The mirror mountings and their controls in the tanks were supported independently on separate concrete piers and steel columns extending up through openings in the base of the tanks. These openings were sealed off by rubber sleeves.

All adjustments to the mirrors inside the tube were made with small motors operated by remote control through a motor generator system operated from the station at the south end of the tube. Two vacuum pumps were used to evacuate the valve, and a vacuum of 0·5 millimeter was obtained.

Rotating Mirror

Light from an arc lamp was imaged by a condensing lens on to a slit. The light coming through the slit passed above a small right-angle prism and on to the upper half of one of the faces of a 32-sided rotating mirror.

Micrometer Which Had Divisions of ·001 inch

This mirror rotated at approximately 500 revolutions per second. From the rotating mirror the light was reflected through a plane-parallel window in the tank to a diagonal flat mirror and then at right-angles to a 50-foot focus concave mirror, which changed the light into a parallel beam.

Reflected Nine Times

From the concave mirror the light passed over a 22-inch diameter flat mirror and fell upon another 22-inch flat one mile away at the north end of the tube. Thence the light was reflected nine times back and forth the length of the tube between the two 22-inch mirrors, finally emerging through the window in the tank over the same path but slightly lower and striking the lower half of the rotating mirror on a face adjacent to the one from which it was originally reflected.

Driving the Mirror

From this face the light was reflected into the small right-angle prism and thence on to a cross wire and was observed in the eyepiece. The single vertical cross wire was mounted in a micrometer which had divisions reading to 0·001 inch.

The rotating mirror was driven by a small compressed air turbine mounted directly on the mirror spindle.

The light emerged from one face of the rotating mirror and was received on the adjacent face. As the mirror started rotating the image gradually passed from the field of view, later to reappear from the opposite side of the field as the mirror approached its proper speed.

The rotating mirror was brought into synchronism with a tuning fork whose period of vibration had to be measured, the slight angle in which the return beam differed from 1/32 revolution was measured with the micrometer. The distance remained fixed.

The time interval to be measured, therefore, was that during which the rotating mirror turned from one face to the next, plus or minus a small angle observed in the eyepiece.

Stroboscopic Methods

The period of the fork was then determined by stroboscopic methods in terms of free-pendulum beats. As the rotating mirror accelerated, light from a 6-volt lamp was reflected from a small mirror on the tuning fork on to a polished face of the nut clamping the rotating mirror to its spindle.

As the mirror continued to accelerate, the image from the tuning fork passed through a series of vibrating and stationary states to a final stationary state for which the beats heard between the fork and the rotating mirror ceased.

At this point a second observer made a setting on the return image formed by the light traversing the tube and read off the micrometer. A reversal of the direction of rotation of the mirror eliminated any necessity for making zero readings.

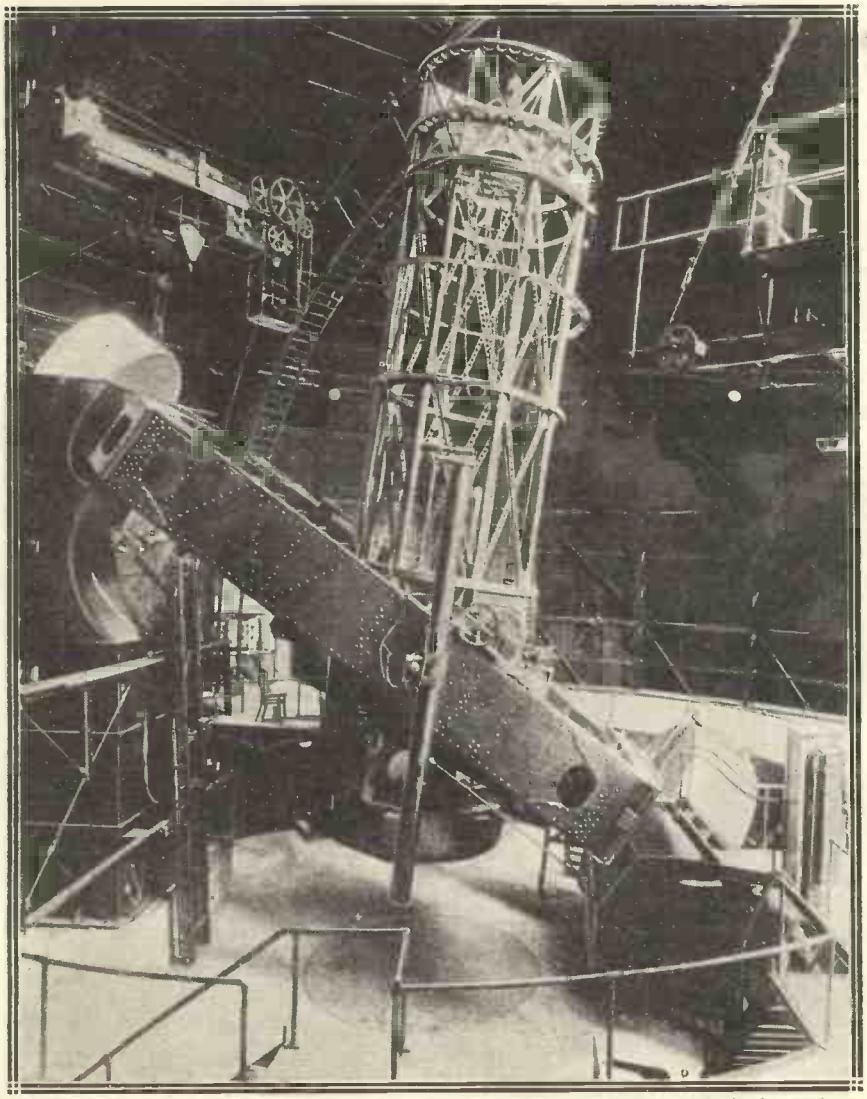
In checking the tuning fork with the pendulum, light from a small lamp was focussed on a narrow slit and passed into the pendulum case, whence it was reflected by a small mirror on the pendulum and focussed on the edge of the tuning fork.

