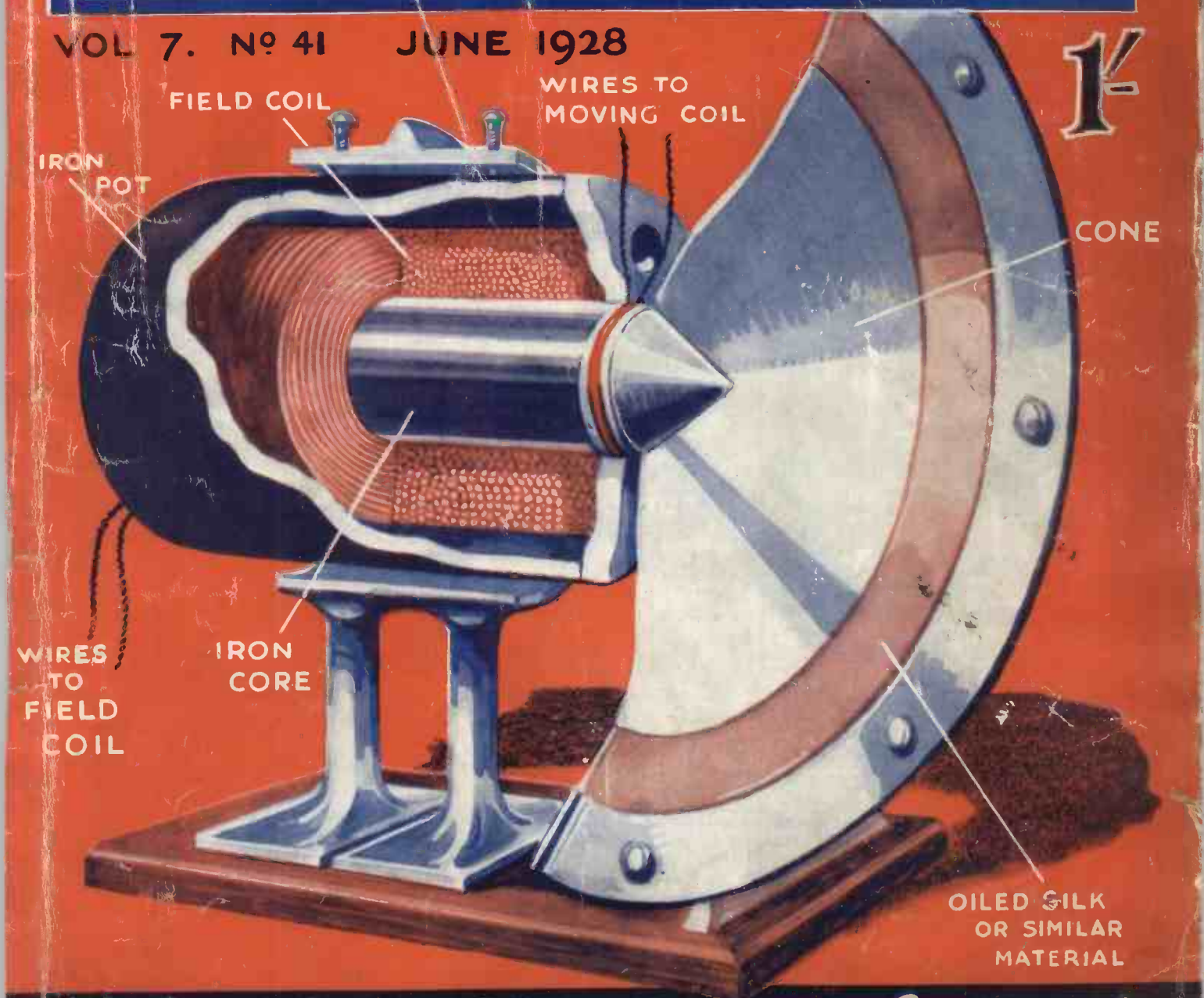
MOVING-COIL LOUD-SPEAKERS - MAKING AND USING

Wireless Magazine

EDITOR: BERNARD E. JONES TECHNICAL EDITOR: J. H. REYNER, B.Sc. (Hons.) A.M.I.E.E.

VOL 7. No 41 JUNE 1928

1/-



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Flat-dweller's 2 (HF, D)	WM76
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Empire Short-wave	AW 28
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Centre-tap 2 (D, Trans)	AW 42
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Trapped Reinartz (D, Trans)	AW 92
"Q" 2 (D, Trans)	AW 99

A blueprint of any one set described in the current issue of the "Wireless Magazine" can be obtained for half-price up till the date indicated on the coupon (which is always to be found on page iii of the cover) if this is sent when application is made. These blueprints are marked with an asterisk (*) in the above list and are printed in bold type. An extension of time will be made in the case of overseas readers.

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Dominions Short-waver (D, 2 Trans)	WM39
Tuned-anode from the Mains (HF, D, LF)	WM43
Screened-grid Short-waver (HF, D, Trans)	WM51
Metropolitan (D, 2 LF)	WM48
Everyday (D, 2 Trans)	WM52
Music Charmer (D, RC, Trans)	WM60
Britannia (D, RC, Trans)	WM67
Home and Garden 3* (D, 2 RC)	**WM78**
M.C.3 Star (HF, D, Trans)	AW 16
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Modern Tuned-anode (HF, D, Trans)	AW 35
Tetrode 3 (HF, D, Trans)	AW 36
Alternative-programme 3 (D, 2 Trans)	AW 38
All-from-the-Mains (D, 2LF)	AW 41
Special (D, 2LF)	AW 44
Economy 3 (D, 2RC)	AW 48
Short-wave (D, RC, Trans)	AW 50
Ether-searcher (D, RC, Trans)	AW 52
Standard (D, 2 Trans)	AW 56
Hartley D.X. (D, RC, Trans)	AW 63
Britain's Favourite (D, RC, Trans) *Price 7d., with copy of "A.W."*	AW 72
Broadcast 3 (D, RC, Trans)	AW 76
Selectus 3 (HF, D, Trans)	AW 81
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Station-finder (HF, D, 2RC)	WM68
Gramo-Radio 4 (D, RC, 2 Trans Push-pulled)	WM70
Q-coil 4 (HF, D, Trans, RC)	WM71
Screened-grid 4* (HF, D, 2RC)	**WM77**
All-purpose 4 (HF, D, RC, Trans)	AW 43
Tuned-anode 3–4 (HF, D, 2 Trans)	AW 49
C.T.4 (HF, D, RC, Trans)	AW 58
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1928 Five (2HF, D, 2 Trans)	WM46
All-the-world 5 (2HF, D, 2RC)	WM63
Cataract 5* (HF, D, RC, Push-pull)	**WM79**
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Wireless Magazine

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Wireless Magazine

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CONTENTS

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THE EDITOR'S LOG

OUR cover design proclaims the June WIRELESS MAGAZINE *to be a special Moving-coil Loud-speaker Issue. Six articles deal with the subject and among the writers are two great authorities, Capt. Round, who for a long time has been developing special designs of moving-coil loud-speakers, and Dr. McLachlan, who, as he reminds us in his article, demonstrated a coil-drive loud-speaker before the Radio Society of Great Britain two and a half years ago. These articles are real contributions to the literature of the subject.*

Two Loud-Speakers to Assemble

Two constructional articles deal with the moving-coil loud-speaker, one the "Junior"—a low-consumption model—and the other a loud-speaker with permanent magnets requiring no field current at all.

A novelty this month is the introduction of the special Gramo-Radio Section. Five years ago there was a tendency to suppose that the coming of broadcasting would kill the gramophone. In the light of events, the idea was grotesque and laughable. Wireless has done as much for the gramophone as for itself, and has directly led to electrical recording, possessing great advantages over the old mechanical recording, and the movement to-day is all in the direction of the electrical reproduction of records.

Practical Gramo-Radio Features

The idea we had in mind in founding this new section was to keep our readers up-to-date in electrical gramophone matters, and we make our bow this month with an article by Major Christopher Stone, whose work for the B.B.C. is well known.

Capt. H. T. Barnett, a prominent writer on gramophone matters, shows how to get the best results from records, and a member of our staff contributes an article explaining how the "pick-up" does its work. In addition, we have a constructional article on a gramo-radio amplifier, which can be added to any existing receiver.

The Finest Portables Available!

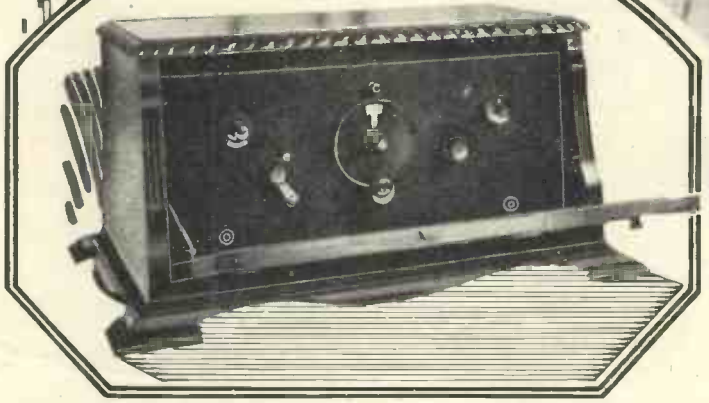
Mr. Reyner's Sunshine Five, which was a notable feature of the May issue, is a very fine set, and in a short article included in this month's pages Mr. Reyner is able to speak of more extended tests to which he has been able to submit the set.

And I have still another portable for the summer wireless man this month—and I believe it to be the first of its kind. It is a four-valver only, but one of the valves is of the screened-grid order, and to say that the results obtained with the set have amazed us is to fail to convey the impression made upon those who first heard it. Mr. J. Godchaux Abra ams took the set out for the week-end and actually and definitely identified twenty-three stations. Another test by a member of staff resulted in thirty-one different stations being heard, but some of them could not be identified. Thus we start the summer season with two high-class and thoroughly reliable portables.

Bernard E Jones

LISSEN LTD., 16-20 Friars Lane, Richmond, Surrey. *Managing Director: Thomas N. Cole.*

The Cataract Five



SPECIALLY SUITABLE FOR OPERATING A MOVING-COIL LOUD-SPEAKER

Designed, Built and Tested by the "Wireless Magazine" Technical Staff

TO operate a moving-coil loud-speaker (or, for that matter, any big modern cone instrument) efficiently, a large undistorted output is necessary and this the Cataract Five is able to produce.

It should be made clear at once that although the receiver employs five valves it comprises only one stage of high-frequency amplification, a detector and two stages of low-frequency amplification, the final stage consisting of two valves arranged in parallel to give adequate output to operate the largest of loud-speakers.

No great range is claimed for the Cataract Five; it is intended simply to pick up a few stations (Continental as well as British, of course) reliably *at full loud-speaker strength.*

Superlative Quality

Every known device has been incorporated to give absolute stability and reliability in the Cataract Five, which gives superlative results as regards quality. And to get good results from any moving-coil loud-speaker it is essential that the receiver itself shall be distortionless.

In order to give the greatest possible service the Cataract Five is provided with a jack so that a magnetic pick-up can be plugged in and gramophone records reproduced electrically (for further details regarding this development see the special Gramo-Radio Section later in this issue).

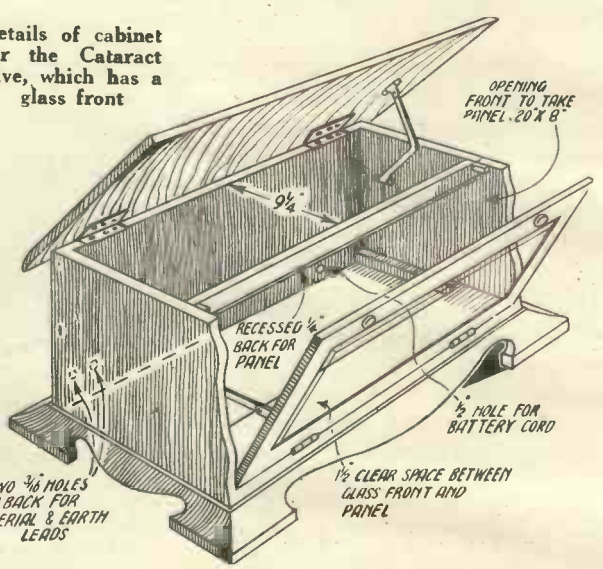
Inserting the pick-up plug automatically switches off the high-frequency valve and allows the detector to be used as a stage of low-frequency amplification.

Other points worthy of note will be apparent from a glance at the circuit diagram. The high-frequency coupling is a split-primary transformer; the secondary is tuned by a .0005-microfarad variable condenser. Reaction is brought to this from the detector and controlled by another .0005-microfarad condenser.

Both the aerial coil and high-frequency transformer are of the Q type, which means that both wavelength bands are covered by the movement of a single switch on the panel.

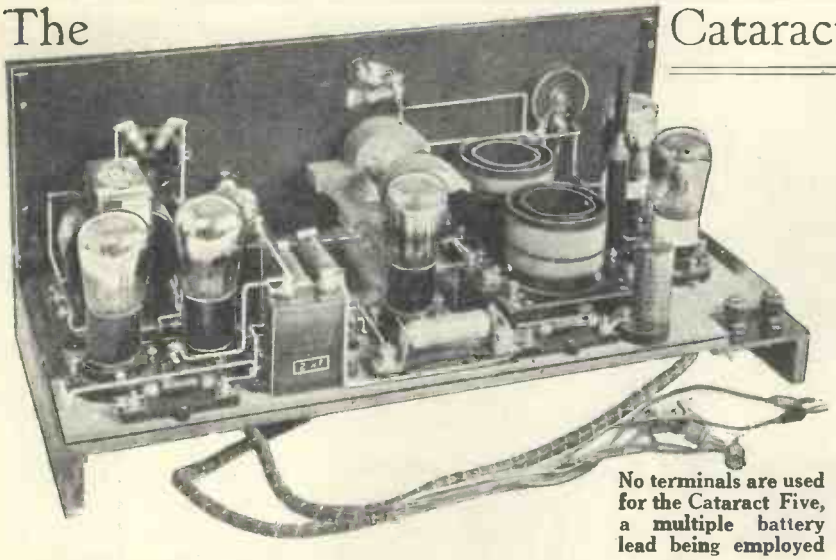
Ganged Tuning Condensers

Moreover, the two .0005-microfarad variable condensers which tune the aerial and high-frequency circuits, are ganged and controlled by a single



Details of cabinet for the Cataract Five, which has a glass front

The Cataract Five *(Continued)*



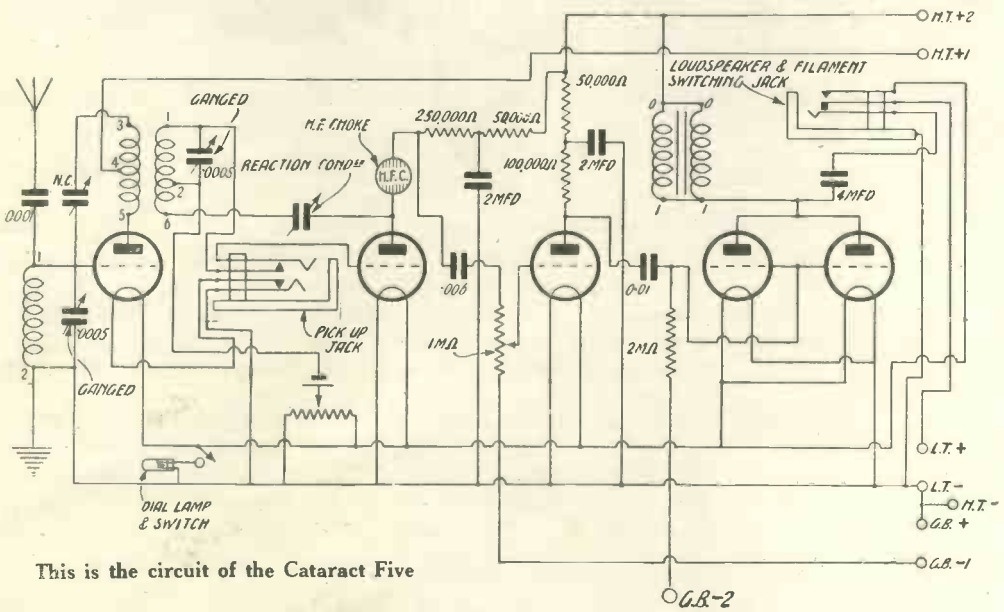
No terminals are used for the Cataract Five, a multiple battery lead being employed

arrangement ensures absolute stability and the absence of such troubles as "motor-boating."

Values of Coupling Elements

The detector is coupled to the first low-frequency amplifier by a 250,000-ohm wire-wound resistance and a .006-microfarad condenser, the grid-leak of the latter valve being approximately of .1 megohm in value, but is variable so that it acts as a volume control.

The coupling between the first low-frequency amplifier and the final parallel-valve stage is through a 100,000-ohm wire-wound resistance and a .01-microfarad condenser, the



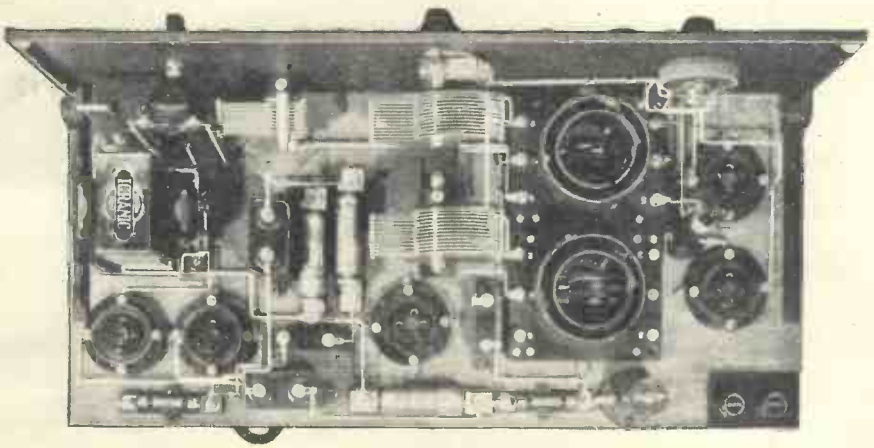
This is the circuit of the Cataract Five

dial on the panel. Ease of tuning is, therefore, assured even for the most inexperienced operator.

Anode-bend detection is incorporated and the best adjustment easily obtained by means of a potentiometer associated with a grid-bias battery.

Anode-bend Potentiometer Control

In the anode circuits of both the detector and first low-frequency amplifying valve is an extra 50,000-ohm resistance, a 2-microfarad by-pass condenser being placed between the anode end of this and low-tension negative. This



Part of the wiring of the Cataract Five is above the baseboard and part is below as shown in this photograph

Gives Absolutely Distortionless Output

usual 2-megohm grid leak being employed.

Direct current from the high-tension supply is prevented from flowing through the loud-speaker winding by a choke output circuit. This consists of the two halves of a double-wound choke placed in parallel and a 4-microfarad condenser. The loud-speaker is thus at earth potential. Inserting the loud-speaker plug into the jack automatically switches on the whole receiver.

Seven Panel Controls

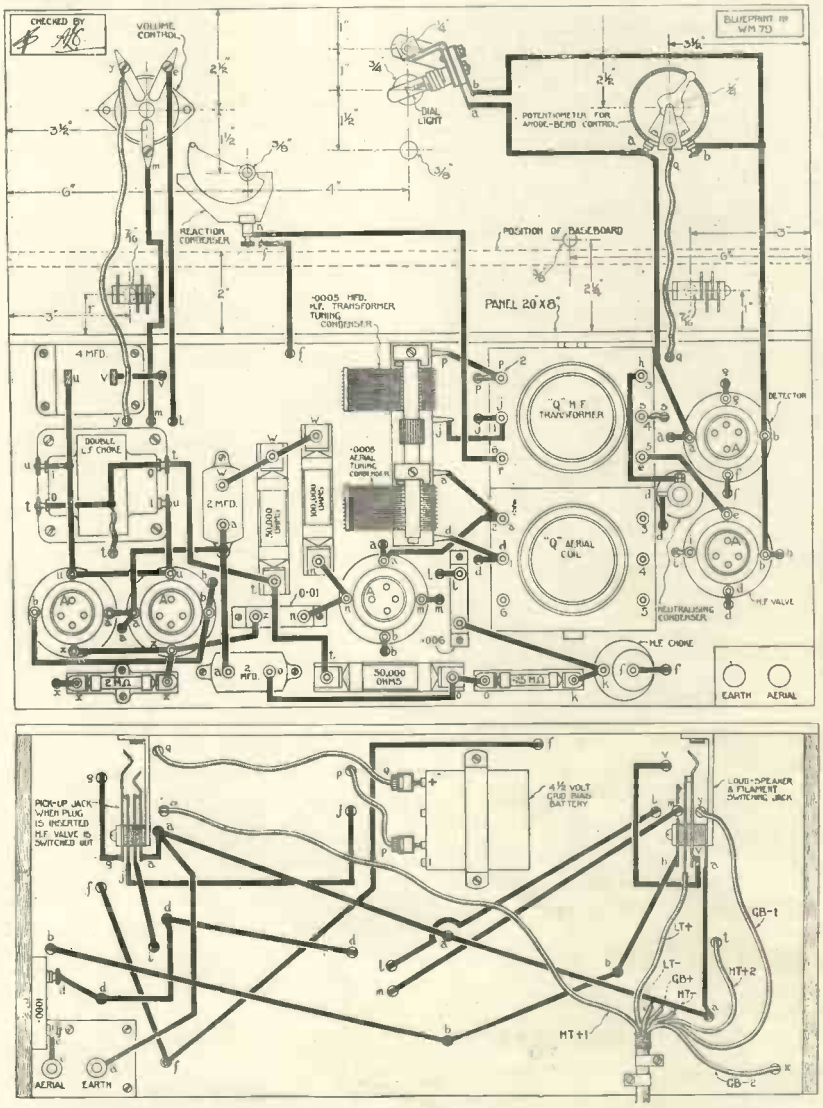
On the panel itself there are seven controls. At the top left is the knob of the potentiometer that controls the anode-bend point of the detector, while immediately below it is the pick-up jack, the function of which has already been explained.

Next comes the lever switch that controls both the Q aerial coil and high-frequency transformer. Both of these components have their switch-gear coupled to a common spindle, and in this way single control is obtained.

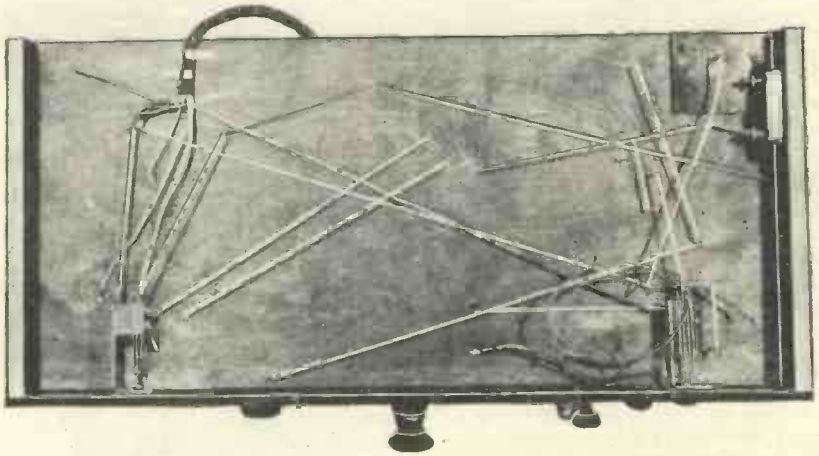
Dial Light for Dark Corners

In the centre of the panel is a vernier dial which controls the gang condenser for tuning the aerial coil and high-frequency transformer. This is provided with a behind-panel light for use in dark corners, the light being controlled by a small on-off switch (not counted as a receiver control) immediately above the main vernier dial.

To the right of the vernier dial are



This layout and wiring diagram of the Cataract Five can be obtained as a full-size blueprint for half-price, that is 9d. post free, if the coupon on page iii of the cover is used by June 30. Ask for No. W.M.79



This photograph shows the sub-baseboard wiring of the Cataract Five

the reaction condenser, volume-control knob, and the loud-speaker jack.

It will be observed from the photograph reproduced in the heading to this article that the cabinet is of the *de luxe* type, and is fitted with a glass front that falls forward when access to the controls is desired. For the sake of tidiness, use is made of a multiple battery cord instead of the more usual terminal strip.

There are several features of interest regarding the layout of the Cataract Five. In the first place, a combination of ordinary wiring and sub-baseboard wiring is used in order

The Cataract Five (*Continued*)

COMPONENTS REQUIRED FOR THE CATARACT FIVE

1—Ebonite panel, 20 in. by 8 in. (Becol, Will Day or Raymond).
1—Two-gang .0005-microfarad variable condenser (Formo 1928 Log).
1—Vernier dial with panel light (Igranic or Formo).
1—Potentiometer (Lissen or Igranic).
1—Megohm variable grid leak (Igranic).
1—.00035-microfarad variable condenser (Formo 1928 Log or Cyldon Bébé).
5—Anti-microphonic valve-holders (Lotus, Benjamin or W. and B.).
1—Neutralising condenser (Gambrell or McMichael).
1—Q aerial coil (Lewcos, Wearite Atlas or Bowyer-Lowe).
1—Q high-frequency transformer (Lewcos, Wearite, Atlas or Bowyer-Lowe).
1—High-frequency choke (Wearite, Cosmos or Igranic).
1—.25-megohm grid leak with holder (Mullard, Dubilier or Lissen).
1—2-megohm grid leak with holder (Mullard, Dubilier or Lissen).
2—50,000-ohm wire-wound anode resistances with holders (Dubilier, Mullard or R.I. and Varley).
1—100,000-ohm wire-wound anode resistance with holder (Dubilier, Mullard, or R.I. and Varley).
1—.006-microfarad fixed condenser (Dubilier type 620, Mullard or Lissen).
1—.01-microfarad fixed condenser (Dubilier type 620, Mullard or Lissen).
2—2-microfarad fixed condensers (Dubilier, Lissen or T.C.C.).
1—Double-wound low-frequency choke (Igranic blue label or Ferranti).
1—4-microfarad fixed condenser (Dubilier type BA4 or T.C.C.).
1—Pair adjustable panel brackets (Deckorem).
1—Ebonite strip, 3 in. by 2 in. (Becol, Will Day or Raymond)
2—Terminals, marked :—Aerial, Earth (Belling-Lee).
1—8-way battery cord (Lewcos).
1—.0001-microfarad fixed condenser (Dubilier type 610, Mullard or Lissen).
2—Jacks and plugs (Igranic Nos. 63 and 65).
1—Cabinet with 9 in. baseboard (Edwards).

to simplify the construction considerably.

Thus the baseboard and panel are not fixed together edge to edge, but the former is placed two inches from the bottom edge of the latter.

It will also be noticed that the use of the two Q coils, placed one behind the other, and of a two-gang condenser to tune them ensures the shortest possible wiring, as each part of the condenser comes almost exactly alongside the particular coil it is required to tune.

Standard Components Only Used

All the components used in the construction of the Cataract Five (a complete list appears on this page) are standard, and should be obtainable from all dealers without difficulty. As far as possible constructors are recommended to follow the original specification.

The first job to be tackled in the construction is the drilling of the panel. This can be done directly from the full-size blueprint, which acts as a drilling template, layout guide, and wiring diagram, or by marking out from the reduced reproduction in these pages.

Full-size Blueprints

Full-size blueprints can be obtained for half-price—that is, 9d., post free—up to the end of June if the coupon on page iii of the cover is used. Address your inquiry to Blueprint Department, WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4, and ask for No. W.M.79.

As soon as the holes have been drilled in the panel, mount the two jacks, the potentiometer, indicating lamp, two-gang condenser, reaction condenser, and (volume-control) variable grid leak. Also make holes for the bracket bolts.

Before fixing baseboard and panel together, however, screw the remainder of the components to the former, as indicated in the blueprint and layout diagram. Notice that on the under side of the baseboard are mounted a .0001-microfarad fixed condenser in the aerial lead and a 4½-volt tapped grid-bias battery, used in conjunction with the anode-bend potentiometer.

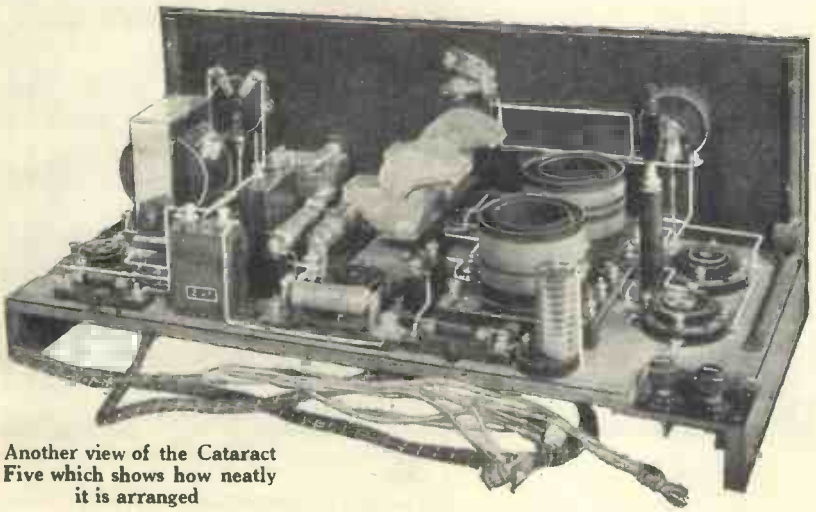
Simple Wiring-up System

When everything has been firmly fixed in position, wiring up can be tackled. This, as has already been mentioned, is a combination of ordinary wiring and sub-baseboard wiring, which is very simple to carry out if the blueprint or layout diagram is carefully followed.

A glance at either will show that each terminal point is marked with a small letter of the alphabet; these letters indicate which points should be connected together and in what order.

First of all connect up all those points marked *a* with one wire or as few wires as possible above the baseboard; where a wire is shown going through the baseboard, drill a hole with a small twist drill and push a wire through.

When all the top *a* wires have been connected and the rest of the wires put through holes in the baseboard, turn the set over. A number



Another view of the Cataract Five which shows how neatly it is arranged

For Operating a Large Loud-speaker

of *a* wires will then be projecting, and these should all be connected together in the most convenient way.

Carry on in the same way with all the points marked *b*, and so on, throughout the alphabet. Although this method of wiring sounds complicated, it is, in practice, very easy to carry out and in a a short time.

Suitable Valves

Suitable 6-volt valves for use in the Cataract Five are detailed in the table on this page. Normally the high-frequency amplifier should have an impedance in the neighbourhood of 20,000 to 30,000 ohms; the detector 60,000 to 80,000 ohms; the first low-frequency amplifier round about 20,000 to 30,000 ohms; and the final parallel valves can be of the super-power type, each with an impedance of anything round about 5,000 ohms or less. Either 2-, 4- or 6-volt valves can, of course, be used.

SIX-VOLT VALVES TO USE IN THE CATARACT FIVE

Make	H.F. Amplifier	Detector	1st L.F. Amplifier.	Paralleled 2nd and 3nd L.F. Amplifiers.
Cossor ..	610H.F.	610R.C.	610L.F.	610P
Cosmos ..	DE50	SP50B	SP50R	SP50R
Ediswan ..	ESS H.F.	—	ES5L.F.	PV610
Marconi ..	DEH610	DEH610	DEL610	DEP610
Mullard ..	PM5X	PM5B	PM6	PM256
Osram ..	DEH610	DEH610	DEL610	DEP610
Six-Sixty ..	SS6075H.F.	SS6075R.C.	SS610P	SS625SP

Equivalent 2- and 4-volt valves can, of course, be used if desired.

To carry out a rough test of the receiver, apply 60 to 80 volts high tension to H.T.+1 (which feeds the high-frequency amplifier only) and 120 volts or so to H.T.+2 (which feeds the remaining four valves). To G.B.—1 apply 3 to 4½ volts bias, and to G.B.—2 as much as 9 to 18 volts, depending upon the type of valve used in the final stage. Tap of 1½ volts negative from the small battery slung underneath the baseboard.

Economising in High Tension

It should be remembered that increasing the grid bias decreases the high-tension consumption, a point of some importance when dry-cell high-tension batteries are used. With a receiver of this type it is preferential to obtain the high-tension supply from an electric mains unit or a high-tension accumulator.

Although there seem to be a large number of controls, the operation of the set is not at all difficult. Having connected up the batteries, aerial, and earth, insert the loud-speaker plug in the right-hand jack and adjust the reaction condenser (on the right of the main tuning dial) until the slight rustling or hissing sound is heard which indicates that the receiver is on the verge of oscillation and in its most sensitive condition. Stations can then be brought in by turning the knob of the centre vernier dial, which tunes both the aerial and high-frequency circuits simultaneously.

As soon as a transmission has been picked up the potentiometer should be adjusted for maximum sensitivity, while the volume can be controlled by means of the variable grid leak of the first low-frequency amplifying valve, which is just above the reaction control.

To neutralise the receiver, tune in a station and then switch off the high-frequency amplifier by disconnecting one of the filament leads, but do not remove the valve from the holder.

Now turn the knob of the neutralising condenser, on the baseboard, until signals become inaudible, when the valve capacity has been balanced out. Re-make the filament connection and carry on in the ordinary way.

Normally only the tuning condenser and reaction condenser need be adjusted, the anode-bend potentiometer being left once the best setting has been found.

To use the set for gramophone reproduction leave everything as it is, but insert the pick-up plug in the left-hand jack. Volume can be controlled.

Readjusting the Potentiometer

In this case the potentiometer should also be readjusted, as the "detector" valve is then being used for amplifying and not merely for rectifying impulses from the high-frequency valve.

As regards the choice of a suitable pick-up, this should be of the high-resistance type unless a special input transformer is also obtained. Practical notes on gramo-radio work will be found in the special Gramo-Radio Section, which begins on page 451.

Always Ready

It will be appreciated that as the Cataract Five gives loud-speaker reception of both long- and short-wave broadcasting stations and can also be used for the electrical reproduction of gramophone records, it is a never-failing source of entertainment.

Should there be no suitable radio programmes available, then some of the excellent records now available will fill the gap. Radio gives a variety of entertainment that could only be obtained from gramophone records at the cost of a small fortune —plays and operas, moreover, are impracticable as records, and the gramophone cannot give topical talks.

Experience An Advantage

Although the Cataract Five is not at all difficult to operate, it embodies so many refinements that better results will be obtained with it after the constructor has had several days' handling of it. Only experience can teach anybody how to get the last ounce out of such a receiver in the way of quality and volume of reproduction.

Why the Moving-coil System is the Best Yet

An Au'horitative Article by Capt. H. J. ROUND, M.I.E.E., Who Now Contributes Exclusively to "Wireless Magazine" and "Amateur Wireless"

I HAVE seen the statement made many times, and as recently as last month, that the moving-coil loud-speaker is only for those who can afford to put into it a lot of power from their receivers.

Now, I would like to say that, from my own experience, the moving-coil loud-speaker is quite as sensitive as any other type of cone I know of.

Nothing Better Obtainable

For the average small sitting-room a properly constructed instrument will work nicely with 120 volts high tension and a power valve equivalent to the DE5A—and the volume of sound will be very satisfying. Moreover, at the moment there is nothing nearly so good obtainable.

Principles and Practice

This is rather by the way, as in this article I am proposing to indicate some of the basic principles on which the moving-coil system works and, also, to indicate how in practice, it does not always follow those principles.

Let us review the problem the loud-speaker is out to solve. At the broadcasting centre a source of sound, say a man speaking, or perhaps a band, is placed in front of a microphone. Through various pieces of gear, the results of this sound arrive at our last valve and our object is to produce, in the air, a duplicate of the original sound.

It is generally accepted now that the rise and fall of pressure in the air round the microphone, due to the sound, shall be made to give a proportional rise and fall of voltage on the grid of our power valve, independent of strength within wide limits (no blasting) and independent of pitch over wide limits (see Fig. 1).

With this voltage on the grid of our power valve, obviously we have to develop in the air equal changes of pressure for equal changes of voltage, independent again of amplitude or frequency.

Value of Theoretical Demonstration

The greatest difficulty is being met in making measurements in the laboratories of sound waves and their pressures, but great assistance is given to the solution of the problem if we can show first of all theoretically that the apparatus we are going to use should give the right result under ideal conditions.

Lord Rayleigh, many years ago, worked out the mathematics of sound production from a spherical

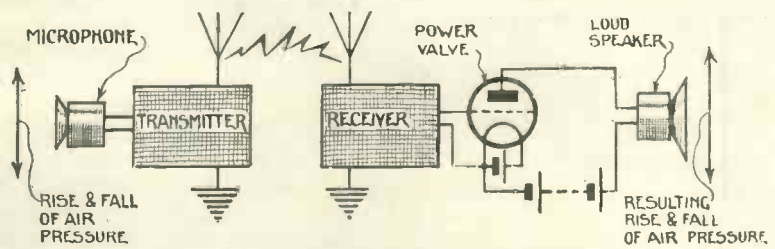


Fig. 1.—The rise and fall of air pressure at the microphone is transmitted through the wireless system until it arrives at the grid of the power valve and here the rise and fall of voltage should be proportional under all conditions to the original air-pressure change. The loud-speaker problem is to take the energy from the valve and produce in the air a rise and fall of pressure proportional to the power-valve grid voltage

source of sound, such as a rubber ball being blown in and out rapidly (Fig. 2a) and he found that to give equal sound pressures at all frequencies the radial expansion and contraction would have to be very different at the different frequencies.

Equal Sound Radiations

Thus, equal radiations of sound would be given at 1,000 cycles and at 100 cycles by a radial expansion and contraction in these cases of 1 and 100; in other words, the radial displacement would have to be inversely as the square of the frequency.

An expanding sphere, such as I have sketched, although it would make the ideal source of sound has never been made to function in the correct way yet—the difficulty being somewhat similar to that experienced in getting a magnet with only one pole, but a fairly near approximation can be made to it by suspending a stiff diaphragm in the centre of a large baffle board (Fig. 2b); when the diaphragm is vibrating as a whole on each side of the baffle board we have a condition somewhat like that produced by half the ideal spherical radiation.

If we adopt some means of making the diaphragm vibrate with the correct amplitude, we shall have a fairly good loud-speaker, and just as in the balloon case, the amplitude will have to be tremendously large at the low frequencies compared with those at high frequencies.

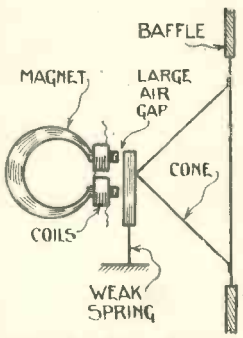


Fig. 3.—Any electro-magnetic system fitted with cone and baffle will give R.K. tone results if the natural period is sufficiently low, but the efficiency will be very low

Amplitude Proportion

If the diaphragm is imagined as being perfectly stiff, the amplitude will have to be proportional to the inverse square of the frequency. Then, if the vibration is $\frac{1}{10}$ in. at 100 cycles, it will be $\frac{1}{10000}$ in. at 1,000 cycles and would have to be 10 in. at 10 cycles to give the same radiation.

There happens to be an extremely easy way of producing vibrations with exactly this law theoretically, and fairly near to the law practically.

For, if the whole diaphragm system is given extremely low natural period, preferably zero period, or just as low as is practical, and it is acted on by a constant force over the whole frequency range, then the amplitudes will be just what we require; providing:

(1) The natural period is lower than the audible limit.

(2) The diaphragm is perfectly stiff.

We thus see how neat the R.K. system is: We have an arrangement which requires an equal force over the frequency range and practically all the known electro-magnetic movements will give an equal force over the frequency range if equal currents are put through their windings.

Unfortunately the ordinary telephone magnet system, depending as it does on a magnet pully or piece of iron, stipulates a diaphragm, which is stiffened sufficiently to prevent a collapse of the system.