Pendulum and Fork

When the fork vibrated, flashes of light from the mirror on the pendulum illuminated the fork in various positions, thus producing a series of sawtooth images. When the fork period was an exact multiple of the pendulum the images appeared stationary.

When the periods differed, the teeth appeared to travel across the field of view. The period of the fork in terms of the free pendulum could be determined from the number of flashes shown in travelling from one tooth to the next.

KEEPING AN EYE ON SPACE



The first attempt to measure the speed of light was by astronomical methods, and the ever-increasing accuracy attained in modern times has been largely due to the astronomer working with powerful telescopes of the type illustrated.

FACTS ABOUT FILAMENTS

By F. A. MASON, M.A., F.I.C., Ph.D.

You can have no doubt—when the H.T. leads have been accidentally shorted across the filament terminals—that the filament is the most important part of the valve. But you may not know that tungsten, from which filaments are made, has a boiling point higher than any other known metal, and a melting point of about 3,700°C. Working with this metal, therefore, is no easy job!

IN radio, as in other affairs of life, it is the little things that matter. The keystone of a wireless set, to mix up a metaphor, is the valve, and the most important part of the valve—with all due apologies to the grids!—is the heated filament. It shoots off a stream of negative electrons that carry forward the modulated electro-magnetic impulses that start at the aerial and finish at the loudspeaker.

An Important Trifle

Of course, if you judged its importance by its weight it would not seem much, just a negligible fraction of a bit of 1 per cent of the weight of the set. But, then, one doesn't do that; and in any case the sole merit of a set without filaments is its silence, as one knows only too well when the H.T. leads have accidentally been shorted across the filament terminals. R.I.P.!

Nature has thoughtfully provided us with a metal, tungsten, which is specially suited for making valve filaments. Tungsten has been in use for many years now for making high-speed steels, familiar to engineers, as tools made with this will keep their edges even at a red heat.

When tungsten wire is heated to a high temperature in a vacuum it gives off a steady, if small, stream of negatively charged electrons which can be utilised in a wireless valve. Dr. Irving Langmuir, the famous head of the Research Laboratories of the General Electric Company in America, found just before the war that the electron emission can be increased something like 100,000-fold if the tungsten filament was first coated with a small amount of thoria (this is the white, powdery substance that falls in your eye when you poke a match through an incandescent gas mantle).

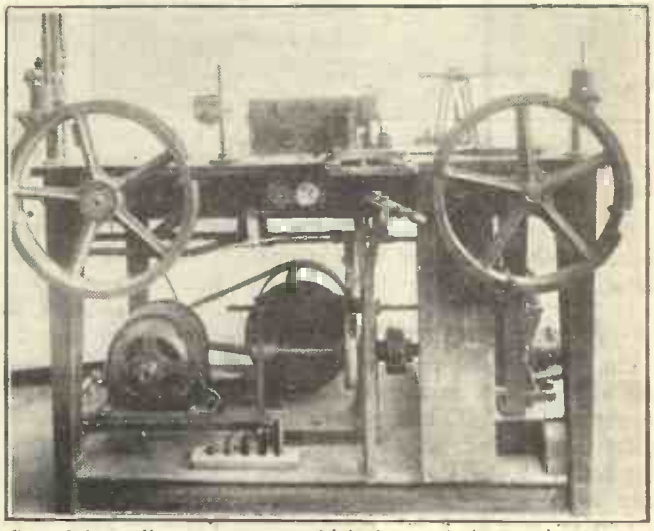
So it is not surprising that this so-called "thoriated tungsten filament" played, and still plays, a vital part in the development of modern radio; and the question of the provision of supplies of tungsten wire of hairlike fineness, literally by the mile, soon became a matter of urgent importance for the future of the whole radio industry. Just here we come up against a really fine snag.

Tungsten itself is a greyish metal nearly as heavy as gold (actually about 19·3 times heavier than water) that will burn up to the oxide if heated in air. Now, ordinary wire, as most of us know, is made by taking long, thin rods of, say, iron or copper, and pulling it through small, steel dies of ever-increasing fineness, with intervals for heating, softening and annealing, until the wire is of the thickness needed.

Awkward Property

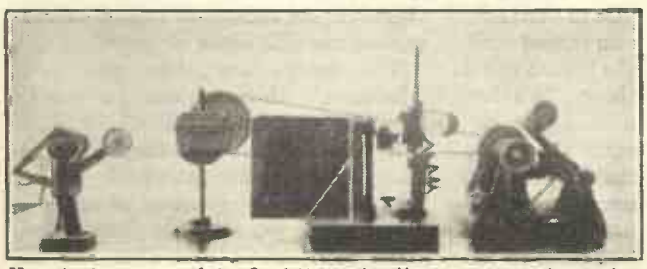
This is all right when you have your metal rods to start with, but with tungsten the crux of the matter is how to get your rods! Tungsten has the very valuable, but also very awkward, property of possessing about the

FIRST STEPS IN DRAWING



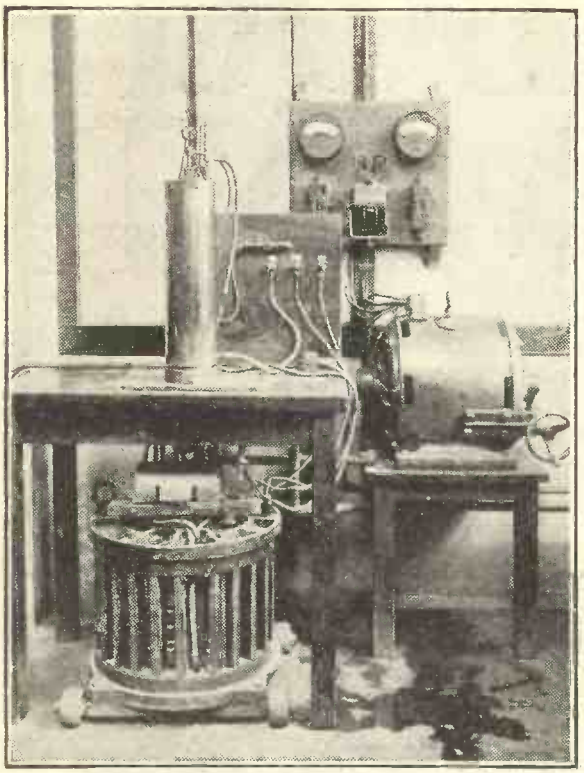
One of the earlier processes to which the ingot of metallic tungsten is subjected. The machine reduces the size of the rod until it becomes a thick wire.

ALMOST READY FOR THE VALVE



Here is shown one of the final "swaging" processes, during which the tungsten wire—which has gradually been reduced in diameter by several other machines, is finally drawn to a diameter of about 1/2,500 of an inch.

The Troubles of Making a Tungsten Ingot



EASY CONVERSION STAGES

By passing hydrogen through tubes in which powdered tungsten oxide is being heated, a metal in the form of a black powder can be secured.

highest melting-point of any known metal.

High Temperatures

Tin, for instance, melts at 232° C., lead at 327° C., aluminium at 660° C., copper at 1,083° C., and pure iron at 1,530° C. Tin *boils* at 2,260° C., and iron *boils* at 2,450° C., whilst tungsten only *melts* at about 3,700° C. (one cannot be sure to a few degrees, of course, at that temperature), so that if you wanted to, you could actually boil tin or iron in a tungsten kettle just as you can boil water in a copper kettle. Only nobody wants to, so it doesn't matter! Still, it gives you an idea, doesn't it?

Now, that very property which has made tungsten so valuable in the days of "bright-emitter valves," and still does so for ordinary gas-filled electric light bulbs, provided its own special problems to be solved before tungsten wire could be made available for use in industry—you will see why in a moment—and the solution of the problem has been a triumph of team-work between chemists, physicists, and metallurgists.

The Discovery

Tungsten—the name, by the way, is from the Swedish and means "heavy stone"—was first discovered in a mineral called Scheelite, in honour of the great Swedish chemist, Scheele. The raw material is crushed up, extracted with acids and alkalis and otherwise ill-treated, until at last the oxide of tungsten is obtained.

With most metals—for instance, iron, copper, lead, tin, and so on—the next stage is, generally, to heat the oxide up with coke or charcoal and a flux to keep the air away and to remove impurities, and so you get eventually your molten pig-iron, or copper, or lead, or whatever it may be.

But with tungsten that is just the trouble, you *cannot* melt the dratted thing under ordinary circumstances, no matter what you do, as any furnace or crucible you liked to use would melt first and flow like molten glass or the proverbial wax. So what are you to do?

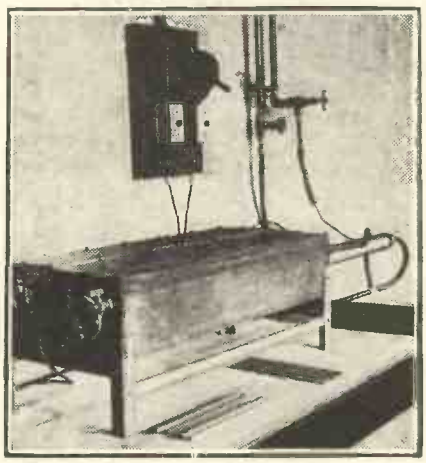
Ordinary fire-clay, for instance, melts at about 1,500° C., and even the more resistant quicklime melts at 2,570° C., as far below the melting-point of tungsten as ice is below the temperature of a white-hot flame!

Producing the Metal

Actually, the tungsten oxide can be reduced to the metal by heating the powdered oxide in tubes through which hydrogen gas is passed; the oxygen passing off as steam and the metal being left as a loose heap of blackish powder without coherence or shape; so our wire seems still as far off as ever.

The next stage is this: the metal powder with a trace of adhesive is pressed tight in an hydraulic press to form ingots about $\frac{1}{4}$ in. square by 8 to 24 in. long, which are just about strong enough to stand up by themselves and no more. These ingots are then heated in an electric furnace to a white heat for half an hour, the small particles of metal "sintering" together just enough to form a rather porous metallic block or ingot.

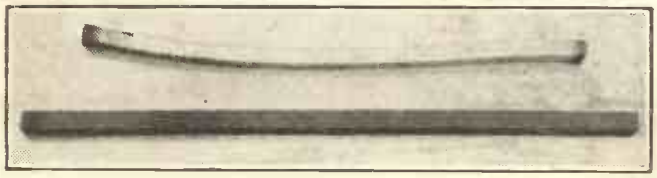
AT WHITE HEAT



The powder obtained from the earlier stage is pressed tight and then finally "sintered" together in this electric furnace to form a porous metallic ingot

The ingots are then put into "formers," which are really a special type of resistance furnace, and a heavy current is passed through; just enough not to melt the metal—or the furnace—completely; and as a result the block of metal slowly shrinks and knits together, so that after half an hour the current is turned off and a small block of true metal is left.

(*Continued on page* 194)



BY GRADUAL STEPS

Above is seen the growth of tungsten crystals in hydrogen. Next, the crystals stuck together to form an "ingot." Finally, two of the pressed and finished ingots ready to be put to the drawing process.

ROUND the TURNTABLE

The Question of Quality Radiogram Reproduction on D.C. Mains—Providing Plenty of Power—Converting to A.C.

By "TONE-ARM."

I HAVE been asked by a reader for the design of a powerful radiogram receiver for operation on D.C. mains. Apparently, he wants to get some five or more watts of undistorted output, but mainly requires this wattage to ensure a safety margin against overloading. Normally, I understand he will use about two watts.