I have produced R.K.-type loud-speakers with iron armatures and the usual magnet windings, but sensitivity was very much below what one would have liked, because the pole of the magnet had to be withdrawn from the armature sufficiently far to allow of the latter, with its attendant diaphragm, being given a very low natural period—a condition not conducive to sensitivity.

There is no reason why, say, a balanced armature system such as that used on the Kone loud-speaker, filed down to increase the air gaps and also to slacken the spring suspension, should not give tones with a small cone and baffle equal to that given by the moving-coil.

But, of course, the moving-coil system is the natural way of solving the problem, because in this way, no forces come on to the diaphragm, except those alternating ones which are required for action.

The theoretical basis of the R.K. is thus nearly complete, for we can assume that the currents through the moving-coil system are proportional to the power-valve grid voltage.

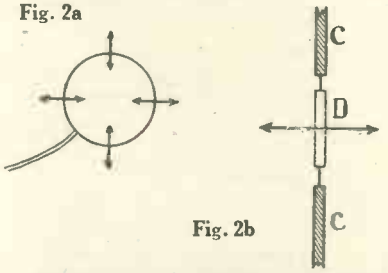
We have through the whole system:

(1) Initial air pressure in front of the microphone, and, as a result current proportional to this through the moving-coil, or other winding; then

(2) We have automatically a displacement of the diaphragm inversely as the frequency squared, and as a result of this;

(3) Equal sound radiation at all frequencies.

Having established the main principles of the R.K. system; let us see what some of the snags are.



A spherical balloon vibrating radially with an amplitude inversely proportional to the frequency squared ($\frac{1}{n^2}$) will radiate sound equally from all frequencies (Fig. 2a.) A practical approach to this is given by a stiff diaphragm D (Fig. 2b) vibrating with the same law in the middle of a large baffle board, CC

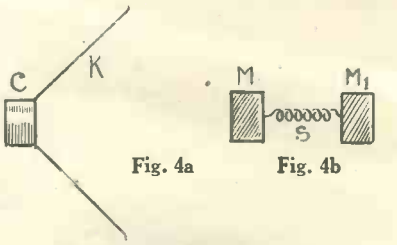
Drop in Coil Currents

I think the first is that the current in the moving-coil is not proportional to the grid voltage on the power valve—the self-induction of the coil is quite sufficient to drop the coil currents considerably at the higher frequencies.

However, we have various ways of putting this matter right and have discussed this in a previous article.

The second and most important error of all is that there is not such a thing as a stiff diaphragm, and we have got to come to a decision as to what is effectually stiff in practice.

In a crude way we can imagine what will happen to an R.K. cone system, which is probably the stiffest system of reasonable size which we know of, but whose stiffness is not perfect.



Harmonics of a cone system

Why the Moving-coil System is the Best Yet *(Continued)*

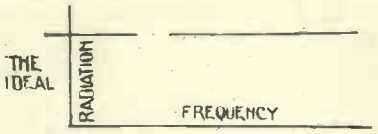


Fig. 5 A.

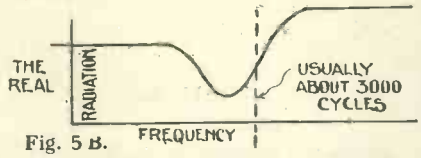


Fig. 5 B.

Result of cone harmonics on sound radiation

In Fig. 4A the coil and cone, C and K, are shown, and a little thought will indicate that very approximately this can be represented by a mass M (Fig. 4 B), a spring S, and a mass M_1, the elasticity of the joint between C and K being equivalent to the spring S.

Now see what happens if forces of varying frequency are applied to C and its equivalent M.

At very low frequencies S is sufficiently strong so that we can imagine M and M_1 as just joined together absolutely stiffly and everything is as it should be, if C or M move to the right, then K and M_1 move to the right.

Moving in Opposite Directions

But what happens when the frequency arrives near the natural period of M and M_1 vibrating in conjunction with S? Certainly in the cone case a very high period, but never outside audible limits. It can easily be seen that M and M_1, and consequently C and K, can easily be moving in opposite directions at the same moment.

High-frequency Reponse

The vibration in practice of an R.K. cone system will thus consist of a component we want with a resonant component on top of this, which has the general effect of spoiling the high-frequency response curve—the part where the R.K. is certainly weaker than its simple theory indicates.

Fig. 5A shows the ideal radiation cone of the R.K., whereas Fig. 5B shows the actual radiation of a particular cone. The curious dip seems to occur in all sizes and shapes of R.K. at some frequency or other, and is the position where the resonant motion is in opposition to the main mass-controlled motion.

By making the masses M and M_1 small and the spring S very strong, the kink can be raised fairly high, where its effects can be minimised by condensers, etc., but this kink is the main cause of the well-known "edge" heard on most R.K. type speakers—as so far it has been impossible to raise it above hearing.

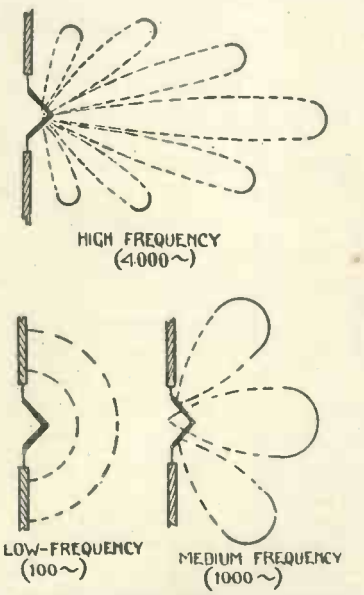


Fig. 6.—Three polar radiation diagrams of an R.K. at different frequencies

It is interesting at this point to introduce all the various factors in the design of the cone system and those who are really interested in the theory of the cone action may like to follow out the influence of the following factors one by one.

(1) Cone size, angle, weight, stiffness, internal damping quality.
(2) Coil weight, diameter, depth and relative weight compared with cone.

Rice and Kellogg were very wise in stipulating that a 6 in. cone was big enough—for in general, there is little advantage and considerable disadvantage in larger sizes.

There is one final main source of error in the moving-coil and cone.

In the Rayleigh balloon radiator, all frequencies are equally radiated and in all directions—but the approximate equivalent in Fig. 2B is only equivalent to Fig. 2A for the lower frequencies, for depending upon the size of D, directional effects begin to come in.

Energy in a Beam

For instance, if D was made 10 in. diameter then at 10,000 frequency the energy radiated will go off in a beam, as sharp as one of the Marconi beam aerials, and even at 1,000 frequency the beam effect is quite marked.

In addition, of course, the R.K., cone is not flat, and the final result at all frequences is quite complicated but can be noted by ear quite easily if one is the possessor of a "squeak" or instrument for producing the full range of musical notes.

Radiation Measurements

In actual practical work it is intensely difficult to measure the true radiation of the loud-speakers, for like a lamp, one would have to take a "mean spherical" radiation, a painful process with sound measurement.

With all its defects, the R.K. loud-speaker remains the simplest way of getting nearly perfect results, but it is only by considering all the side issues that we shall get finally an instrument of greatly-improved quality.

Towards a Radio Millenium

Radio Progress Recorded in Five Scenes

SCENE: The interior of a commercial radio station at Sultanabad, on the fringe of Northern Persia.

Time: The night, at that hour when the sweltering heat of the day is changing to the chill of night, and the windows of the radio shack are still wide open despite the foul air blowing up from the village.

Dramatis Personæ: One, the operator, tired of the eternal buzz of 600-metre spark, and anxiously awaiting the relief due in half an hour or so.

The business of the day is practically finished. The operator takes out of his pocket a much-thumbed newspaper cutting. He swings the main switch over from "send" to "receive," cuts off the power to the rotary gap and adjusts the carborundum crystal with meticulous care. Then—the great moment.

The tuner tapping switches are turned back a stud or two, bringing the set off the official 600-metre mark. More crystal tickling . . . and the operator pushes the phones tightly to his ears.

Not often is a message quite so well worth receiving as is this. He is hearing the first real broadcast from the Mother Country—Madame Melba singing in a temporary "studio" at the Chelmsford Marconi station. Hundreds of amateurs in England, and a few as far away as Berlin and Madrid, are doing the same thing.

◆ ◆ ◆

Scene: A cabin in the *Victorian*, the ship in which the Empire Press Union delegates are crossing to Canada.

Time: The whole day, for days and days and days.

Dramatis Personæ: Busy wireless operators, busy cabin boys carrying Press messages, and—busiest of all—Mr. Arthur Burrows, much later to be the B.B.C. Director of Programmes and the Master Mind at Geneva.

An explanation of the hustle is needed. Twice daily the radio staff of the *Victorian* produce a ship's newspaper. That, in itself, is a romance. The evening edition contains American news, obtained by radio *telephony* from the station at St. John's, Newfoundland, and it is the first newspaper to be so supplied with news.

That is another romance, and an explanation of the hustle in the radio cabin.

◆ ◆ ◆

Scene: 2MT, Writtle.

Time: February, 1921.

Dramatis Personæ: An engineer studying an aerial ammeter, and praying that the fiends in the amateurish and roughly-wired-up gadgets will not "gang aglay," not to mention Chief-Engineer cum Station-Director cum Programme-Director cum Master of Ceremonies, Capt. P. P. Eckersley, now the head of all radio technicalities of the British Broadcasting Corporation.

Under special licence from the Postmaster-General, 2MT is allowed to give 10 minutes C.W., 10 minutes speech and 10 minutes music. Thousands of amateurs put aside important business engagements each Tuesday evening to make the most of this valuable half-an-hour of impromptu Eckerslian wit from Chelmsford.

For half-an-hour once a week (the morse was soon dropped) "P. P. E." thrills the radio world in a way it has not been thrilled since the establishment of regular broadcasting.

◆ ◆ ◆

Scene: A small room at the top of Marconi House in the Strand, overlooking Father Thames. Despite its wireless wonders, no room in Marconi

Towards A Radio Millenium (*Continued*)

House has ever been so quaintly furnished. A faded green carpet, muslin wall hangings blackened with London grime, a few chairs, a desk, two telephones, and . . . microphones.

Time : 1922.

Dramatis Personæ (including stage property) : A typist, clicking away incessantly; phones ringing incessantly; engineers incessantly shouting at, singing in and swearing at microphones; crowds of artistes besieging the room and demanding auditions. In the centre of this modern Babel is Mr. Jefferies, vainly trying to compile daily three-hour programmes.

When the broadcasting hour approaches the chaos is cleared. The microphones are ready for action, the phones are silent, the unsuccessful artistes have been pacified and the successful ones told to remain till the evening, the room has been cleared and the typist has gone home to tea.

Not so Mr. Jefferies. He stays till ten o'clock, or maybe eleven, and conducts the evening's programme. A real one-man job !

In the next room an engineer is watching the clock with more than usual care. The reason is that for three minutes in every ten he has to close down the newly born 2LO transmitter and listen-in for chance S O S signals—a red-tape measure which corresponds with the red-flag man who had to walk in front of motor-cars !

◆ ◆ ◆

Scene : Almost any home.

Time : The evening.

Dramatis Personæ : Paterfamilias and the rest . . . *and* the loud-speaker.

2FC, Australia, re-broadcast from London, is being heard on paterfamilias' humble two-valver.

QUEUE.

Has Radio Widened Your Interests ?

THIS article does not intend to deal with the educational effect of broadcasting on the listener-in. It is directed to the more serious experimenter, to the man who delves into the secrets of the workings of Nature. Not that he realises, at first, that he is doing so. It is my endeavour in this short chat to bring to the notice of serious radio experimenters the fact that they are investigating the great fundamental laws of Nature when they intend only to experiment with radio.

Investigating Minerals

The experimenter investigating the simple crystal rectifier wants to find the most perfect detector and his search compels him to study and investigate, under both natural and laboratory conditions, many types of minerals.

He probably reads up their history and the manner in which they reached their present state. Then, perhaps, he tries compounds, and fuses other chemicals into the natural mineral. This requires at least an elementary knowledge of chemistry.

Going on to the valve, the radio student has to study the electron theory of matter in order to understand the working of it.

Magnetism and Electricity

Magnetism and electricity must be examined. Under this subject alone, he realises the great forces at man's command; light and heat are both manifestations of the hidden force of the electrons which he uses in his valves.

The flow of a current of electricity; the strain in the ether round the conductor carrying this flow, he finds, is used to introduce inductance into his circuits where desired. It is also used to drive great motors, and flood a city with light from huge generators. He uses the electric current to light the filaments of his valves.

The ether, the atom, and the free electron bring the experimenter face to face with the fundamentals of life. In his studies he finds that an atom resembles his own solar system. He likens the positive nucleus to the sun, the fixed electrons to the planets, and the free electrons to the comets. He ponders on the greatest riddle of modern times. Are electrons and protrons the building blocks of the Universe? Is our solar system merely an atom, part of a molecule in some great, gigantic scheme of building?

Spanning the Oceans

Leaving theory, he equips his den with the best receiver he can afford to make up. He listens to the voices and music of many nations. He spans the oceans and hears the voices of his cousins in the far-flung dominions of the Empire.

Then, perhaps, he gets a transmitter and communes with men he will probably never see. He comes up against the mysteries of the fading of signals he endeavours to receive and send, to and from his distant friends.

Heaviside Layer

The Heaviside layer claims his attention for a while. He wonders whether it stops his signals which radiate vertically from his aerial, or does their sharp angle of incidence enable them to penetrate the layer and continue on through space for eternity? The ether has no resistance, he understands, while if space is curved, as presented by Einstein, might not his signals return to earth in countless centuries to come?

From this, inter-planetary communication leads him to speculate on the possible plurality of worlds. Mars, with its legends and romance; Venus, the crescent planet of eternal clouds; Jupiter, the solar system in miniature—do his moons sustain intelligent life? Will the Heaviside layer of these planets for ever prevent them communicating with one another, or will the layer be used as an aerial to signal across space the tidings of other worlds?

Reaching Out

And thus does radio broaden the mind of the serious experimenter, causing him to look out on to nature and to reach out beyond his own little locality; out into other countries; out over the seas and continents; out into space and the planets, and beyond into systems of other suns and planets, out into the Great Unknown.

E. J. G. L.

THE CHUMMY FOUR

Enormous Range and Volume

DESIGNED, BUILT AND TESTED BY THE "W.M." TECHNICAL STAFF

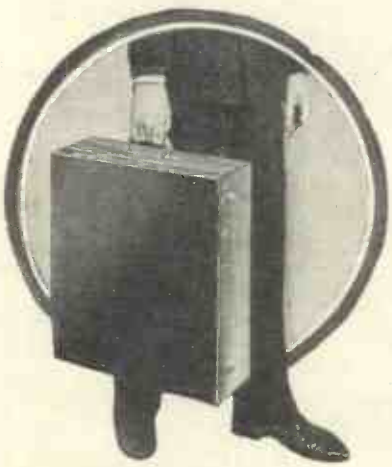
ALTHOUGH opinions differ as to whether a complete receiver that weighs 30 lb. is really "portable" or merely "transportable," everybody who has heard the Chummy Four in action (and it has been demonstrated to a number of well-known people in the wireless trade) agrees about the remarkable results it gives.

Twenty-one Foreign Stations!

In London, at distances varying from half a mile to three miles from 2LO, this remarkable set has picked up twenty-one foreign stations on the loud-speaker with a frame aerial only 16 in. square.

Such stations as Daventry Experimental, Langenberg and a few other German stations can be brought in loudly enough to be heard in several rooms of a house and even in the case of more distant stations, such as Buda Pesth and Copenhagen, the quality of reproduction is quite remarkable.

A list of stations received at loud-speaker strength—loud enough to be heard comfortably, that is—appears on page 402. These results are vouched for by Mr. J. Godchaux Abrahams, the well-known authority on foreign broadcasting matters.



See how the Chummy Four hangs by one's leg. It is not uncomfortable to carry, although it weighs 30 lb.

Mr. Abrahams speaks four foreign languages and is so well in touch with European broadcasting affairs that he can instantly recognise any transmission—almost by the carrier wave! He has tested the Chummy Four side by side with a well-known commercial five-valve portable set and found—yes, you are right—the Chummy Four won by a good margin.

And what is the secret of these astonishing results with a portable four-valver? Well, the answer is a screened-grid high-frequency amplifying valve.

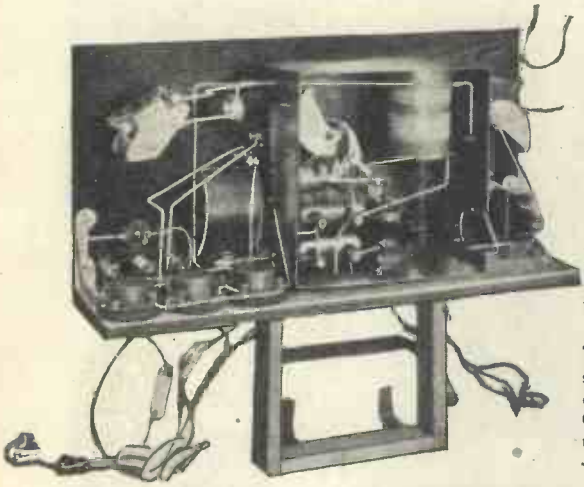
The possibilities of the screened-grid valve have not yet been fully realised by the majority of wireless people, but the WIRELESS MAGAZINE Technical Staff has from the beginning thought well of them and was responsible (in September last) for the publication of details of the first set to contain one.

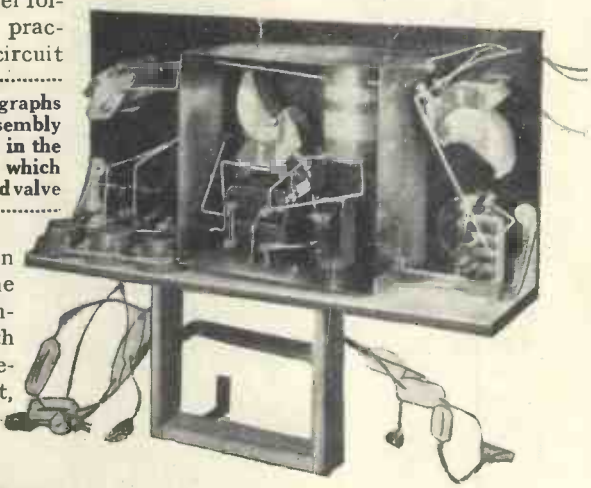
First Screened-grid Portable

Once again the WIRELESS MAGAZINE leads the way, for the Chummy Four (at any rate up to the time of going to press) is the first portable set with a screened-grid valve to be produced by any British radio periodical.

Receives Twenty-three Stations on the Loud-speaker!

The Chummy Four (Continued)





These two photographs show the neat assembly of the components in the Chummy Four, which uses a screened-grid valve

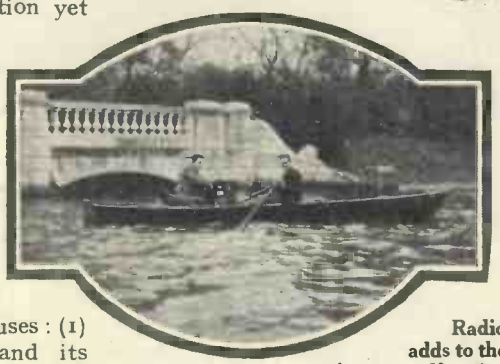
It is true that in practice the amplification obtained from a screened-grid valve is nothing like the value possible on paper (which is in the neighbourhood of 100), but it is very much greater per stage than can be obtained from any other form of high-frequency amplification yet devised.

Evident from Results

That this is so is evident from the results obtained—and a station on the loud-speaker is worth two in the ether, to revise an age-old proverb!

The fact that very great amplification is obtained can be attributed to three causes: (1) The screened-grid valve and its associated anode-tuning coil and condenser are completely screened by a metal box; (2) the frame aerial is wound on the door of the cabinet and kept away from the set itself, and (3) a full 120-volts high tension is available for the anodes.

Apart from these special points the receiver follows standard practice. The circuit (which is reproduced on this page) comprises one stage of high-frequency amplification, a detector with reaction into the high-frequency valve anode circuit, a stage of resistance-capacity coupled low-frequency amplification and a stage of transformer-coupled amplification.