This is the right way to look at things. A large factor of safety is essential if undistorted reproduction is to be obtained. But I am sorry he wants a D.C. design, because I cannot give it to him.

Use a Converter

Unless he is to use the 400 volts or more supplied by having both sides of a three-wire system at his disposal, I do not see how he can, by using plain D.C., get the output power he requires. There are no D.C. valves made that will give it to him unless he goes in for banks of valves in parallel, and that is a most unsatisfactory business as a rule.

But he is not stymied by any means, and I advise him to do what I do myself, what I have been forced by circumstances to do in order to get sufficient radio power from the D.C. supply I am on, and that is to use a converter, and an A.C. set.

Quiet Running

It sounds an elaborate proposition, but it is nothing of the kind really, for it is easy enough to build a five- or six-watt A.C. set, giving ample margin, and then with modern converters, one can change the more or less useless D.C. mains into an A.C. supply and carry on to one's heart's content.

The rotary converter for home use is not exactly a new idea, but only comparatively recently have these machines been made so soundless in running that one can have them alongside or under the set without upsetting the reproduction by super-imposing on it the hum of the converter.

They are not absolutely silent, but they are near enough to make no odds, and the one I am using is excellent in that respect. They can be obtained in many wattages and with various voltage inputs from down among the 90's (where they are useful for small lighting plants used in country houses) up to the standard voltages of 200 to 240.

The output can be had from some 90 watts to 180 or more, but for most purposes it will be found that for an ordinary set the 90-watt type is large enough, while for radiogramophones where the gramophone motor has also to be run off the converter the 120-watt is sufficient. There are cases where in very large sets the larger converters are required, but for the set my correspondent will be building the 120-watt type will be ample.

Clean Output

I am using one of the Electro Dynamic machines, and must say that although I was sceptical at first it has disproved my suspicions and I find it a great boon, especially as I am on very dirty mains and always had trouble with D.C. sets in the matter of hum elimination.

The A.C. output of the converter is very clean, and with the improved wattage of the set which is now available the results are very gratifying.

As regards the set for my correspondent I cannot go into details here, but understand from one of my colleagues that a set of the class required will be discussed in an early issue of this journal. I am allowed to say that it has six valves, making use of a diode detector and an output valve of the D.O.20 type, giving an undistorted output of some six or so watts.

Enough Said!

Preceded by a couple of ganged stages of variable-mu amplification, this makes a powerful and most satisfactory radiogramophone. Tone control is included so that the records can be adjusted for frequency faults, and—well, I must not say any more about it now.

SUPER POWER ON A.C. OR D.C.

Florence Austral, the famous prima donna, examining the "H.M.V." Superhet Ten Auto Radiogram. This powerful A.C. instrument can be used also on D.C. mains by means of the type of converter discussed in this page.

IN PASSING

Assorted Jottings on Radio Themes

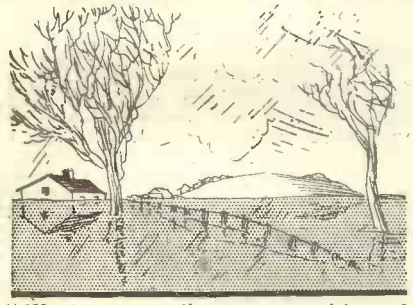
MY particular taste in weather, not far removed from the normal, methinks, leads me to deem February the month which must have been thrown in as a sort of a make-weight when the high gods divided the year's weather into twelve parts. It is redeemed by no pleasing feature save alone by its brevity.

A Dead Season

It is too long after September to conjure up memories of that wonderful month, and too far from May to give one the feeling that winter is nearly over. It is the dead centre of a dead season, the month dedicated either to floods or the freezing of the Thames.

My sport last month with the notion of radio foresight reminded me that we have a rudimentary prevision of weather conditions, which is made possible by radio reports from various

DEDICATED TO FLOODS



"We have a rudimentary prevision of weather conditions."

places in Britain and the Continent. The B.B.C.'s reports, or perhaps they are the Air Ministry's, are models of that style, affected by a certain well-known Almanack, which cunningly combines verisimilitude with an adequate vagueness veiled by a form of words.

"Some fog locally!" What could be safer? Again: "Forecast for to-morrow. None issued!" Words failed them!

Such, however, is the sophistication of our generation that we no longer regard weather as a menu, carefully-designed according to season and

Those Weather Forecasts—Empire Broadcasting Programmes—The Lost Radio Nicknames — An Experimenter To The End.

produced by some transcendental chef. No, it is merely the sum total of a series of barometric fluctuations and thermometric variations, the whole kindly assisted by the dear old Gulf Stream.

I never could swallow the Gulf Stream legend, and I am willing to wager my nephew's home-made loud-speaker against an empty pail that if the Gulf Stream shot off round Gibraltar we should not notice any difference. The idea of its warming us up is as incredible as water-divining, though water-divining may be done every day for aught I know to the contrary.

Assegai in the Bay

Nobody has succeeded in giving a reasonable explanation of how "divining" is worked; fairly recently a parcel of German scientists undertook to discover the secret, but had to go back home biting their beards in *furor Teutonicus*.

Attempts to explain the thing on radio lines have failed, mainly because no special connection has been found between radio and a bit of forked twig. I think that it must be a throw-back to the old African witch-doctoring, when the wizards threw their bits of stick around and either found H_2O or got an assegai in the front bay.

Things the twentieth century cannot show—a dipsomaniac water-diviner, and an atheist specialising in "negro spirituals." These "negro spirituals" the crude, semi-articulate, materialistic, howling of an enslaved people but one remove from the *tom-tom* and the *ju-ju*, are at least eloquent of hard labour and misery.