Radio adds to the pleasures of boating

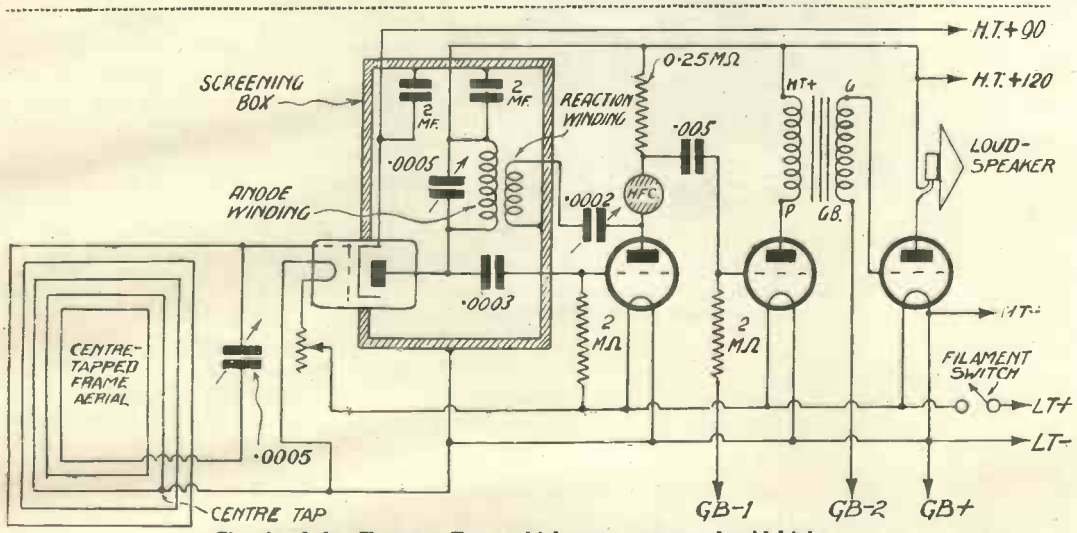
At this stage it may be desirable to draw some comparison between the Chummy Four and the Sunshine Five, another portable set described by J. H. Reyner, B.Sc., A.M.I.E.E., in the previous issue of the WIRELESS MAGAZINE.

Chummy Four and Sunshine Five

Briefly the differences between the two receivers are as follows:—

CHUMMY FOUR: (1) Reception limited to 250–600 metre broadcasting band; (2) five controls—frame-tuning condenser, anode-tuning condenser, reaction control, filament rheostat, and on-off switch; (3) 120 volts high-tension available; (4) weighs 30 lb. complete; (5) operating position the same as carrying position; (6) home-constructed loud-speaker; (7) cost, approximately £15.

SUNSHINE FIVE: (1) Reception possible on 250–550 metre and 1,000–2,000 metre bands; (2) three controls—frame-tuning condenser, reaction control, and combined wave-length



Circuit of the Chummy Four, which uses a screened-grid high-frequency amplifier. Note the centre-tapped frame aerial

Enormous Range for a Portable

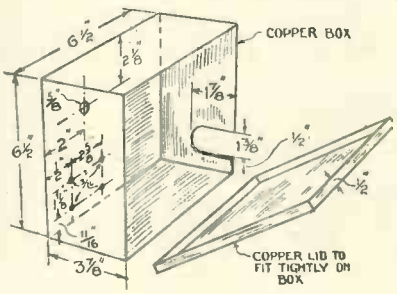
change and on-off switch; (3) 100 volts high tension available; (4) weighs 21 lb. complete; (5) operating position horizontal, carrying position vertical; (6) ready-assembled loud-speaker; (7) cost, approximately £15.

From these comparisons it will be apparent that each set has some special advantages and disadvantages, but the reader will be able to judge for himself which will best suit his particular purpose.

Special Layout

Regarding the layout of the Chummy Four there are several things that should be noticed. The case is very narrow—it measures only 6 in. across—and although it weighs 30 lb. complete, is not difficult to carry because it hangs freely from the hand without fouling the legs; this will be apparent from one of the photographs reproduced in these pages.

However, many people who need only a transportable receiver to move from room to room will find that the Chummy Four adequately meets their needs. In many cases it will give vastly superior results to even a good three-valver with an ordinary aerial. (Once again, the reader is invited to glance at Mr. J. Godchaux Abrahams' test report on page 402!)

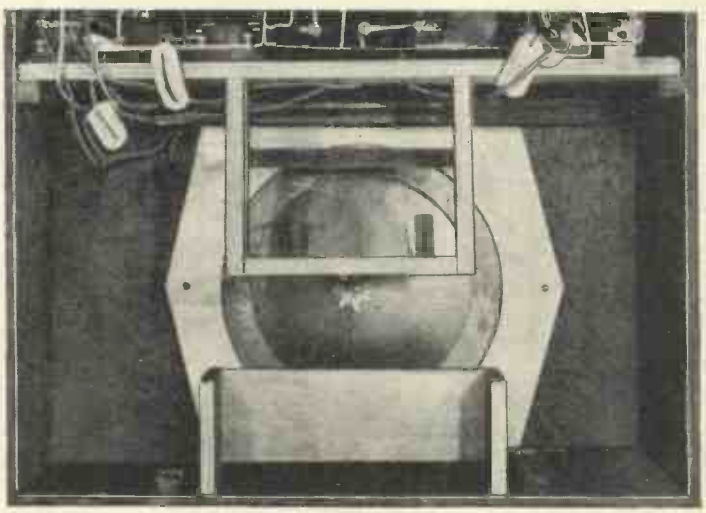


(Left): Details of the screening box for the high-frequency valve in the Chummy Four

Trying out the Chummy Four after a car journey. Vibration does not affect it

Lissen high-tension batteries ensure economical operation; and C.A.V. accumulators with jellied acid obviate any risk of metal parts being corroded by accidental acid spray.

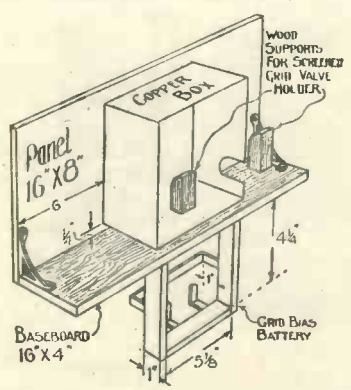
A Goodman loud-speaker unit gives remarkably good reproduction even when a super-power valve is not used in the last stage.



The Chummy Four incorporates a home-constructed cone loud-speaker, which is seen here. In front of it are brackets to hold the grid-bias batteries (top) and accumulators (bottom). A 60-volt high-tension battery is placed in each corner

Alternatives

For these reasons constructors are recommended to follow the WIRELESS MAGAZINE specification. Where alternatives can be used they are mentioned for the convenience of readers, but where no alternatives are indicated it can be taken that no other part would be suitable—not necessarily because it is electrically inferior, but because it probably would not fit.



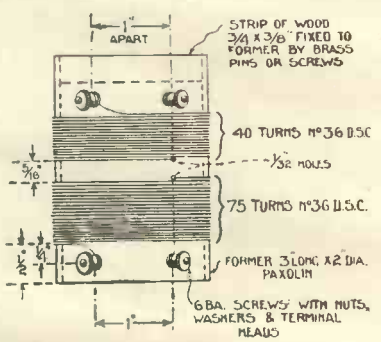
How the receiver is arranged inside

Considerable care has been given to the choice of components for the Chummy Four, and every part used is there for some particular reason.

Special Components

For example, Formo 1928 log condensers are used for their size and general utility; McMichael vernier dials are compact and appreciably add to the ease of operation by virtue of the fine control they give; Loewe vacuum grid leaks and condensers ensure perfect stability.

A Mullard low-frequency transformer gives perfect reproduction without any fear of interaction;



These are details of the anode coil for the screened-grid high-frequency amplifying valve

Anytime, anywhere, the Chummy Four is always ready for action!

The Chummy Four (Continued)

A glance at the photographs will show clearly how the parts are arranged. The cabinet is divided into two compartments. The top part accommodates a standard 16 in. by 8 in. panel, with a 4 in. baseboard, on which the receiver proper is assembled.

In the Lower Compartment

In the lower part are arranged the cone loud-speaker, two 60-volt high-tension batteries, two 9-volt grid-bias batteries, and two 2-volt accumulators. Brackets and fillets are provided so that when the back is screwed on all the batteries are held firmly in position and cannot come loose.

Full-size Blueprint

Before beginning the construction of the set the reader is recommended to obtain a copy of the full-size blueprint that is available. This can be obtained for half-price, that is 9d., post free, if the coupon on page iii of the cover is used by June 30. Address your inquiry to Blueprint Department, WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4, and ask for blueprint No. W.M.80.

Although a full-size blueprint greatly facilitates construction, its use is not, of course, essential, and all the necessary details are reproduced in these pages.

The first step to be taken in the actual construction is, of course, the drilling of the front panel. This can be done directly from the full-size blueprint or by marking out from the layout reproduced in these pages. Fix the panel to the baseboard by means of brackets.

It will be found that the left-hand bracket, looking from the back, must

TEST REPORT ON THE CHUMMY FOUR

WHEN the Editor of the WIRELESS MAGAZINE *asked me to test out a new portable set recently thought out and constructed by the Technical Staff, I looked askance at the comparatively simple model placed before me.*

For many months I have been seeking a portable multi-valve receiver of good selectivity, which will do more than pull in on the loud-speaker two or three transmissions at a spot within one mile *of the 2LO aerial!*

I have tried sundry portables for which great claims were made, but the test at my house has proved too severe for them. Perhaps on the top of Ben Nevis I might have logged thirty transmissions—possibly—but I do not happen to live on Ben Nevis. So I took this particular set home.

I plumped it down on a table, opened the lid, and idly twiddled the condensers. Result: 2LO, at shattering strength. But, when I found that by a movement of less than three degrees I could cut out this transmission, believe me, I sat up and took notice.

During the early part of the evening, Cologne, Hamburg, Frankfurt, Stuttgart, Langenberg, and Radio Toulouse followed each other in quick succession; tuning the receiver proved as simple as handling a super-het. The quality of the reproduction was all that could be desired; considerable help was given by the remarkably smooth reaction the circuit possessed, and the volume of sound was easily controlled by the rheostat provided for the high-frequency valve.

"Now this," said I to my companion, "is the set for which I've been looking for months," and he agreed.

I gave the receiver a severe test; a portable must be portable *and it must be capable of suffering rough usage; it cannot be carried as a baby in arms.*

We placed it in the back of a small saloon car, and set out for Beacon Hill, in Hertfordshire. A part of the run is on poor, loose roads, and the receiver was bumped and rattled somewhat badly. But it turned up smiling at the end, although I felt sure that at least one of the valves would break, I could hear it knocking against a condenser.

Out in the open, much to the surprise of many onlookers, two British and four foreign stations were picked up within a few minutes. Whilst the car was running the set was also tried, and worked well. That same evening (Sunday, April 29), on my return home, I devoted four hours to a tour with the Chummy Four and append the loggings of the transmissions picked up at full loud-speaker strength. With the exception of one, as stated in table, each station was actually identified by its call.

In my opinion, it is one of the best receivers produced by the "W.M." Staff. Not only is it portable, but the results obtained with it surpass in many ways those one may expect from fixed multi-valve receivers for which, as every reader knows, an elaborate aerial and earth system has to be installed.

If I cannot borrow this set from the WIRELESS MAGAZINE *I shall feel inclined to steal it!*

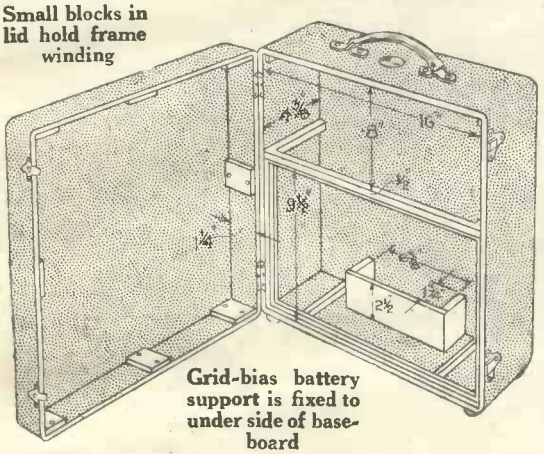
J. GODCHAUX ABRAHAMS.

Wave-length in metres	Station	Dial No. 1	Dial No. 2	Reaction
236.2	Stettin	36	15	40
241.9	Nuremberg	43	19	38
250	Muenster	45	23	40
279	Lille	59	32	50
283	Cologne	62	40	42
297	Hanover	73	46	50
319	Dublin	81	57	42
322.6	Breslau	85	61	49
337	Copenhagen	90	65	55
340	*Frenchman (Petit Parisien?)	92	65	55
364	London (2LO)	101	71	No.R
365	Leipzig	104	76	40
379	Stuttgart	107	81	36
389	Toulouse	112	85	36
396	Hamburg	114	89	59
428	Frankfurt	123	98	54
468	Langenberg	138	112	58
491	Daventry (5GB)	142	118	20
535.7	Munich	150	124	66
549.3	Milan	155	130	50
555.6	Buda-Pesth	160	135	60

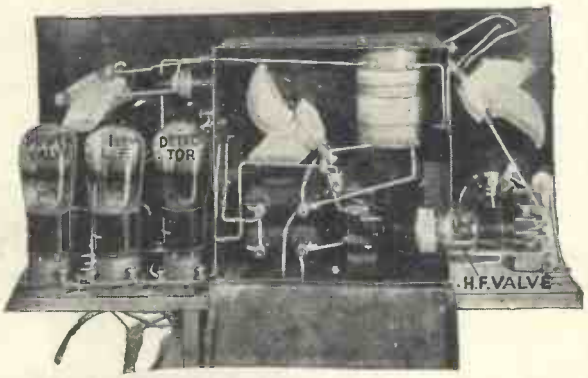
(Tested on April 29, 1928). * This station could not be identified; for thirty minutes it broadcast election results, but gave no call!

[As well as these stations, a member of the "W.M." Staff has also received two Spanish stations, one identified as Madrid and the other believed to be San Sebastian.—Ed.]

Small blocks in lid hold frame winding



Grid-bias battery support is fixed to under side of baseboard



(Above).—View of back of Chummy Four receiver. The lid of the metal screening box has been removed (Left).—Details of the cabinet

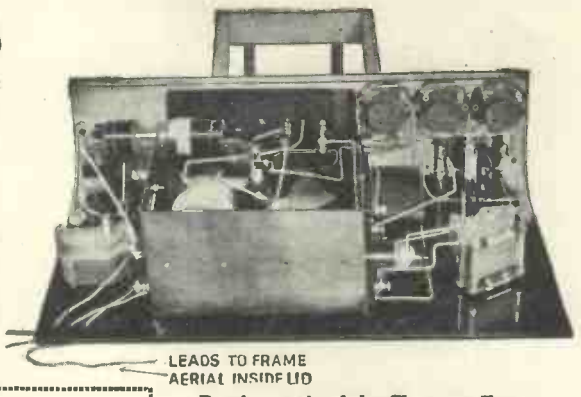
Complete Installation for £15

be cut away slightly to accommodate the holder for the last valve.

Metal Screening Box

Next, prepare the metal screening box; this can be obtained ready assembled the correct size or, alternatively, a standard box can be cut down with a pair of shears. Drill all by the constructor from the diagram reproduced in these pages.

Next, screw to the bottom of the metal box the wooden block on which is mounted one half of the screened-grid valve holder. Directly underneath this block, between the baseboard and the bottom of the box, is placed another ebonite washer, the block being held in position by a 1½-in. screw inserted from the underside of the baseboard.

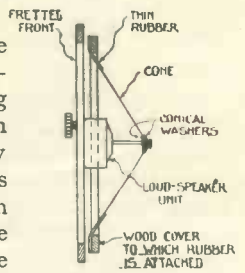


Receiver unit of the Chummy Four photographed from top of panel

COMPONENTS REQUIRED

1—Ebonite panel, 16 in. by 8 in. (Resiston, Becol, or Raymond).
1—Metal screening box with lid (Magnum or Formo).
2—.0005-microfarad variable condensers (Formo 1928 Log).
2—Vernier dials (McMichael).
1—.0002-microfarad variable condenser with small dial (Cyldon).
1—7-ohm panel rheostat (Lissen, Igranic, or Peerless).
1—Screened-grid valve-holder (Burndept).
2—2-microfarad fixed condensers (Lissen, Dubilier, or T.C.C.).
1—Anode coil as specification (Burne-Jones).
1—High-frequency choke (Omnora, Wearite, or Igranic).
1—Low-frequency transformer, ratio 4 to 1 (Mullard).
3—Anti-microphonic valve-holders (Redferns).
1—On-off switch (Bulgin Midget, Lotus, or Lissen).
1—Pair small panel brackets (Magnum, Camco, or Bulgin).
2—2-megohm grid leaks with clips (Loewe).
1—.005-microfarad fixed condenser with clips (Loewe).
1—.0003-microfarad fixed condenser with clips (Loewe).
1—.25-megohm grid leak with clips (Loewe).
1—Ebonite strip, 2½ in. by 1¾ in. (Resiston, Becol, or Ready-Radio).
2—Ebonite washers, ⅜ in. bore and ¼ in. thick (Ready Radio).
6—Lengths Glazite.
3—yards thin rubber-covered flex (Lewcos).
2—60-volt high-tension batteries (Lissen).
2—9-volt grid-bias batteries (Lissen).
2—2-volt accumulators (C.A.V. type 2NS9 with jellied acid).
1—Loud-speaker unit (Goodman double acting).
1—Piece gold-finished cone paper (Goodman).
1—Piece rubber sheet, 1 ft. square (any sixpenny stores).
10—Wander plugs, 6 red and 4 black (Igranic).
10—Indicating tabs for flexible wire, marked: two H.T. +, one H.T. —, two G.B. —, one G.B. +, one L.T. +, one L.T. —, one L.S. +, one L.S. — (Bulgin).
1—Cabinet with baseboard, battery brackets, loud-speaker front and back (Ready-Radio).
2—Ozs. No. 28-gauge d.s.c. wire for frame aerial (Lewcos).
8—Ebonite strips, 1½ in. by 1 in. (Ready Radio).
12—6BA 1 in. round-head screws with nuts (Bulgin or Ready-Radio).
36—½ in. No. 3 brass wood screws (Bulgin or Ready Radio).
2—1½ in. brass wood screws (Bulgin or Ready-Radio).
3—Dial indicators (Bulgin).
1—Station log, small (Bulgin).

At this stage the two 2-microfarad blocking condensers can be mounted by means of bolts passing through the ebonite panel and the front of the screening box. All these parts can be clearly seen in the photographs of the back of the set.



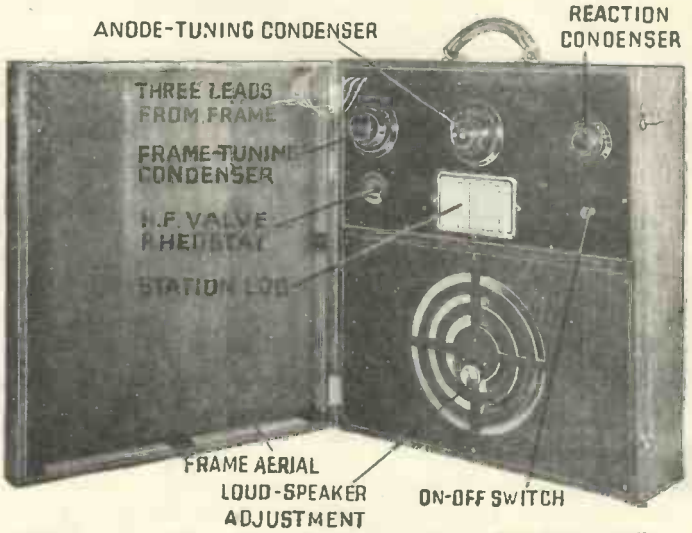
Arrangement of loud-speaker

Attention should now be turned to that portion of the receiver to the right of the screening box (looking from the back). Here mount the frame-tuning condenser and filament rheostat on the panel, and the other half of the screened-grid valve holder on a wooden block on the baseboard.