In the interests of the U.S.A. they ought to be banned; assuredly the B.B.C. would do well to drop them and no longer offend the ears of Wilberforce's countrymen with those evil memories. Besides, Hollywood would have us believe that life to a negro was just one melon after another, washed down with rye whisky to the accompaniment of vocal choruses of a slightly nostalgic tendency.

AN INCREDIBLE IDEA

"If the Gulf Stream shot off round Gibraltar."

But this bad propaganda for the U.S.A. brings me straight to the question of what use we are to make of the new Empire broadcasting station. Obviously the Empire scheme cannot have for its sole purpose the provision of songs from the shows for solitary sojourners abroad.

Potted Burns

In order to operate it in the interests of Empire some form of propaganda, however camouflaged it may be, must be radiated. It is not enough to set the young rubber-planter a-jigging in his bungalow, or to bring a tear to the eye of a Scotch accountant in Singapore by purveying Blattnerphone Lauder or potted Burns. No! This

"A Hat and a Half and a Holiday"

Empire broadcasting must be used to produce Empire-consciousness.

"Big Ben" has no significance for a Boer farmer, a Hongkong silk merchant, a Ceylonese shopkeeper, an Indian weaver or a French-Canadian. But I think that the King-Emperor's voice makes them sit up and "think big."

The Empire programmes which I have seen so far give evidence of lack of objectivity, which is a besetting

EMPIRE BROADCASTING

"What fashions are in vogue."

defect of the B.B.C.'s programme-building (together with an over-ruling avoidance of recognition of the first principles of entertainment); they are too subjective because the responsible officials are, as a body, specialists in everything except the art of pleasing, a subject of which it may be said that the Irresistible Force of Public Opinion has met that Immovable Object, the B.B.C.'s Policy of Non-pleasing.

Not that I would deny that they have scored a few lucky shots.

I would suggest that as we cannot always be "showing the flag," the Empire station should boom the Navy a bit; it would go down with India, Africa, and the Straits Settlements like cake at a school treat. Information about our weather in various parts of Great Britain; what plays and films are on, what topics are uppermost, what fashions are in vogue, what new buildings are in course of construction—all this sort of thing appeals to the Briton abroad, and for those whose homeland is abroad, talks by their national representatives here would be much appreciated.

Subtle Propaganda

For subtle propaganda I commend the B.B.C. to the Germans and the use which they made of Nauen during the war. But I believe that even they feared our propaganda when that genius Northcliffe had charge of it. What a pity that his mantle cannot fall upon the B.B.C.!

Modest Nicknames

It has been interesting and amusing during the past ten years to watch the birth and development of radio jargon. What a spate of unconscionable epithets and nouns, to be sure!

Twenty-odd years ago we had a few modest nicknames for certain of our simple radio devices; the coherer became the "queerer"; the magnetic detector was, of course, "Maggie." The first type of two-electrode valve detector was dished up to us in a cabinet which we called "the cottage piano," because it looked like one.

The Navy called condensers "jars," and, I believe, still does, using "jars" instead of farads as units of capacity. Our large aerial inductance coils were termed "hats," the smaller ones "half hats," and so we had the phrase, "a hat and a half and a holiday," meaning an aerial inductance and a reaction coil—the "holiday" being the space between them.

All that is nothing to the lordly, technical nomenclature which has been evolved by the radio advertising expert, the technical journalist, and the latter-day radio engineer. Variable-mu; chassis (help!); push-pull; triple-ganged; "skip-distance"; mains-driven; decibel; screened grid; and (oh, 'orrors!) signature tune.

Well, I suppose that a developing art has to breed its own jargon, but I am glad that the grand old words, beer and beefsteak and apple dumplings have been let alone by the advertisement "copy" writers.

Always a Snag

I was reading an advertisement of a handy little layout by means of which an alarm clock is rung at any set time, a bedside lamp switched on, a kettle boiled and a pot of tea infused. How perfectly jolly!

If I had one I should arrange to wake up a bit earlier in order to see the gadget working—especially when it brings the boiling water into the teapot. But it will not wash the cups, fill the kettle and put more dry tea in the pot. There's always a snag in these inventions.

Next year, I hope, this device will be advertised as being capable of lighting the fire, letting in the cat and banging on the maid's door; the alarm clock sets the radio valves to work and an impulse from the London Regional then starts all the machinery. Golly! How the house would resound! What about one's beauty sleep?

Fully Charged Cows

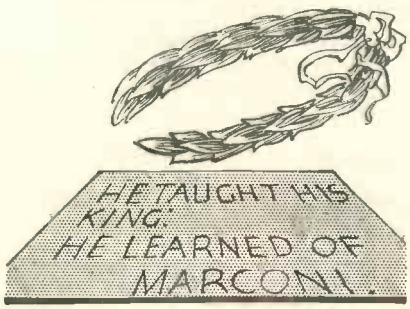
Talking of advertisements, "Exchange and Mart," and all that sort of thing, recalls to me that at Christmas time a radio dealer, disgusted by the lack of coin in his district, reverted to the process of barter most successfully. In exchange for radiogramophones, receivers, and spare parts, he took his Christmas turkey and certain livestock.

But suppose all the farmers become radio dealers, and all the radio dealers become farmers! Oh, what an admixture of jargon will then arise. Fully charged cows! Pea-fed accumulators!

* * *

A few words about Mr. G. S. Kemp, who died on January 2nd. I knew him for many years and can testify that he lived for wireless and died in its service. When Marconi brought his apparatus to England, Mr. Kemp was lent to him by the

A FINE EPITAPH



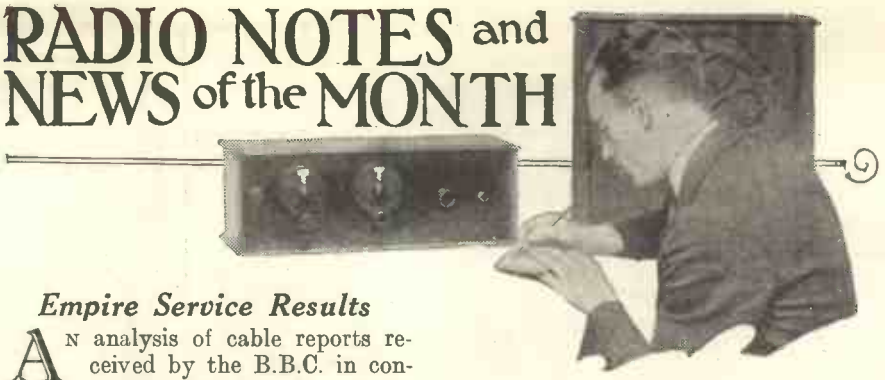
"He lived for wireless and died in its service."

Post Office, and remained with him till January 2nd, 1933.

He was with Marconi in Newfoundland, when the historic "S" was received from Poldhu. He was an experimenter to the end. His notebooks, which I have seen, are worth a journalist's ransom.

Before serving the Post Office, Mr. Kemp was in the Navy and had King George—then a prince—in his class. What an epitaph might be his. "He taught his King; he learned of Marconi."

RADIO NOTES and NEWS of the MONTH



Empire Service Results

An analysis of cable reports received by the B.B.C. in connection with signals sent out from the Empire short-wave transmitter, shows that results achieved in all zones, other than the Canadian zone, have greatly exceeded anticipations.

Reception has been very good in Australia and New Zealand, and of 100 cables received from the Indian zone, 80 per cent were favourable and 20 per cent reported fair reception.

Reports from Africa

Excellent reports are received from within the African zone, seventy cables having been received by the B.B.C. In addition, good reports are to hand from Italy, Switzerland, Egypt, Spain, Palestine, etc., all of which fall within the path of th African "beam."

Canada Not So Good

From the West African zone thirty-three cables indicated good reception, and particularly good results are reported from South America.

However, reception in Canada between 1 and 3 a.m. G.M.T. is not so good, although an improvement is expected when the present mid-winter conditions have passed. Excellent reception is reported from the West Indies and British Colonies in the north of South America.

Broadcasting Philosophy

In a speech of welcome to the delegates of the Third National Conference of Wireless Group Leaders and Listeners at Broadcasting House recently, Sir John Reith, the Director-General, stated:

"I am not sure it may not be almost pre-eminently the mission, responsibility and privilege of broadcasting to give people a philosophy of life." Philosophy, said Sir John, taught two things—acquiescence in facts and discontent with them. What was needed was a greater toleration and respect for the ideas of others. "If this educational work is to proceed satisfactorily it can only be through a high degree of collaboration between us and you and your like as wireless group leaders throughout the country."

An Archbishop's View

An interesting message was read by Sir John which he had received from the Archbishop of York. "I become increasingly convinced that there is a great future for broadcast educational work, but we have more to learn than we yet know about the way to make it effective and valuable."

The Human Touch

The Archbishop certainly hits the nail on the head here, for if the B.B.C. would only introduce a little more of what Kipling calls "the common touch" into its educational broadcasts—if it refrained from allowing its doubtless enthusiastic educational experts to indulge in the pedantic and rather academic method of broadcasting educational subjects—if, in short, it paid a little more attention to the psychology of humanity, it is pretty certain that the B.B.C.'s educational influence would be greatly enhanced.

B.B.C. and G.T.C.

The fight between the G.T.C. and the B.B.C. is likely to go on, for as we go to press we learn that no agreement has yet been reached. Mr. George Black, the Production Director of the G.T.C., stated after the last meeting that no arrangements had been made to resume negotiations.

Mr. Black wanted the B.B.C. to pay so much money a year for the privilege of using some of his big stars for broadcasting, but the B.B.C. declined. The B.B.C.'s attitude is that collaboration is for the good of all.

Necessary for Stars

It is perfectly true that Mr. Black cannot continue successfully with running first-class music-hall entertainments unless he has stars; but, on the other hand, the B.B.C. does

(Continued on page 193)

RADIO NOTES AND NEWS OF THE MONTH

—*continued from page 192*

not necessarily have to have stars in its broadcast programmes.

Furthermore, the B.B.C. has considerable revenue to draw upon, and can afford to spend the time and the money in building up its own radio stars.

The Artistes' Attitude

Mr. Black says his attitude is dictated by business considerations, and it is true that the number of variety performers who can afford losing G.T.C. contracts in order to take up broadcasting is very small. It is said that variety performers are waiting with interest to see what financial proposals the B.B.C. are likely to put up in answer to Mr. Black's arguments, but we think it very likely that the B.B.C. will not put up any proposals at all.

It is really up to the variety artistes to get together and make up their minds whether they will tolerate a broadcasting ban being included in their contracts.

Television Progress

In their report submitted to the fourth ordinary general meeting of the shareholders, the Baird Television Co. said that "very considerable progress" has been made towards the commercial production of television sets. It is also stated that provision has been made for obtaining the further necessary working capital to ensure commercial production and marketing.

According to the "Morning Post," the terms of which such further capital is to be obtained, however, are not mentioned. Against a share capital of £825,000 the amount of tangible assets is very small, for out of total assets of £838,383 no less than £517,153 is represented by patents and rights, and £251,651 by General Development Account, which represents expenditure of all kinds, including director's fees, experimenting and advertising, after deducting amounts received from sales of apparatus.

Patent Prospects

The cash assets consist of cash of £15,193 and Treasury Bonds of £8,190, and, as the "Morning Post" points out, the value of the shares therefore depends upon the prospects of developing the patents to a stage where they will enable a commercial profit to be earned.

Over 5¼ Millions!

The Post Office issued 5,262,953 wireless licences last year, of which 140,000 were taken out in December. The December figure was the highest for some months. In November, 1932, 381 persons were prosecuted for operating wireless sets without licences, and in each case a conviction was secured. Out of this number, 38 were in London, and 43 in Manchester.