The necessary holes in the box to accommodate bolts, wires, etc., as shown by the diagram.

The box is held close to the panel by means of the anode-tuning condenser, an ebonite washer being placed between the condenser and the inside of the box. When the box has been clamped firmly, screw the anode coil to the top.

This anode coil can be bought quite cheaply already wound or can easily be built up



This photograph clearly shows the various controls of the Chummy Four

Other Valves

To the left of the screening box (on the panel) are the reaction condenser and the on-off switch, while on the baseboard are the holders for the detector and two low-frequency amplifying valves.

Between the valve holders, right at the back edge of the baseboard, and the panel is an ebonite strip

The Chummy Four (Continued)

A welcome addition to the tea party —the Chummy Four quickly makes friends !

carrying the two resistances and condenser that comprise the resistance-coupling unit. The clips are supplied by the Loewe people and can be mounted on the ebonite strip as shown by the constructor.

On the Box

These are not quite all the components, however, as the high-frequency choke and the low-frequency transformer are mounted on the left-hand side of the screening box, as will be seen from the photographs.

It is essential to keep the valve holders as close to the back edge of the baseboard as possible, otherwise the valves will foul the transformer and reaction condenser when the set is transported.

A further point to observe is that holes must be drilled through the baseboard so that flexible battery leads can be passed through.

Wiring up the Chummy Four

As soon as all the parts have been firmly secured wiring up can be started. This operation will be very greatly facilitated by reference to the full-size blueprint. A blueprint is not absolutely essential, of course, although a great convenience, and a wiring diagram is reproduced in these pages.

On both the blueprint and the wiring diagram each terminal point is marked with a small letter; these letters indicate which points should be connected together and *in what order*.

For example, first connect together all those points marked *a* with one wire or as few wires as possible; then connect all the points marked *b*; and so on through the alphabet, observing the proper alphabetical sequence. It is important to keep the wires as far separated as is possible in order to avoid stray capacity effects.

It will be observed that the clips for the coupling condenser between the anode and the screened-grid valve and the grid of the detector are held in position merely by the wiring. This condenser (which looks like a grid leak) is almost exactly in the centre of the screening box.

For extra rigidity a small elastic band should be placed round the clips to pull them towards each other.

Leads of about a foot in length (of thin rubber-covered flex) should be provided for connection to the batteries in the lower half of the cabinet. It is advisable to place indicating tags on these leads when the set is first wired up before being placed in the cabinet.

Do not forget also to provide three fairly short flexible leads for the connections to the frame aerial in the lid; a centre-tapped frame is used.

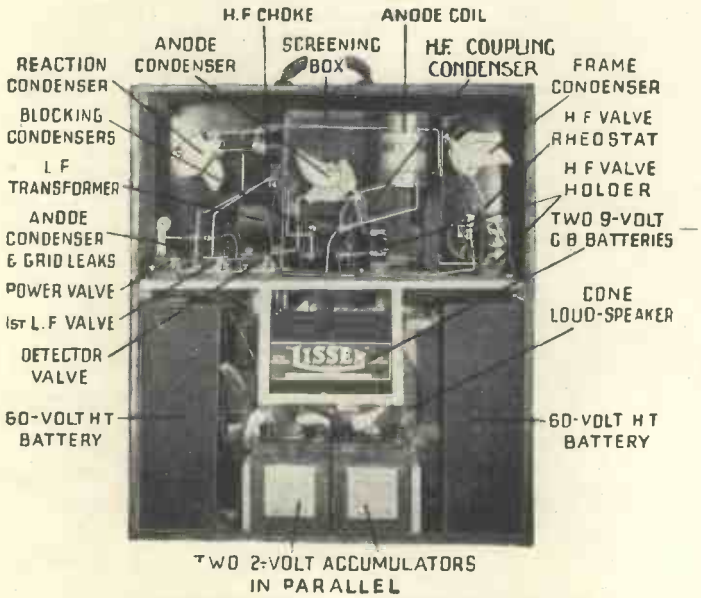
Before leaving the receiver, place the two vernier dials in position (see that they are not too close to the panel or tuning will not be smooth). A small plain dial is needed for the reaction condenser.

Pointers for Condenser Dials

Three dial pointers are, of course, required. These can be of metal or three small cuts in the panel can be filled with Chinese white.

Next tackle the construction of the loud-speaker. This is not at all difficult as no special supports are required for the unit, which is fixed directly on the front of the cabinet, inside.

The cabinet is supplied with a "back" piece (see sketch reproduced in these pages) over which should be stretched and stuck a sheet of thin rubber.

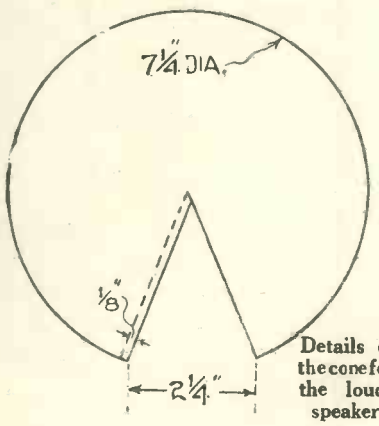


The arrangement of all the parts in the Chummy Four is clear from this photograph

Forming the Cone

Next form the cone, the dimensions of which are also indicated in a separate diagram. As soon as the overlapping edges are firmly stuck together cut a hole in rubber about two inches less in diameter than that of the cone when completed.

Now take the cone and attach it



Details of the cone for the loud-speaker

Has Received Twenty-three Stations!

to the reed rod of the loud-speaker unit by means of the nuts and conical washers supplied. After this the "back" piece of wood with the rubber attached should be placed over the cone so that the apex projects through it and the rubber overlaps the wide part of the cone by about an inch all round and forms a more or less airtight joint.

Leaving an Air Gap

The "back" piece should not be screwed tightly to the front of the cabinet, but should be about ¼ in. from it. It is, of course, held back by the tension of the rubber. Through this ¼ in. air space should be passed the cord from the loud-speaker unit; it should be cut down to a reasonable dimension.

The receiver is now nearing completion, but there is still the frame aerial to wind. This is not difficult if undertaken with reasonable patience.

It will be seen from the diagrams that the wires are held in position by eight small blocks of ebonite, one placed in each corner and one in the centre of each side. The block in the right-hand top corner is provided with three small bolts.

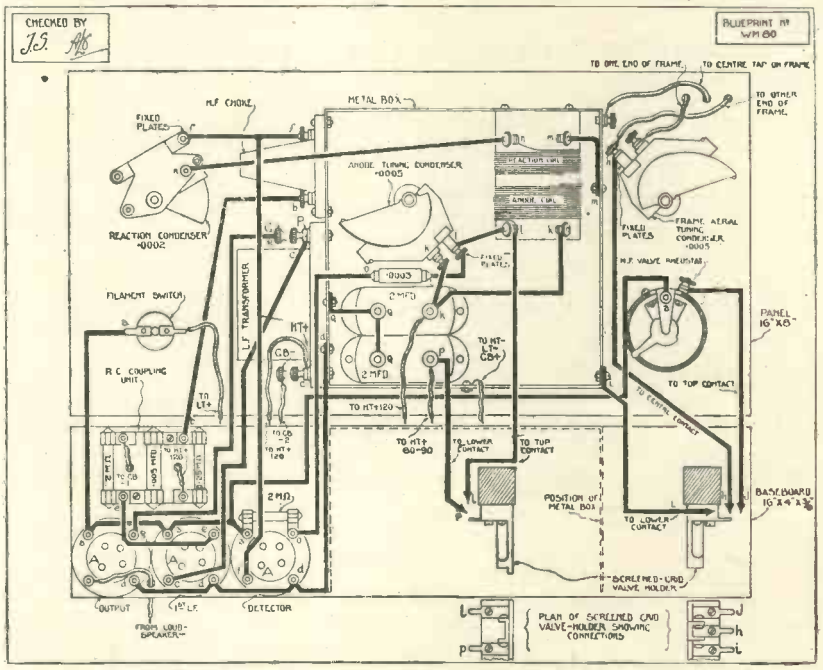
How to Wind the Aerial

Two holes are provided in each block for the fixing screws and these holes are located one at each end. First screw all the four corner blocks in position by one screw only, this going through the hole in the block nearest the actual lid.

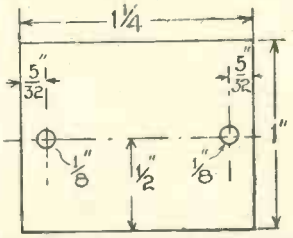
Starting at the inside bolt on the block at the right-hand top corner, wind on seven turns of wire and then take a connection to the centre terminal on the block in the same corner, continue the winding for another seven turns and finish off at the outside of the three bolts.

Insert the four outside screws in the corner blocks and then screw the remaining blocks in position, spreading out the wires so that they are evenly spaced.

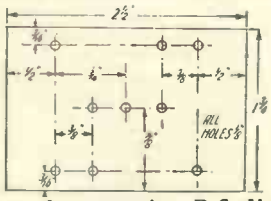
Now the actual construction is completed and the parts can be assembled. First place the panel and baseboard in the top half of the cabinet and screw it in position by means of two screws passed through the baseboard into the batten on which it rests. Then screw the fretted front holding the loud-speaker, in position.



This layout and wiring diagram of the Chummy Four can be obtained as a full-size blueprint for half-price, that is, 9d. post free, if the coupon on page iii of the cover is used by June 30. Ask for No. W.M. 80



Details of block for fixing frame-aerial winding (eight of these are needed)



Strip for mounting R.C. Unit

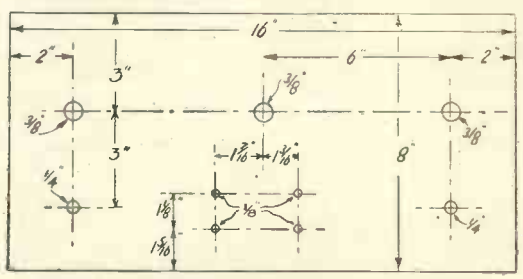
Connecting Up the Batteries

Connect up the batteries before they are placed in the lower part of the box. Indeed, many amateurs may prefer to carry out a rough test to adjust the various voltage tappings before the batteries are placed in position.

However, the two 9-volt grid-bias batteries are held in the bracket immediately underneath the baseboard, while a 60-volt high-tension battery is placed in each corner, on the bottom of the cabinet. The two 2-volt accumulators are placed at the bottom of the cabinet directly behind the cone loud-speaker.

Choice of Suitable Valves

Before discussing battery voltages it will be desirable to discuss valves. Only one make of 2-volt screened-grid high-frequency valve is **at**



Layout of the front panel of the Chummy Four, not needed if a blueprint is used

The Chummy Four (Continued)

VALVES TO USE IN THE CHUMMY FOUR

Make.	H.F. Amplifier.	Detector.	1st. L.F. Amplifier.	2nd. L.F. Amplifier.
B.T.H.	—	—	B210L	B215P
Cosmos	—	SP18B	SP18R	SP18RR
Cossor	S5210	210RC	210LF	220P
Ediswan ...	—	—	GP2	PV2
Marconi ...	—	DEH210	HL210	DEP215
Mullard	—	PM1A	PM1LF	PM2
Osram	—	DEH210	HL210	DEP215
Six-Sixty ...	—	SS210RC	SS210LF	SS215P

present on the market and that is the Cossor. There is no doubt that the astonishingly good results obtained with the Chummy Four are almost entirely due to the efficiency of this valve.

Remaining Valves

As regards the other valves, there is a large choice. For the detector, first and second low-frequency amplifiers, the following combinations have proved very successful: (1) Marconi or Osram DEH210, HL210 and DEP215; (2) Mullard PM1A, PM1LF and PM2. Other combinations are given in detail in the table reproduced on this page.

If an anode resistance of 250,000 ohms is used (the normal value) a valve with an impedance of 70,000 to 80,000 ohms should be used as detector; the impedance should not exceed the last value.

Impedance of Detector Valve

The rule is that the valve impedance should be one-third that of the anode resistance, so that if a 500,000-ohm resistance is used a valve with an impedance of the order of 170,000 ohms will be suitable—such a valve as the B.T.H. B8 or Ediswan 210R.C.

The first low-frequency amplifier should have an impedance round about 20,000 ohms. The new Marconi or Osram HL210 is especially good, and in spite of the high amplification factor the Mullard transformer is so efficient that the quality does not suffer; this valve has an impedance of 25,000 ohms and an amplification of 15.

A super-power valve is not essential for the last stage as the Goodman loud-speaker unit gives remarkable quality with a valve of relatively high impedance. Excellent results have been obtained with an Ediswan PV2 (6,700 ohms).

The advantage of using such a valve is that quite an appreciable amount of low-tension current is saved. A Mullard PM252 gives slightly mellower reproduction, but on the other hand it consumes .3 ampere as compared with .15 ampere for the PV2. This is a matter for the constructor to decide for himself.

High-tension Voltages

Now as regards voltages, the full 120 volts of both high-tension batteries is normally applied to all the anodes. Actually a voltage of 80 is sufficient for the screening grid of the high-frequency valve, but it is impossible to obtain this value when Lissen batteries are used.

These batteries are not tapped for the first 30 volts and, therefore, when two are wired in series it is impossible to take a tapping between 60 and 90 volts. In all our tests of the Chummy Four we applied 90 volts to the screening grid; this value is not too high when 120 volts is applied to the anode.

Proof of the Pudding . . . .!

If the valve had not been operating efficiently it would not have been possible to get to twenty-three stations on the set!

Therefore, take the H.T.+ lead for the anodes to the 60-volt tap on the second battery and the H.T.+ lead for the screening grid to the 30-volt tap on the same battery.

To G.B.—1 apply 3 to 4½ volts negative and 9 to 12 volts to G.B.—2. In fact, put as much grid bias as possible on both low-frequency amplifiers as this decreases the high-tension consumption.

Forty Hours L.T. Running

With the two accumulators in parallel the actual capacity available is 22 ampere hours, so assuming a consumption of .45 ampere for all four valves approximately 40 hours

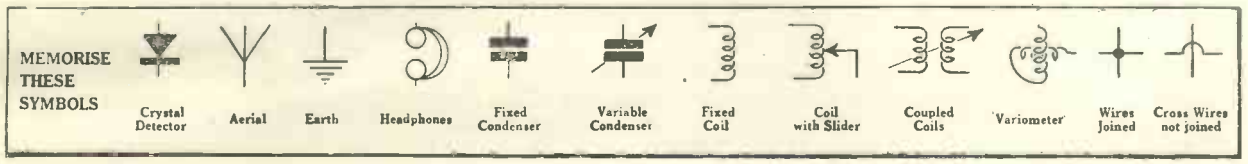
(*Continued on page* 474)

WHAT STATION WAS THAT?

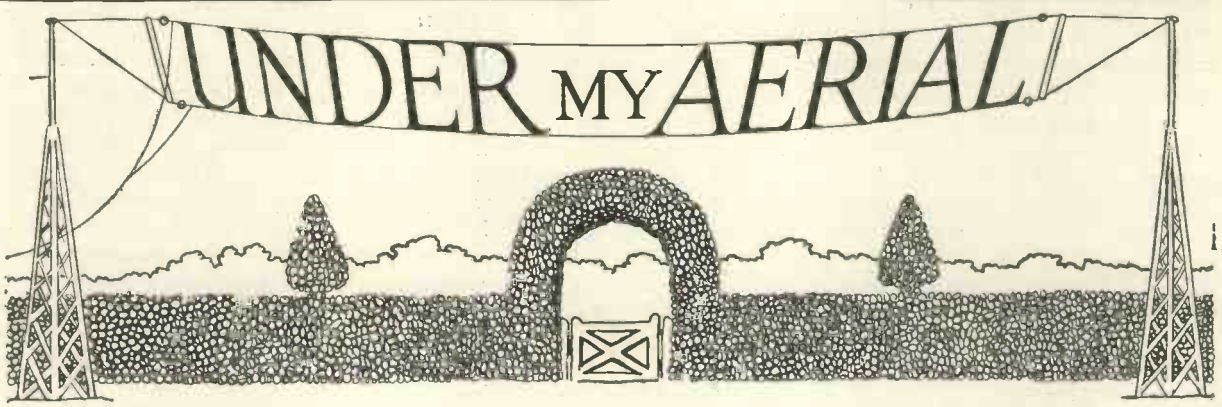
The Editor of the "Wireless Magazine" has made arrangements to assist readers who are in difficulty over the identification of broadcasting stations they receive.

Each query should give as many particulars as possible (such as time, date, wavelength, language, and distinctive call or signal) and should be accompanied by the coupon on page iii of the cover and a fee of one shilling (postal order or stamps).

Address each query to "Station Identification," "Wireless Magazine," 58/61 Fetter Lane, London, E.C.4.



HALYARD'S Chat on the Month's Topics ***Sketches by GLOSSOP***



Your Holiday

HAVE you given any thought to your summer holiday yet? It is about time you began to think about it, isn't it?

When you are planning your summer

Your Holiday

holiday this year, where to go, when to go, and what to take with you when you do go, it would not be a bad idea if you let wireless come within the purview of your deliberations, now would it? A wireless "busman's holiday" is not at all a bad holiday, you know.

I should think that one of the best ideas with regard to wireless and your holiday would be for you to try to get somewhere where wireless conditions are totally different from the wireless conditions you are used to at home.

Thus, if you happen to live very near to a broadcasting station, you might try to spend your holiday at a place which is at least fifty miles from the nearest broadcasting station. Similarly, if you live a long way from your nearest broadcasting station, you would enjoy grappling with the problems which come from living under the shadow of a broadcasting station.

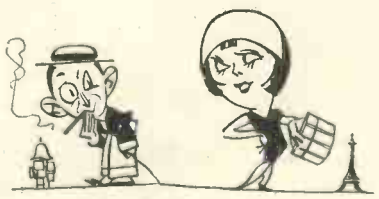
No matter where you go for your holiday, I think you ought to take a wireless set with you, even if it is only a simple crystal set. Wireless is great fun on a holiday especially if you have a portable set with you and can get about a good deal. You could have quite a lot of fun with the Chummy Four which is described on another page of this issue.

◆ ◆ ◆

Wireless in France

I have just returned from a visit to Paris and I am conscious of a feeling of disappointment over the apparently slow rate of progress of wireless in France.

You can form a good idea as to the state of wireless in a country from the number of aerials to be seen as you travel through that country. During the railway journey from Boulogne to Paris I kept a constant



Wireless in France

look-out for aerials and I was really surprised at the small number I could see from the train. In comparison, between London and Folkestone there seemed to be aerials everywhere.

Paris is hardly a great place for wireless shops. There were certainly wireless shops here and there, but these wireless shops were mostly on the small side. In the majority of cases, wireless was evidently a side line of an entirely different kind of business.

You can well imagine that, when I did run up against a wireless shop in Paris, I took a jolly good long look at it and reckoned it up pretty thoroughly. You can also imagine that I did a considerable amount of mental arithmetic converting francs to pounds, shillings, and pence in my efforts to compare wireless prices in Paris with those in London.

On the whole, I came to the conclusion that wireless goods were cheaper in Paris than in London at the present rate of exchange.

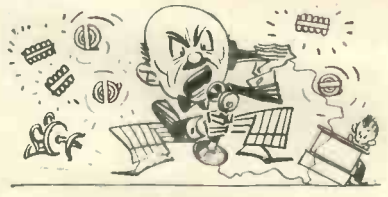
◆ ◆ ◆

Novelties

The display of wireless goods which interested me most in Paris was one which I happened to see in a window of a large store. I spent a long time looking at this window and making notes on what I could see.

Efficient-looking glass insulators were the first novelty to attract my attention. I was not surprised to see these glass insulators since the insulators on the telephone poles in France are of glass and not of porcelain, as in England.

There was a type of aerial which was new to me, a ribbon aerial an inch wide, the ribbon not being made of copper strip but of fine wire gauze, the wire being enamelled copper. I



The Display

wondered if this ribbon gauze aerial would flutter about in a breeze in the same curious way that copper strip used to do. This type of aerial,

You Must Not Overlook the Chummy Four on Page 399!