RECENT RECORD RELEASES

—*continued from page 147*

excellent examples of dramatic recording and they cannot fail to send a thrill through many a man and woman who hears them.

England's most popular music-hall comedienne, Gracie Fields, is heard this month in one of the newest hits, How Deep is the Ocean, and a comedy song, One Little Hair on His Head. The former is wonderfully rendered, but the theme of the latter does not give Gracie a chance.

In somewhat different style are Try a Little Tenderness and, once again, How Deep is the Ocean, played and sung by the high-spirited music-hall duo, Derickson and Brown.

Harry Roberts, the wizard of the xylophone and late of Jack Hylton's and Henry Hall's bands, has made a medley of hits of the moment which can be guaranteed to cheer up the most despondent listener, as also will Raie Da Costa, when she is heard playing Let's Put Out the Lights and My Romance.

There appears to be a craze at the moment for introducing the surnames of people into dance music. I have already mentioned "Yes, Mr. Brown," and now George Olsen and His Music occupy one side of a 10-inch record by voicing the feelings of a modest girl in Puleese, Mr. Hemingway. The H.M.V. record of this number can be thoroughly recommended.

VOLUME WITHOUT WATTS

—*continued from page* 158

the pentode, it is advisable to adjust the valves to the correct (and equal) anode currents roughly by giving them the same bias (about 14·5 for the Pen.220A.), and to make final adjustments by giving them separate screen-grid voltages. The circuit shows the valves either with common screen volts (thick line) or with separate screen volts (in which case the one valve is connected to the H.T. screen tap by the dotted line shown, and is disconnected from the other valve screen).

The resistance in series with the bias is necessary to prevent any form of oscillation in the push-push circuit, and if much experiment is to be done in the way of disconnecting the *detector* anode circuit, or withdrawing the H.T. plug feeding that valve, while the set is switched on a resistance of some 50,000 ohms should be connected across the primary of the input transformer.

This prevents heavy voltage surges being transformed to the grids of the pentodes, resulting in a great strain on the valves. If heavy positive surges are impressed on these valves' grids, the high space current suddenly liberated may damage the valves.

The resistance and condenser across the primary of the output transformer, or across the choke in the circuits shown, provide the usual pentode impedance equaliser, and the values are adjusted to suit the listener's taste as to the degree of high-note reproduction obtained.

The Impedance Equaliser

Usually a matter of 20,000 ohms and ·01 mfd. are most suitable, though some prefer a lower value of condenser. It is easily tried, however.

When operating, the average anode current taken by the scheme will vary according to the strength of modulation being much higher if the full output milliwattage is maintained than if less strength of reproduction is employed. Naturally, with such reception as that of dance music or organ recitals, symphony orchestras, loud passages and so on, the average current is higher than in the case of vocal items, news, quintets, and so forth. A pretty fair average is some 7 or 8 milliamps.

This is a great saving over the unavoidable 20 milliamps or so which is the order of the day with normal set design, and which is consumed whether or not any modulation is received and irrespective of the strength of reception.

Incidentally it must be noted that with quiescent push-pull a greater output wattage is obtained than with the use of one valve, in addition to the saving of H.T.

CAN WIRELESS WAVES BE PHOTOGRAPHED?

—*continued from page* 172

which are the next in wavelength to infra-red rays.

The degree of success attending these experiments may be judged from the photograph of the cup and saucer which illustrates this article. The subject of this picture was "illuminated" by the *heat* from two domestic electric irons which can be seen, grossly over-exposed, on either side of the cup and saucer. Absolutely no light of any kind was visible in the room in which the photograph was taken. The irons were heated normally and did not glow.

If, once more, we take a glance at the chart of frequencies, we see how closely this experiment approaches the wireless man's preserve. Only a narrow band of at present unused frequencies separates infra-red rays from the very ultra-short wireless waves.

Surely, if a photographic plate can be made sensitive to heat, it is only a matter of mere logical development for materials to be made which respond to slower and slower ether vibrations until the radiation of an electrical oscillator can be photographically recorded.

It is interesting to speculate on the uses to which such a plate could be put. The investigation and recording of the efficiencies of screening materials, the recording over protracted periods of fading phenomena, and, of course, television, all suggest themselves as problems of wireless interest which photography could then be used to solve.

FACTS ABOUT FILAMENTS

—*continued from page* 186

The ingot of tungsten is then placed in a special Carnera-like centrifugal hammer until finally a rod or thick wire about 1 millimetre to 3 millimetres thick is obtained.

After this the rod is slowly forced through a series of steel or diamond "swaging" dies until it has been reduced to a wire of the desired thickness, or thinness.

After all this, and before it can be used for wireless valves, the wire has to be specially treated with certain chemicals to give it the necessary coating of thoria or other material used to increase its electron-emitting power.

The whole thing is quite a triumph over apparently insuperable difficulties, and should make every wireless "fan" realise how much he owes to scientists for the preparation of such an apparently simple thing as a valve filament. A bit easier to burn out than to make, isn't it?

WHY RESISTANCE-FED UNITS?

—*continued from page* 174

still has a low secondary self-capacity. When this transformer is resistance-fed, it will, therefore, give as much or greater amplification than an ordinary 3–1 transformer directly connected.

Greater Step-Up

We can go a stage farther by using what is known as auto-coupling, in which the primary and secondary are joined in series, and the primary winding forms a tapped-off part of the two windings connected together. Here we are obtaining the advantage of an even greater step-up, without in any way altering the number of turns.

An auto-transformer cannot be directly connected in the anode circuit of a valve, and again a resistance-fed unit scores in this respect, since auto-connection can be used as there is no anode current in the windings which would otherwise be short-circuited to earth.

We have seen, therefore, that the resistance-fed unit has some very definite advantages to offer over the ordinary system, and even over that of an ordinary transformer when resistance-fed.

Lower Grid Bias

It is just as easy to use a resistance-fed transformer as it is to use an ordinary type, but there are one or two points to remember.

I have already pointed out that inserting a resistance in the anode circuit of the valve lowers the voltage, and it is therefore necessary to use a slightly lower grid-bias voltage for the particular valve.

Owing to the excellent bass amplification, a well-designed resistance-fed unit might give rise to a suspicion of motor-boating or instability, and accordingly the circuit must be properly decoupled.

Tapped for Decoupling

In some of the resistance-fed units which I have designed I have incorporated a tapped resistance so that the first part can be used for decoupling purposes, while the second part is used as the feed resistance. It is, therefore, only necessary to connect a condenser of about 2 mfd. between the junction point and earth.

In order to obtain the best results it is essential to use a suitable resistance, and for a medium impedance valve a value of 30,000 ohms is a very good compromise. If a higher impedance valve is used, about 50,000 ohms is better. In the case of a very low impedance valve, a much lower value of the order of 10,000 ohms to 12,000 ohms is more suitable.

Another rather important point to remember is that a small nickel core transformer is more prone to pass on high-frequency energy than an ordinary large transformer. It is, therefore, most necessary to remove all traces of high-frequency from the detector by means of a proper choke and condenser filter, while a small series H.F. stopping resistance can be connected between the grid terminal and the grid of the subsequent valve.

I have said nothing about the question of distortion. Theoretically, it is possible to obtain what is known as amplitude distortion if the transformer used in the unit is not properly designed with reference to the operating point on the curve of the special nickel alloy.

Here I am on the brink of really advanced theory, and at this point it seems desirable to stop, as these are matters which concern designers rather than users.

From the user's point of view, however, I am reproducing an oscillogram showing a resistance-fed transformer amplifying at 50 cycles, from which it is evident that there is negligible distortion from all practical points of view.

Really Diminutive

Probably many readers have no conception of the really diminutive size of the transformer bobbins and stampings. I have photographed two experimental bobbins and also some stampings. The one with the larger centre limb is a standard size. but the other I had specially made. It is interesting to note that the centre limb is only 7/32 in. wide, only twelve stampings being used, and even less in the case of the one with the larger limb.

WHAT'S BEEN DONE ABOUT THE ETHER?

—*continued from page* 182

scientist in the world. In fact, it may be said that the second Michelson-Morley experiment stands as a supreme example of the degree of accuracy which the scientific method makes possible.

However, once again a negative result was obtained. Although the apparatus was capable of detecting the most minute change of direction, the beam of light obstinately kept rigidly to its path and showed not the slightest trace of being wafted by the mildest of ether zephyrs.

The scientific world breathed a sigh of relief. "Now we know," said all the learned societies. "The ether *is* hypothetical."

The Concertina Effect

Unfortunately, this tranquil state of assurance was very soon disturbed.

Two other scientists, Lorentz and Fitzgerald, pointed out that the Michelson-Morley experiment had overlooked a very vital factor. It was, they observed, a known fact that a ship travelling through water actually "concertina-ed" to an extremely small, but measurable, extent. The ship when in motion is compressed so that it is really a little shorter than when it is at anchor.

This being so it would naturally follow that the passage of the earth through the ether would be attended by a similar concertina effect, and so would everything on the earth, *including Michelson's and Morley's scientific "yardsticks."*

This was a terrible blow. "Then we still don't know if an ether exists," cried all the learned societies. One scientist even went further and elaborated to a definite hypothesis the idea of a body contracting when moving through space. This is now known to (but not generally understood by) all the world as Einstein's Special Theory of Relativity. The Theory proves that Michelson's and Morley's negative result can be accounted for by their apparatus contracting just that amount to make the beam of light appear unaffected when it may have been.

So there you have the position as it stands to-day. The most noble efforts have been made by science to prove the existence of the ether with, however, no sort of conclusive result which can be communicated to the man in the street.

Michelson's and Morley's marvellous experiment had, of course, tremendous consequences in that it lead directly to the principle of Relativity. That, however, important as it may be to some people, can hardly be said to answer satisfactorily the ordinary man's query: "What *is* this ether?"

BATTERY VOLTS ARE NOT PLATE VOLTS

—*continued from page* 166

laboratory is likely to contain an instrument capable of measuring it. What, then, are we to do? It can be calculated, if you can obtain the grid-current curve for your detector, and draw a load line, as in Fig. 2, which shows at the point X that this bias is just over half a volt.

The last valve to be dealt with is V_4 in the output stage.

This is a power valve, and we will suppose that the plate current is 8 milliamperes. The resistance of the primary of the output transformer (or the windings of an output choke if one is used) may be taken as about 1,000 ohms. The voltage lost to the valve is, therefore, 1,000 × ·008, or 8 volts only, leaving an actual plate potential of 120—8=112 volts.

In this article I have dealt with the circuit of a battery-operated set, but the H.T. voltages in a mains-operated set can be measured in just the same way.

VARLEY "SQUARE PEAK" SUPERHET

—*continued from page* 148

sockets are also available for leads to an external speaker. The maximum undistorted output of the set is 1,600 milliwatts, which is more than sufficient for all normal domestic requirements.

The set is designed for use with an external aerial and earth system, although our tests point to the fact that the aerial need be nothing more than just a length of wire round the picture rail.

In view of our earlier remarks concerning the astonishing sensitivity of this instrument, it seems quite unnecessary again to refer to it. But it may be of interest to add by way of conclusion that the high note cut-off to which superhets in general are prone is not a characteristic failing of the Varley version.

The drawback in this case has been overcome by a scientific process of L.F. correction, resulting in a balance between bass and treble that leaves absolutely nothing to be desired.

Undoubtedly it is a fine set, and we have not the slightest hesitation in recommending it.

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