Under My Aerial *(Continued)*

though, might have been intended solely for indoor use.

The accumulators to be seen in this window were labelled *fer nickel accumulateurs*. There were several small and extremely neat crystal sets of familiar design and there was what was claimed to be the world's smallest valve receiver.

I took particular note of several loud-speakers of unusual design. One such loud-speaker had a pleated-paper diaphragm shaped in the form of a nasturtium leaf, the reed attachment being in the same eccentric position as the stalk of the leaf. Another loud-speaker I rather liked the look of was one which had a cone made of some transparent substance resembling mica.

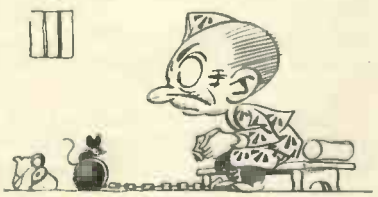
Altogether, I had a most interesting time in front of that particular window of wireless goods.

◆ ◆ ◆

Wireless Students

During my recent stay in Paris, I had several meals at the *Cafe de l'Entr' aidé* (I hope the spelling is somewhere near it) in the Latin Quarter. At this café the waiters are university students who earn their own meals by waiting on others and, in that way, reduce their cost of living while they are at the university.

I was very interested in these



During My Recent Stay

waiter students, particularly so because other university students in this same Latin Quarter of Paris help to support themselves while at the university by making and selling wireless sets in their spare time.

Indeed, so important has this spare-time work become amongst these "wireless" students that a number of them have recently formed themselves into a company for the manufacture and sale of wireless equipment. The idea behind the formation of this company is that, by combining together, the spare-time wireless work of these students can be more or less standardised and made much more profitable.

If you were a university student in Paris and you had to help to support yourself by earning money in your spare time, don't you think you would prefer to turn your hand to wireless rather than to anything else?

I am certain that I, for one, should do far less damage with a soldering bit than with a pile of soup plates.

◆ ◆ ◆

Howling Epidemics

A couple of nights ago there occurred in my district one of those unusual and puzzling outbursts of howling which seem to suggest that the whole wireless population has suddenly gone mad. Luckily an explanation was forthcoming and I, for one, was not unduly perturbed. A similar explanation, I am sure, might be given of similar howling epidemics in other districts.

Early on that evening I had called to see a wireless neighbour of mine, and I was reminded that one of the best singers in our district was singing from our nearest broadcasting station. I had forgotten about this, and I was glad to be reminded.

Accordingly, I hurried home, switched on my set and tuned in the station from which our local singer was singing. I happened to strike a silent interval just before the first song and the howling was absolutely the worst I have heard for years. Even when the singer was singing the howling continued and reception in this district must have been pretty awful. Probably the whole wireless population for miles round was making frantic efforts to hear the local celebrity, hence the howling.

I began to reason the thing out and I came to the conclusion that, the more popular a particular item

Howling Epidemics

in the programme from the local station, the greater the number of listeners who would tune in that station and the greater the howling.

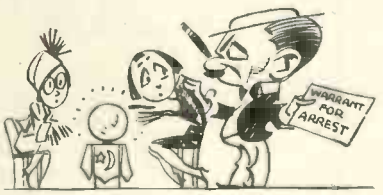
The Crystal Again

According to an American writer, wireless enthusiasts everywhere are coming back to the use of the old-fashioned crystal as a detector. When used in conjunction with up-to-date high-frequency amplification, says this same writer, the crystal delivers an output of extraordinary quality.

What do you think of the crystal as a detector? Do you uphold this "crystal purity" theory?

Personally, I am inclined to think that the crystal is a little over-rated sometimes as a detector in comparison with our modern valves. There is no doubt about the quality given by a crystal detector, but the crystal can be a very troublesome little thing when used as a detector in a multi-valve set.

The writer referred to above describes a receiver in which he uses three high-frequency amplifying



The Crystal Again

valves, a crystal detector and three low-frequency amplifying valves, the crystal being our old and well-tried friend, carborundum. There is no doubt that excellent results should be obtained from such a receiver.

If there does happen to be a revival over here in the use of the crystal as a detector, I shall be perfectly happy about it, for I must have at least a dozen crystal detectors put away somewhere on the shelves of my wireless store-room.

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Aerials

You know that I have a great weakness for aerials, and that, wherever I go, I take careful note of the aerials I happen to see. This weakness did not desert me during my holiday in France. On the contrary, I filled four or five pages of my notebook with aerial notes and sketches.

From the aerials I saw in France, I came to the conclusion that the single-wire aerial is not so popular

Halyard's Chat on the Month's Topics

I have a Great Weakness

in that country as it is in England. Twin-wire aerials and multiple-wire aerials formed the greater proportion of the aerials I saw in France.

I did see an occasional single-wire aerial, though, and I was most interested when I visited a large school, where wireless is studied as part of the work in science, to see that the three aerials there were all of the single-wire type.

One variety of twin-wire aerial I saw in Paris puzzled me considerably. Instead of the two wires running alongside each other at the same height above the ground, one of the wires ran directly above and parallel to the other wire. The two wires were thus in a vertical plane and they were separated from each other by a vertical distance of two feet or so. The down lead came from the upper wire to the lower wire and thence to the lead-in through a window frame.

I saw this type of aerial on several occasions and, in each case, the aerial was supported on two vertical rods fixed to the front of a building in such a way that the two aerial wires were just above the lower edge of the roof, but were not as high as the ridge of the roof.

Probably, because of its height above the ground, this type of aerial was more efficient than one would expect it to be from its shape.

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Sky Shouting

"You remember that sky writing done in smoke from an aeroplane some years ago, don't you, George?" I said to my one and only wireless consultant the other evening.

"Very well, indeed," replied George. "It used to amuse me vastly to see the fellow go back a couple of miles to dot his i's."

"That sky-writing sensation of days gone by, George, has now its counterpart in America in a sky shouting scheme."

"Which brings about thunderous applause, I suppose."

"Listen, George. This sky voice from an aeroplane was so loud that it made itself heard above the roar of the aeroplane engine, the roar of street traffic and all other ground noises. In fact, a whole city was made to stop and listen."

"How exciting! I suppose the typist stopped in the middle of a dash word, the barber paused in the middle of a stroke, the——"

"That will do, George. So powerful was the loud-speaker equipment on the aeroplane that the voice could be heard up to a distance of five miles from the machine."

"You mean down to a distance of five miles, as the crow drops. Any casualties?"

"None reported, George. The microphone was placed in a sound-proof cabin on the aeroplane. Valve

You Remember . . .

amplifiers were used and the amplified sounds were sent out through three loud-speakers built into the aeroplane in such a way that their horns pointed downwards towards the earth. I wonder what kind of valve amplifiers were used to obtain such tremendous amplification?"

"High-freakquency amplifiers, I should imagine."

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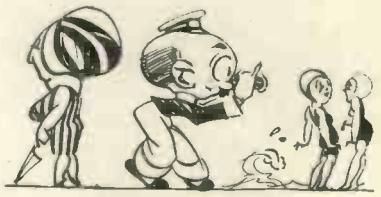
Broadcasting Parliament

What are your views on the question of the broadcasting of Parliamentary debates? Would you



What are Your Views?

be in the least degree excited at the possibility of parts of the proceedings of the Houses of Parliament being broadcast to you?

For the present, of course, there is little likelihood of such a wireless innovation in our country. The Prime Minister has stated very definitely that there is a preponderating body of opinion against broadcasting the proceedings of the House.

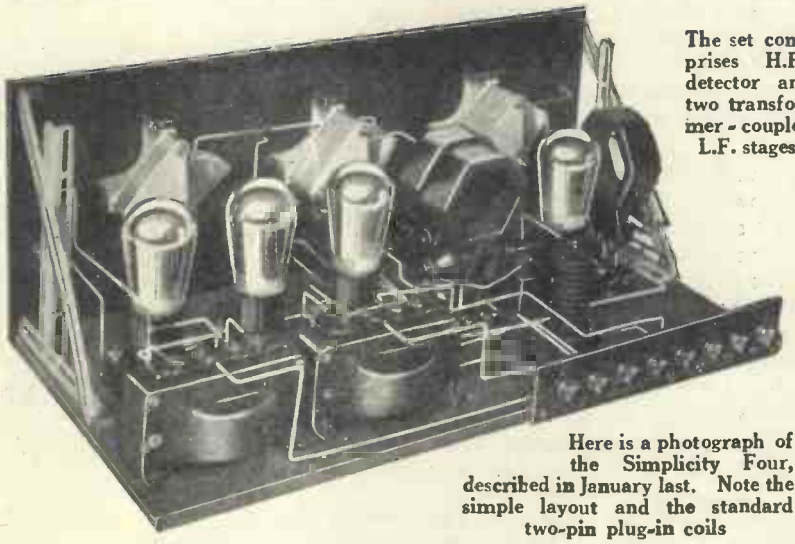
Should the broadcasting of Parliament ever be permitted, I can foresee some very pretty problems for the programme builder over the matter of time. If a definite day and hour were fixed upon at random some weeks in advance, listeners might hear some very dull speeches on a very dull subject.

Things happen in the House somewhat spasmodically. There are times when a speaker, with suddenly awakened powers of rhetoric, will captivate the whole House. Such a speaker at such a time would obviously captivate wireless listeners throughout the whole country.

The only way in which listeners could have the undoubtedly great pleasure of listening to the best speeches in the Houses of Parliament would be by having B.B.C. officials in constant attendance at the House and ready to switch over at a moment's notice. Such a plan, however, would scarcely commend itself to the programme builder any more than it would to the broadcast artiste whose turn was suddenly cancelled.

HALYARD.

Reader's Successes with "W.M." Sets



The set comprises H.F., detector and two transformer-coupled L.F. stages

Here is a photograph of the Simplicity Four, described in January last. Note the simple layout and the standard two-pin plug-in coils

These unsolicited testimonials from readers are certain proof that the claims we make for our receivers are justified in practice. The letters reproduced here are, of course, only a selection of what we receive. If you have built a "W.M." set let us hear your opinion of it!

EXHIBITION FIVE

BELOW is a most interesting report on the Exhibition Five (WIRELESS MAGAZINE, *October*, 1927), *a replica of which is now in use by the captain of a tank steamer. He was on a voyage from Liverpool to the Gulf of Mexico at the time of writing this letter to a friend who built the set for him*:

I know you will be very keen to have this letter and know how the set has turned out and I am very pleased to tell you it is splendid. I coupled it up when I got away and immediately got splendid results and have had no hitch whatever.

I kept Daventry every night regularly on the loud-speaker to the distance of 2,600 miles easily, and then, after that static began to assert itself and, although I could still get the station and hear the Savoy bands every night, there was no pleasure in it, as the more I tuned it the more noisy became the static. Even up to last night (and we were then at Abaco, which is 3,800 miles) I could still hear Daventry quite well.

Will easily do 2,600 miles on the Loud-speaker!

I can safely say that under *ordinary* conditions the set will easily do 2,600 miles on the loud-speaker and the listener would be able to follow speech, etc., but after that distance there is always the static to contend with, even during the finest of weather.

The reason I am able to fix these distances is that I picked up quite a lot of U.S. stations immediately after leaving home (Liverpool) and found that they also began to come in at about the same range of 2,600 miles.

Fading has not bothered me much, providing the set is properly tuned, although I find it is a little difficult to tune, as there appears to be no set rule as to the position of the three variable condensers with reference to each other. Sometimes best results are obtained with the first dial reading considerably lower than other two, and at other times the reverse applies, although always I notice the number two and three condensers read approximately the same.

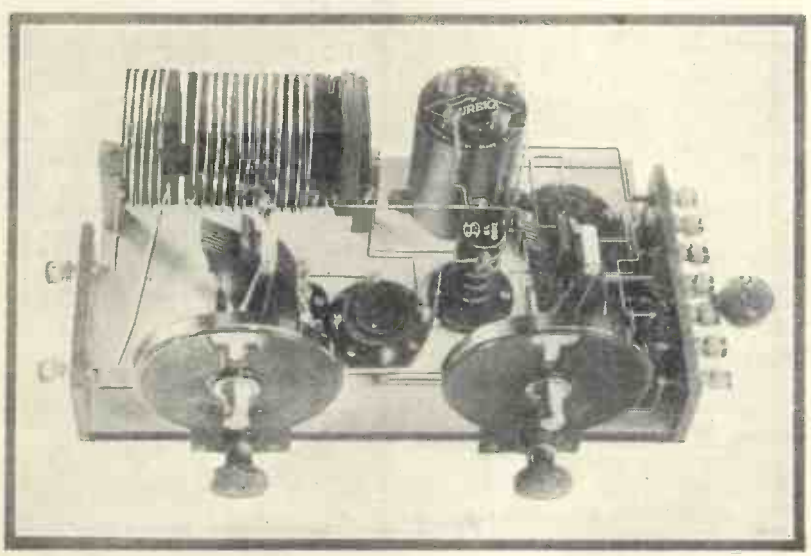
I might say I have never bothered to use phones although I am sorry you did not make it possible for me to have less than five valves in use *all the time*. Frequently a cut down in valves would be of the greatest assistance in heavy static, and to have to bring all five valves into use always is rather a handicap. Even if the last two valves were on a rheostat it would help as several of these large American stations are very powerful and with the enormous number of them "on the air" it would make tuning easier, I imagine, if the valves were controllable.

I got far more satisfaction and better results when I was 1,800 to 2,000 miles from the U.S. stations than I do when I am 600-800 miles distant and find that the closer I am the more howling I get and the more difficult it is to tune a station perfectly. KDKA I simply cannot clear of an incessant howl now that I am 800—900 miles away and yet at 2,000 I was getting him perfectly.

No Re-radiation

Everybody here is amazed at the results I get and I take quite a pleasure in tuning it in "full blast" once in a while just to let them see what it can do. . . . You have certainly turned out a set far beyond my expectations.

One thing I have overlooked and that is, it doesn't re-act on other people's aerials. My aerial runs parallel about ten feet by the ship's, and the operator tells me it has never interfered with him yet, but the Chief Engineer has a three-valve set which plays up hell with both of us once he starts his knob-twisting every night. . . . I must say I have a set which satisfies me.



The Girdle Two, a free blueprint of which was given with the September, 1927, issue Back numbers are 1s. 3d. each, post free

SIMPLICITY FOUR

Published in answer to many requests for an efficient and up-to-date four-valver using ordinary two-pin plug-in coils the Simplicity Four (WIRELESS MAGAZINE, *January*, 1928) *is an excellent receiver for general use, as can be gathered by this letter from a Burnley radio engineer* :

I have not seen any remarks from your readers regarding the above receiver, so I hasten to remedy this by saying that I have built this fine and simple four-valver.

You will notice from my letter heading that I am in the trade, and it speaks well for the set to say that I have used it for demonstration the last two months with success. Daventry, 5XX, is loud enough for this purpose with the reaction coil withdrawn, and this is exceptionally useful in avoiding tramway interference, which is a great trouble here. 2ZY, the local, is usually the same strength.

When the tramways are quiet I can put in a reaction coil and tune in upwards of fifteen stations on the loud-speaker, including the following: 5GB, Langenberg, Frankfort, Berne, Hamburg, London, Newcastle, Belfast, and, on the long waves, Hilversum (a star!) Zeesen (another star!), Kalundborg, Motala, and others on both ranges that are unidentified.

Not bad at all for a set which does not use the classical six-pin coils, etc. Several of the above stations are netted in daylight. Many thanks for a good simple set.

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GIRDLE TWO

From all over the world we have received letters of praise for the Girdle Two, (WIRELESS MAGAZINE, *September*, 1927), *a short-wave set that could be built at very low cost, Here is a letter from New South Wales* :

I have noticed from time to time, under your heading "What Readers Think of Our Sets," letters from this side of the world telling of readers' doings with sets suggested in your magazine. I may say I am prompted to write by reason of the results I have got from the Girdle Two.

I may state I built your Round-the-world Three and the Welcome Three; in fact, any low-wave set that came out in your magazine. But the Girdle Two is the king of them all, and others are building it.

I made a few alterations: First I found I could not get down below 30 metres, so I made another coil, with 3, 6, and 9 turns. I now get down below 20 metres.

The Girdle Two is true to name, for I have indeed girdled the earth with it for many months and, to crown all, I received 5SW on test and every time he is on the air since. A proud man I was when on Christmas Eve I worked him with two pairs of phones and a small loud-speaker. His strength was grand. I worked him again on your Christmas Day. I got up at 2 a.m. to get him, but he was not too good, that is, not strong, but very clear. I sent a report to my brother in England.

I enclose list of stations I received, but I cannot read morse, and there are scores of them that I don't know who or what they are. It may also surprise you to know that with a common crystal set I get all A-class stations in winter, but just now I only get 2FC and 2BL (Sydney), 4QG (Brisbane, 500 miles), 5LO (Melbourne, 500 miles), 5CL (Adelaide, about 900 miles) in winter. Is this good? No one will believe it until they hear it. I may say that this is the only time I wrote to anyone about it, for I don't care to boast. I do it for the love of it.

Stations received on Girdle Two: Russia, USSR, RFN; England, 5SW; Holland, PCJJ; New Zealand, 4WW, 2AQ; West Australia, 6 AG; Victoria, 5AJ; South Australia, 5WS, 5BW; and New South Wales, lots of them—also lots of morse I know nothing about.

Listeners living nearer home are no less enthusiastic about the Girdle Two. Another reader, at Folkestone, submits what must surely be an unbeatable record :

I am writing to tell you of my results with that wonderful little set—the Girdle Two. I have made it as described in your September, 1927, issue, except for the variable condensers, which are .00025 microfarad for A.T.C., and .0003 microfarad for reaction.

This is the first short-wave receiver I have had, and since September 9, 1,261 stations have been logged between 14 and 80 metres. Telephony stations include 2XG, ANH (Java), PCLL, 2XAD, 5SW, 8XK (26.8 m.), 2FC (Sydney) (four times at readable strength out of six times heard), PCJJ, 3LO, Melbourne (five times readable out of seven), 2XAF, G-2NM, JHBB (Ibarakiken, Japan, on 37.5 m.), AFK, Zeesen (37.65 m.), Radio Lyon (40.20 m.), KDKA (43 m.), Karlsborg, WLW (52.02 m.), Radio LL, and KDKA (63.7).

I have also heard amateurs in these countries: 337 in U.S.A., twenty-two European countries, and Argentina, Australia, Belgian-Congo, Bermuda, Brazil, Canada, Chile, Cameroons, China, Cuba, Costa Rica, Egypt, Greenland, India, Indo-China, Iraq, Iceland, Kenya, Libya, Labrador, Madagascar, Morocco, New Zealand, Palestine, Siberia, Syria, South Africa, Uruguay, and Venezuela.

My most varied day was Sunday, February 12, when, between 00.05 hours and 22.30 hours G.M.T., I heard signals from Argentina, China, Belgian-Congo, New Zealand, Morocco, U.S.A., Chile, Canada, India, Egypt, Indo-China, and Australia.

My aerial is 60 ft. long and 50 ft. high, with a down lead of 12 ft. Many thanks for this excellent set which has truly "Put a girdle about the earth" for me.

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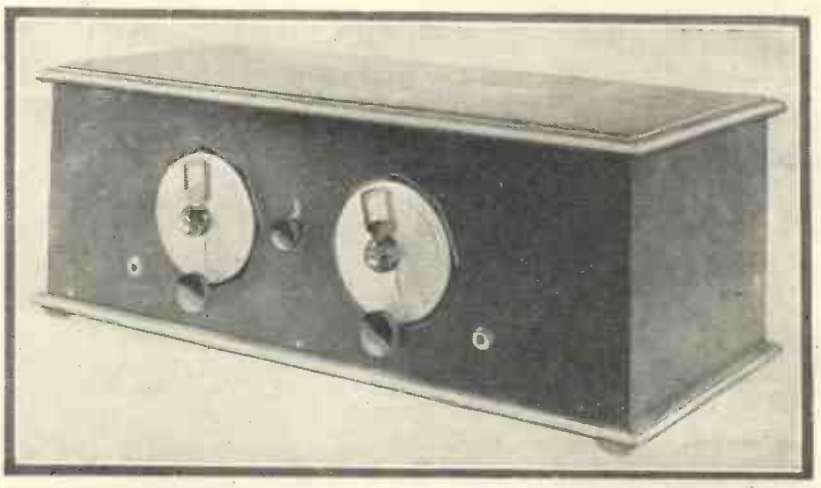
REVELATION FOUR

A reader in Kensington, only 2¾ miles from 2LO, is able to cut this station with the Revelation Four (WIRELESS MAGAZINE, *July*, 1927), *and has received twenty-eight stations on the loud-speaker. Here is his report* :—

I constructed the Revelation Four just before Christmas. I must say I was extremely surprised at the results, as after my last four-valver I never expected to cut out 2LO enough to receive many other stations.

Reception is impossible for 15° either side of the London reading, after that interference is only slight, and soon ceases altogether.

I inserted a three-pole change-over switch to cut off the second low-frequency stage when necessary; also two grid-bias tapping, which improved matters in my case.



Neat in appearance and simple to operate is the Revelation Four, described in July, 1927. It is not yet out of date, though!

Making a "Junior" Moving-coil Loud-speaker

A Cheap Yet efficient Loud-speaker Assembled and Tested by the "Wireless Magazine" Technical Staff

A MOVING-COIL loud-speaker designed for great volume must necessarily be of large dimensions. A very strong magnetic field is required, and for this reason the "pot" must be of a size sufficient to carry the wire of the field coil.

Electro-dynamic or moving-coil loud-speakers have hitherto been rather of the public-address type.

It will be realised that instruments like these must be of high price, owing to the amount of wire, etc., used in the construction.

Experimenting With Smaller and Cheaper Types

The WIRELESS MAGAZINE Technical Staff has for some time been experimenting with smaller types of moving-coil loud-speaker. That described here has very small dimensions and, of course, the cost has been considerably reduced; the price for the complete set of parts should not exceed £3 to £3 10s.

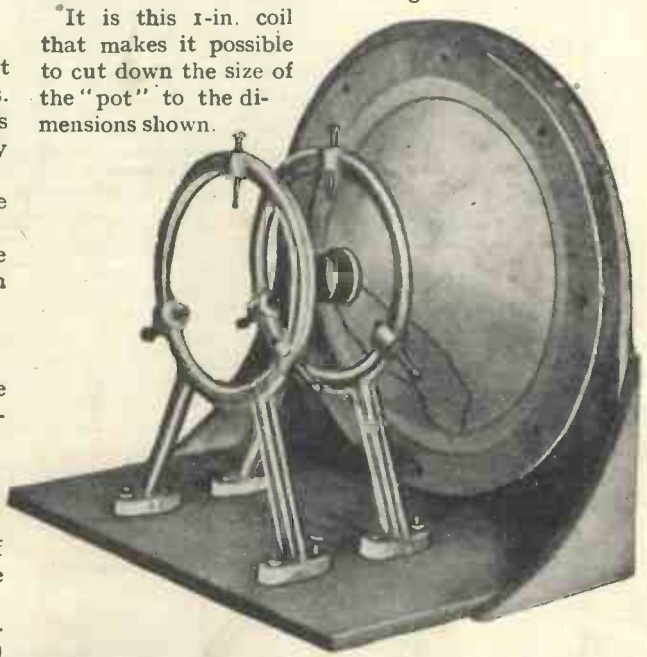
A glance at the photographs will show the type of construction employed. A wooden baseboard and frame carry the moving coil and cone diaphragm.

The "pot" is supported by two metal carriers provided with centering screws. The complete stand and pot, etc., can be obtained ready-made from Goodman's, of 27 Farringdon Street, E.C.

Assembling the "Junior"—not a difficult job

It will be noticed that the usual 2-in. coil has been dispensed with and a coil only 1 in. in diameter is employed. This makes the centre pole-piece only 1 in. in diameter, and therefore extra room is available for winding the field coil.

It is this 1-in. coil that makes it possible to cut down the size of the "pot" to the dimensions shown.



Cone and moving coil of the "Junior" mounted on the framework

There are four operations in making a moving-coil loud-speaker, and these will be described in order of construction.

Size of Air Gap Between Centre Pole and Cap

The pot-magnet is made from cast iron. It consists of a shell of iron with a centre pole-piece 1 in. in diameter. The cap which fits on the open end of the shell is a push fit, with a hole drilled out the centre so as to make the space between the centre pole and cap $\frac{3}{32}$ in.

The field coil is wound on a cardboard bobbin. It consists of 1,250 turns of No. 22 gauge enamelled wire wound in even layers, well shellacked and baked.

Binding the Coil with Insulating Tape

When wound, the cardboard former should be removed and the coil bound with insulating or Empire tape and again well shellacked.

The completed winding should now slip easily over the pole-piece. The ends of the winding can be brought out through two insulated bushed holes in either the bottom or top of the "pot." The cap can now be fixed on to the shell and the "pot" is complete.

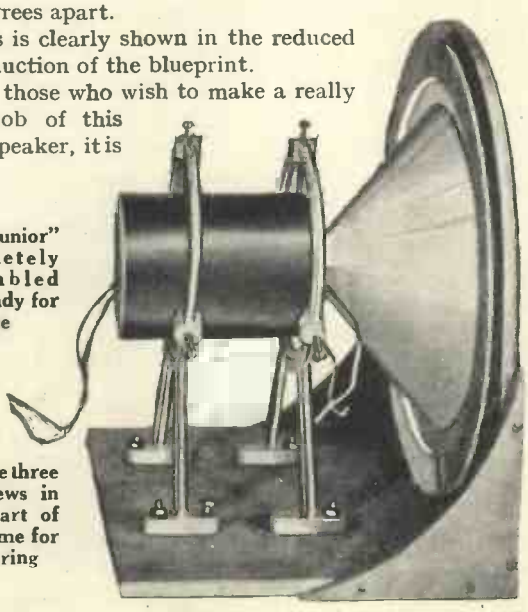
The winding is suitable for 6 volts and consumes .5 ampere, which is exactly 3 watts.

Making the Paper Cone Itself

The cone is made from Whattman's N-surface drawing paper, which can be obtained from any stationers. Two circles are described, one 10 in. in diameter and the other 1⅛ in. in diameter. Two radii are also drawn 90 degrees apart.

This is clearly shown in the reduced reproduction of the blueprint.

For those who wish to make a really good job of this loud-speaker, it is strongly advised that a blueprint is used when making it.



The "Junior" completely assembled and ready for use

Note the three set-screws in each part of the frame for centering

The cone should now be cut as shown in the diagram, leaving the flap on one edge for sticking.

"Feathering" the Edges of the Cone

This can be simplified and a stronger job made of it if the edges to be stuck are first of all "feathered," that is, rubbed with a piece of coarse sandpaper and scraped with a sharp knife. Seccotine or Durofix should be used for making this joint.

Front of the "Junior" Loud-speaker

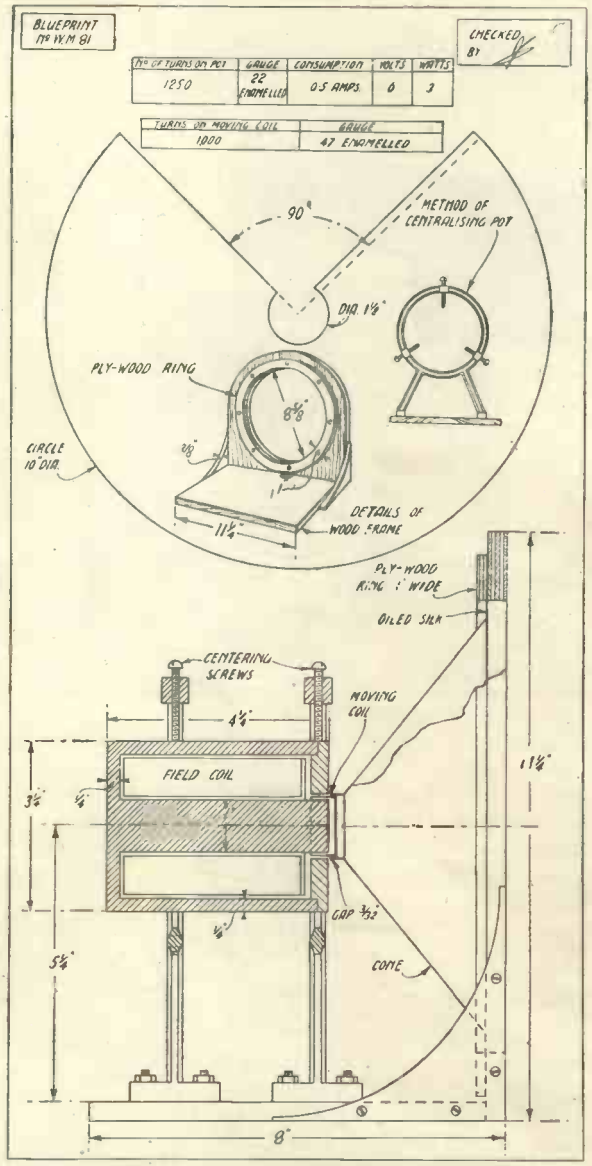
A weight placed on the edge will strengthen the joint.

When the cone is stuck, it is ready for the moving coil.

The moving coil is wound on a thin vulcanite former 1 in. in diameter, and is wound with 1,000 turns of No. 47 gauge enamelled wire. This is best bought ready made, and it is not advised that it should be constructed by the reader unless he is an expert.

If bought ready made, it will be found that the former has been made so that its inside end has been turned to 45 degrees, making it possible to slip on the apex of the cone with plenty of surface for glueing.

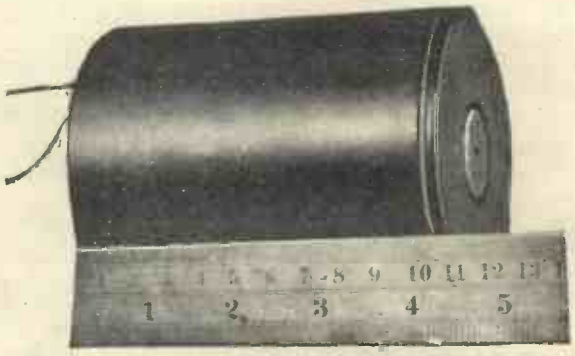
The cone should be laid face downwards on a table, and the coil is stuck on its apex. It is absolutely essential that the plane of the coil is parallel to the table.



This layout can be obtained as a full-size blueprint for half-price, that is, 6d., post free, if the coupon on page iii of the cover is used by June 30. Ask for No. W.M.81

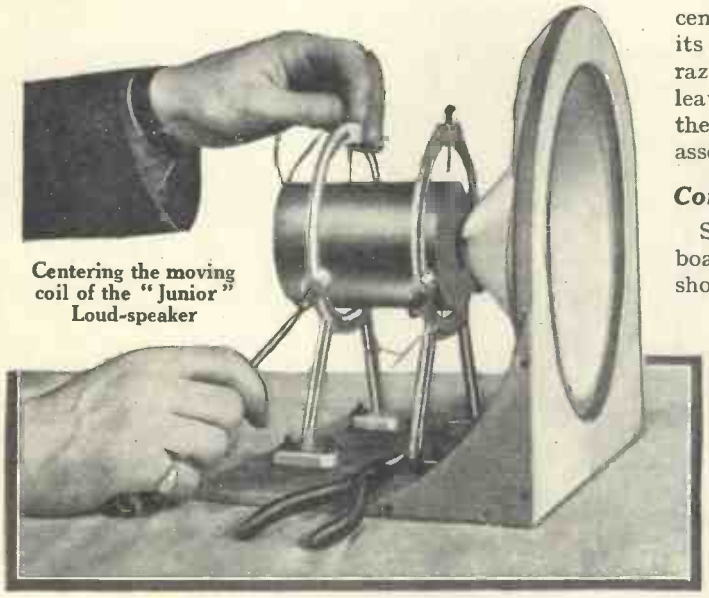
A flat weight must now be placed on top of the coil until it has thoroughly stuck.

We now come to what is probably the most tricky operation, fixing the diaphragm to the oiled silk.



This photograph shows the small magnet "pot" of the front of the "Junior" Loud-speaker

Making a "Junior" Moving-coil Loud-speaker (*Continued*)



Centering the moving coil of the "Junior" Loud-speaker

Remove the plywood ring from the main frame by undoing the small screws round its periphery. Obtain a piece of oiled silk about 12 in. square and lay this face downwards over the hole in the frame.

Slightly stretch it and fasten down by means of drawing pins placed at suitable distances round the edge. The silk should be stretched so that it is quite taut.

Cutting Away the Surplus

The plywood ring can now be placed on top of this and fixed with screws. The drawing pins can be removed and surplus oiled silk cut away by means of a very sharp razor blade.

The cone diaphragm is now prepared for sticking to the oiled silk. Take the cone and lay it face downwards on a table or flat board. Obtain a small flat steel rule and press the end of this on the periphery of the cone in such a way that it bends flat.

This sounds a difficult job, but in reality is quite simple.

Roughen the edge of the cone with a piece of coarse sandpaper and apply a thin coating of Seccotine or Durofix. When dry, apply another coating and place the cone in the centre of the oiled silk. Place a small flat weight on top of the coil and wait until the glue is thoroughly dry.

We now have the diaphragm suspended in the centre of the oiled silk, with the silk stretching across its base. By a careful manipulation of a sharp safety razor blade this centre portion of silk can be cut out, leaving only the diaphragm suspended by means of the oiled silk. The parts are now ready for complete assembly.

Completing the Assembly of the "Junior"

Screw the diaphragm and frame to the baseboard and fix the wooden brackets either side as shown in the photographs.

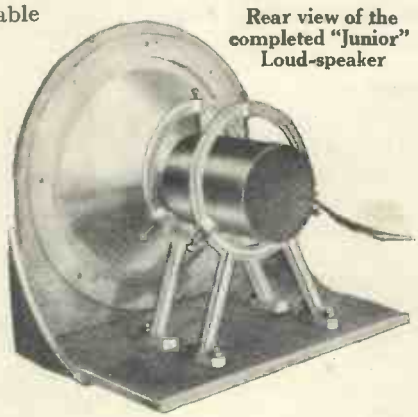
The metal carriers are fixed to the baseboard by means of the bolts supplied. They should be fixed centrally, the first one so that the moving coil first comes inside the ring, and the second about three inches behind it.

The "pot" can now be placed inside the rings and the screws adjusted so that the coil moves freely backwards and forwards inside the gap without touching the sides.

This can best be adjusted by looking at the front of the diaphragm.

The re-entrant cone has been omitted in this loud-speaker, as it has been found to be unnecessary, and its omission makes centering the diaphragm easy.

The screws should be carefully adjusted until a space is seen right round the centre pole-piece.



Rear view of the completed "Junior" Loud-speaker

If the diaphragm has been made to specification and the silk stretched as explained earlier in the article, no trouble will occur in respect of the moving-coil dropping down on to the sides of the gap. It is very important that this does not happen, and the success of the loud-speaker depends entirely on this.

Testing the Loud-speaker

The loud-speaker is now ready for test. Connect a 6-volt accumulator to the "pot" winding and connect the output of the receiver to a choke or 1—1 transformer, if this is not already incorporated in the set, to the two wires on the moving coil.

Too much emphasis cannot be laid on the fact that the set must be of good design and incorporate at least one power valve in the last stage. A number of sets have been described in the WIRELESS MAGAZINE which have been specially designed to work this type of loud-speaker.

It is useless to attempt to get good results without a baffle. A baffle can consist of a wooden board about 2 or 3 ft. square, or can be made in the shape of a box. The centre of the baffle is cut out large enough for the diaphragm to show through.

CONTINENTAL NOTES

Special authoritative notes on broadcasting developments in all parts of the world garnered by JAY COOTE specially for the "Wireless Magazine"

ON most nights when atmospheric conditions are favourable to the reception of long-distance transmissions, if no programme of exceptional attraction has been noted in my diary, I forsake the beaten tracks for more or less virgin paths and spend some time at my receiver in an endeavour to pick up a signal from stations which, although duly recorded in my wavelength list, have not been fished out of the ether.

Southern Europe

Take the extreme points of Southern Europe as an example. If the Fates are propitious we can hear Cadiz or Seville, but so far as I can recall no mention is ever made of Carthage (Tunis), or Rabat (Morocco), on the North coast of Africa, two transmitters which have been working regularly for the last few months.

Carthage is a station of some two kilowatts in power, situated just outside the capital of Tunisia; it broadcasts on a wavelength of 1,825 metres (163 k.c.), and is on the air daily from 1 P.M. During the day there is but little chance of getting even a squeak from it, but as it seldom closes down before 11 P.M. there should be a chance of picking up its signals later in the day.

The call, given out by a male announcer is: "*Ici Poste de Radiodiffusion de Tunis,*" and during the intervals, between items: "*Ici Radio Carthage*" (in French), repeated twice. The main evening transmission starts at 8.30 P.M. B.S.T. with a peal of bells—possibly a carillon from a local church tower—and from 10 P.M. the studio usually goes over to the local Kursaal for a relay of dance music.

Not Giving Up Hope!

I have not given up the hope of logging this transmitter, for on two occasions, at the exact time stated, I distinctly heard bells—alas, the signals faded clean away, and morse intervened.

Now, Radio-Maroc, installed at Rabat, on the Western coast of Morocco some one hundred and ten miles west of Fez, of which it is the port, may be easier to pick up. As the crow flies, it is not so very far from Cadiz, and is a broadcasting station nearly four times the power of the one operating in the Spanish city.

The transmitter has been erected by the French Posts and Telegraphs; although stated to be working on 398 metres, the wavelength varies between 416 and 420 metres. In this instance the call is: "*Ici Poste de Radiotélèphonie des PTT de Rabat,*" and it styles itself *Radio-Maroc.*

Between items you should hear the ticking of a metronome, so familiar to you in connection with Radio Toulouse and PTT Lyons. For its evening transmissions, which begin at 6 p.m., it relies on the concerts given by the bands of the 26th Regiment of Artillery and the Chasseurs d'Afrique; later it takes dance music from a cabaret called *Le Pavillon Bleu* (I expect it is !) and on some nights when a military band is performing on the main public square, it is relayed to the transmitter which remains on the air until midnight or later.

Unfortunate Wavelength

For the present, at least, the choice of wavelength is an unfortunate one, as it is too close to that of Gothenberg or Kattowitz to be comfortable, but in certain districts where the Swedish station is but poorly received, there should be a possibility of reaching out to French Morocco. On frequent occasions it has been heard here.

◆ ◆ ◆

It is some little time since I referred to the interval signals adopted by Continental stations. When I did so, most of them were content to set a metronome ticking in the studio between programme items, and the number of transmitters on the air utilising this method rendered individual identification somewhat onerous.

It was difficult to know, unless one were sure of the wavelength to which the receiver was tuned, whether the transmission emanated from, say, Radio Toulouse or Stuttgart, from Breslau or from Milan.

Although I believe that at the Geneva Conferences no agreement has been arrived at on any special system of signal by which the stations could identify themselves to distant listeners, apparently the individual studios have thought out the matter for themselves.

Some New Interval Signals

Many have departed from this interval signal, and have elaborated a new one off their own bat. Take, for instance, Koenigsberg; if you listen to its transmissions you will find that should there be a pause between two programme items, you will hear two notes (A flat and D flat) sounded rapidly one after the other for a period of some four seconds, then an interval of the same duration, followed by a repeat of the signal.

Munich, on the other hand, has not entirely discarded its "tick-tack," but adds to it a sharp and short hoot of a siren, a note also used to open the transmission before the actual station call is given out.

By this time, no doubt, you are all acquainted with the three notes given out by the Stuttgart station; on some evenings, they will be repeated for a period of some five to ten minutes—C, D, G.; C. D. G.; C. D. G., *ad nauseum*—yet, although irritating to one's nerves, it must be said in their favour that they considerably facilitate tuning in to the actual wavelength.

Stockholm, when no announcements are made in the course of a transmission, contents itself with rapidly ringing a small bell.

From Radio Toulouse

As to Radio Toulouse, you cannot mistake its broadcast, for on one of those evenings on which the studio supplies a mixed programme, you will hear a burst of music (query? band or gramophone), usually followed by a short lull, then *tock tock, tock tock*, a call: *Ici Radio Toulouse*, and more metronome until the announcer is ready for the next item.

In the same way you cannot fail to recognise the Polish stations, for their calls are peculiarly distinctive. Warsaw sends out the morse letter W (· - -) which you may hear from the relays if they are taking the capital

Continental Notes *(Continued)*

programmes. In addition to a metronome, you will also hear announcements in various foreign languages, of which French and English predominate.

From Wilno, you will pick up, as an individual signal, three blasts on a horn, and Kattowitz treats you to a very colourable imitation of an anvil struck by an exceptionally active blacksmith; Posen, except for the fact that it opens its transmissions with the chiming of a clock, from the St. Mary's Church at Cracow, has not forsaken the metronome.

Its lady announcer, however, is very conscientious, and at frequent intervals calls: *Allo! Radio Posnan* (pronounced *Pos-nanne*). Finally, in the intervals of programmes broadcast by Cracow, you should distinguish the tinkling of sledge bells.

Undoubtedly there must be considerable difficulty in devising new individual sounds, easily memorised by listeners, which are easily distinguishable from extraneous noises and morse transmissions in the ether. The Polish stations, in my opinion, have struck an original note (no pun intended!) which should prove an incentive to other studios to do likewise.

◆ ◆ ◆

Almost every month it is my good fortune to draw your attention to the arrival on the air of new transmissions; June will not prove an exception.

To-day we must register the advent of two Belgian stations, those of Schaerbeek and Ghent.

Radio Belgique, as you know, has been established for some years, but is still a privately-owned transmitter, inasmuch as although it is authorised to broadcast, it is not in any way subsidised by the State. Belgium does not possess a broadcasting service monopoly, similar to other European countries, and listeners are not compulsorily taxed in order to defray expenses for the upkeep of the transmitter.

For this reason, in Belgium, authority was obtainable by other than the Radio Belgique Authorities to supply wireless entertainments, providing an annual tax was paid by the transmitter to the State. This freedom has allowed a small association to erect a station at Schaerbeek, a suburb of the capital; it is only a small studio capable of being heard within a very restricted area, and it operates on 230 metres.

Wave-length in Metres	Station	Call Sign	Wave-length in Metres	Station	Call Sign	Wave-length in Metres	Station	Call Sign	Wave-length in Metres	Station	Call Sign
24	Chelmsford	5SW	288.5	Edinburgh	2EH	379.7	Stuttgart	—	549.3	Milan	—
30	Bergen	—	289.3	Radio Lyon	—	384.6	Manchester	2ZY	555.8	Budapest	—
30.2	Hilversum	—	294.1	Dundee	2DE	391	Toulouse	—		Hamar	—
36	Lyon (PTT)	—		Hull	6KH	394.7	Hamburg	—	566	Augsburg	—
37	Vitus (Paris)	—		Innsbruck	—	400	Bilbao	—		Cracow	—
45.3	Doeberitz	—		Stoke-on-Trent	5ST		Cadiz	EAJ3		Hamar	—
61	Paris	Radio LL		Swansea	5SX		Cork	6CK	575.8	Freiburg	—
	Doeberitz	—	297	Liverpool	6LV		Mont de Marsan	—	576	Vienna (Wien)	—
158	Beziers	—		Radio Agen	—		Plymouth	5PY	588	Zurich	—
192	Akureyri	—		Hanover	—	401	Aachen	—	680	Lausanne	—
198	Biarritz	—	300	Algiers	—	405	Salamanca	EAJ22	720	Ostersund	—
204.1	Kaisersleutem	—		Bratislava	—	405.4	Glasgow	5SC	760	Geneva	—
217	Radio Luxembourg	—	302	Radio Vitus	—	408	Reval	—	776	Laibach	—
			303	Koenigsberg	—	411	Berne	—	775	Kiev	—
230	Ste. Etienne	—	306.1	Belfast	2BE		Notodden	—	995.5	Leningrad	—
	Schaerbeek	—	307.2	Zagreb	—	416	Grenoble	—	1,000	Leningrad	—
236.2	Stettin	—	310	Oviedo	—	416.7	Goteborg	—		Basle	—
238.1	Bordeaux	—	310.2	Marseilles	—	420	Rabat	—	1,069	Hilversum	HDO
240	Nimes	—	312.5	Newcastle	5NO	422	Kattowitz	—	1,080	Strasbourg	—
246	Juan-les-Pins	—	319.1	Dublin	2RN	428.6	Frankfort	—	1,111	Warsaw	—
241.9	Nurnberg	—	322.6	Breslau	—	434.8	Freidriksstad	—	1,180	Stembol	—
	Muenster	—	326.1	Bournemouth	6BM		Seville	—	1,153	Kalundborg	—
252.1	Bradford	2LS	323.9	Almeria	—	435	Wilno	—	1,180	Stamboul	—
	Cassel	—	329	Gleiwitz	—	441	Brunn	—	1,190	Boden	—
	Montpellier	—	333.3	Naples	—	448	Rjuiken	—	1,250	Königswusterhausen-Zeesen	LP
256	Kiel	—		Reikjavik	—	448.4	Rome	—		Motala	—
259	Toulouse	—	335	San Sebastian	EAJ8	450	Moscow	—	1,380	Moscow	RDW
260.9	Malmo	—		Cartagena	—	453.8	Stockholm	—	1,450	Lahti	—
264	Lille (Poste du Nord)	—	337	Copenhagen		458	Paris Ecole Sup.	—	1,525	Daventry	5XX
			340.9	Paris	Petit Parisien	460	Belgrade	—	1,604	Kharkov	—
267	Strasbourg	—				461.5	Oslo	—	1,700	Paris	—
272.7	Sheffield	6FL		Huizen	—	462	Barcelona	—	1,750	Angora	—
	Bremen	—	344	Posen	—	470	Langenberg	—	1,800	Bucharest	—
	Danzig	—	344.8	Barcelona	EAJ1	477.7	Lyons	—		Norddeich	—
	Klagenfurt	—	348.9	Prague	—	484.6	Berlin	—	1,850	Carthage	—
273	Limoges	—	353	Cardiff	5WA	491.8	Daventry Experimental	5GB		Huizen	—
275	Ghent	—	357.1	Graz	—	500	Aberdeen	2BD	1,870	Kosice	—
275.2	Dresden	—	361.4	London	2LO	504	Porsgrund	—		Huizen	—
	Nottingham	5NG	365.8	Leipzig	—	508.5	Brussels	—	1,950	Scheveningen	—
277.8	Leeds	2LS	370	Paris	Radio LL	517.2	Vienna	—	2,000	Kovno (Kaunas)	—
278.8	Bordeaux	—	370.4	Bergen	—	535.7	Munich	—	2,650	Paris	FL
280	Renne	—	375	Helsingfors	—	545.6	Sundsvall	—	2,800	Temesvar	—
283	Colognes	—		Madrid	EAJ						

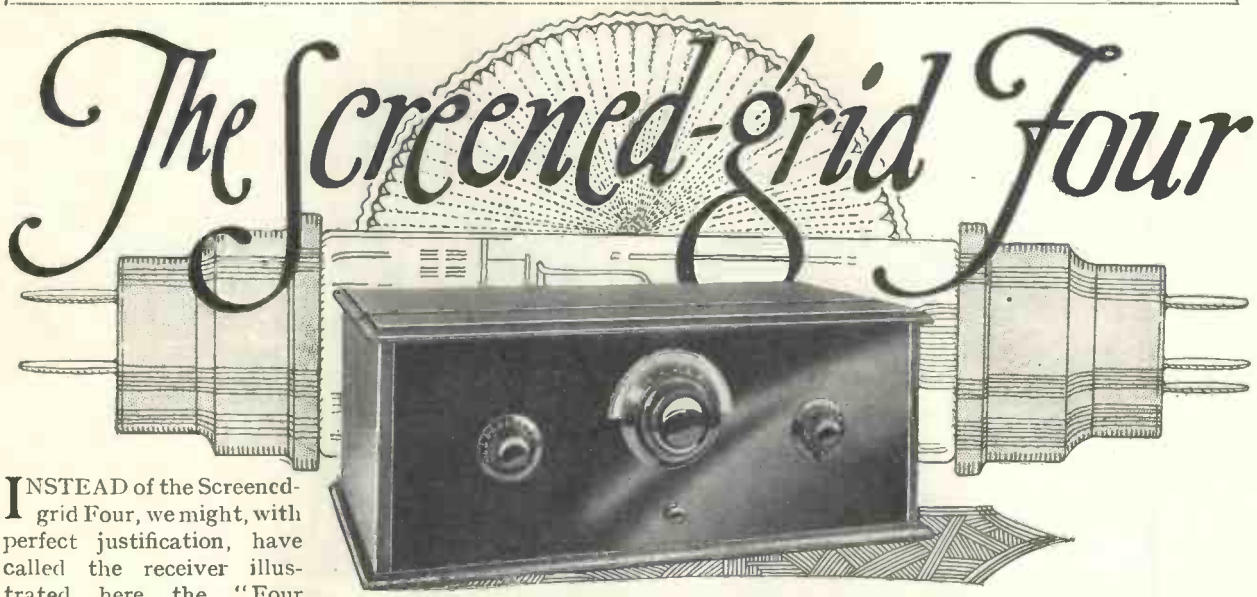
Specially Drawn for the "Wireless Magazine" by GLOSSOP

Some Baffle!

"In order to get the best results from a moving-coil loud-speaker it is essential to use a baffle; this should be as large as is practicable."—*Extract from* WIRELESS MAGAZINE.

An astonishing degree of amplification can be obtained from the new screened-grid valves, and the set described in this article will be found to be very powerful. Although it is a four-valver, it is extremely simple to construct, and no beginner need hesitate about tackling it if he wants to start right off with a big receiver

The Screened-grid Four



Designed, Built and Tested by the "Wireless Magazine" Technical Staff

INSTEAD of the Screened-grid Four, we might, with perfect justification, have called the receiver illustrated here the "Four that's as Good as a Five" —in many cases, indeed, it will be much *better* than existing five-valvers.

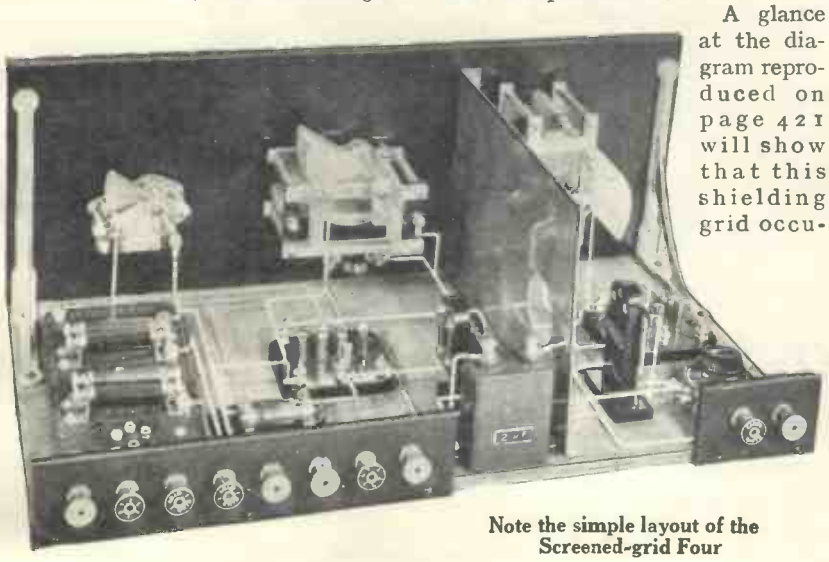
Screened-grid H. F. Valve

Most readers will guess that it owes its success to the use of a screened-grid high-frequency valve, originally an American invention, which has been brought to its present high state of efficiency in this country by Captain H. J. Round, M.I.E.E. (whose Press contributions now, by the way, appear exclusively in the WIRELESS MAGAZINE, and its associated weekly, *Amateur Wireless*).

The reason why the screened-grid valve is such a great success is because it provides an almost perfect electrostatic shield between the grid and plate circuits, thus preventing the feed-back of high-frequency currents, the most common cause of losses in amplifiers.

This shield comprises a second grid, placed between the ordinary operating grid and the plate; normally it carries a positive potential of the order of 80 volts, the exact value being quite critical within several volts for a particular valve.

A glance at the diagram reproduced on page 421 will show that this shielding grid occupies the whole diameter of the glass bulb, and, in order to get the very best results, it is desirable to continue the shielding externally by means of a copper plate.



Note the simple layout of the Screened-grid Four

How the Valve is Arranged

In practice a hole is cut in the copper that will just allow the valve to be passed through horizontally, and this is held in position so that the periphery of the shielding grid is exactly in line with the hole in the copper plate.

So far the best results with the new valves have been obtained in conjunction with tuned-anode couplings, and that is the method adopted in this instance. For the sake of obtaining the greatest efficiency, astatic coils have been used; these have practically no external field at even high frequencies, and are therefore a second assurance that as few losses as possible shall take place through leakage.

Six-pin Binocular Coils

The particular type of coil utilised is the six-pin binocular. These coils are provided with reaction windings, and in this case reaction is taken from the detector valve into the high-frequency coupling circuit.

A glance at the complete circuit

diagram on this page will show that the aerial is tapped to the aerial coil; this is done to obtain a good degree of selectivity. This aerial coil and its associated .0005-microfarad variable condenser are completely cut off from the rest of the circuit by means of a copper screen, through which is placed the screened-grid high-frequency amplifier in the manner already described. In the circuit diagram this copper screen is indicated as a thick black line which is connected to earth.

First Anode Circuit

The anode coil is tuned by another .0005-microfarad variable condenser, voltage variations across this circuit being transferred to the grid of the detector valve through a .002-microfarad fixed condenser; the detector valve is supplied with the usual 2-megohm grid leak connected to low-tension negative.

Reaction is obtained by coupling a coil connected between plate and negative filament of the detector valve to the anode coil, and is controlled by a .0001-microfarad variable condenser.

Re-radiation Impossible

In this way it is impossible for re-radiation to take place from the receiver into neighbouring aerials and, when desired, reaction can be pushed to the limit without fear of causing interference to neighbours.

It will be seen that the detector valve and the two low-frequency amplifiers, together with their associated coupling units, are enclosed by a dotted line; this indicates that they are built up as a complete unit, which can be obtained by the constructor already assembled. The unit actually contains three valve holders, two coupling condensers of .002-microfarad capacity, and clips for the anode resistances and grid leaks, which must be ordered separately from the unit.

For each low-frequency amplifier an anode resistance of .25 megohm and a grid leak of 2 megohms is utilised; these values should be retained for the best results. If the made-up unit is used, it is, of course, impossible to change the values of the coupling condensers. The use of such a unit considerably facilitates the construction of the receiver, as can be seen from the photographs.

It should be noted that in order to get critical control the filament circuit of the high-frequency amplifier is provided with a rheostat, while the whole set can be switched on or off by means of a simple push-pull switch.

The numbers alongside the coils indicate the connections to the six-pin bases for the binocular coils.

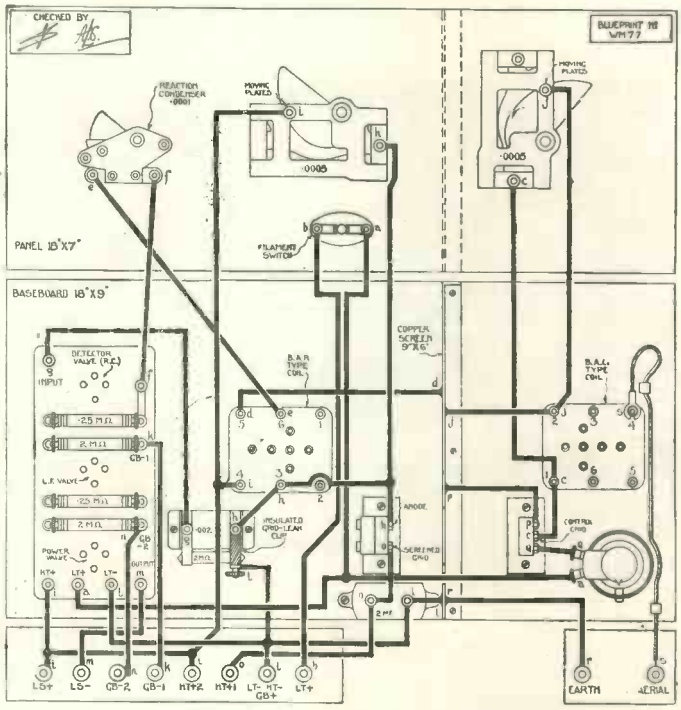
It will be seen that a common high-tension supply is provided for all four valves, this being brought to a terminal marked H.T.+2. H.T.+1 supplies the necessary potential of 80 volts or so to the grid of the high-frequency valve, this lead being blocked to earth by means of a 2-microfarad fixed condenser.

In this connection care should be taken in the choice of suitable high-tension batteries. Some 60-volt batteries are not tapped at all for the first 30 volts, and so it is impossible to get anything between 60 and 90 volts from them

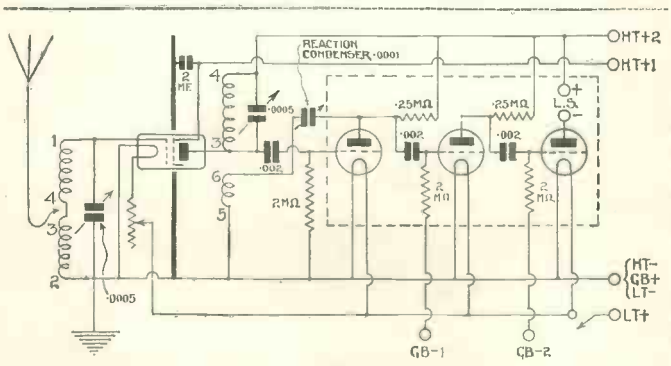
Tapping from Negative

The only thing to be done in such a case is to tap up from the negative end of the batteries, which means, however, that the full voltage is not being obtained for the valve anodes.

Constructors will wonder, perhaps, after a glance at the photograph of the front of the set reproduced in the heading, why the centre condenser (which tunes the anode) has been



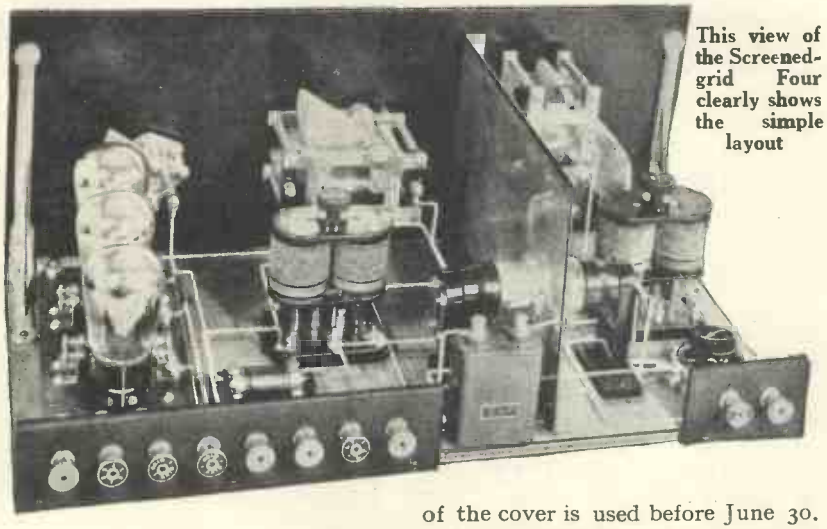
This layout and wiring diagram can be obtained as a full-size blueprint for half-price, that is, 9d., post free, if the coupon on page iii of the cover is used by June 30. Ask for Blueprint No. W.M.77



This is the circuit of the Screened-grid Four. The part enclosed in the dotted line is made as a complete unit

A Four-valver That Is Unbeatable for Range and Volume

The Screened-grid Four (*Continued*)



This view of the Screened-grid Four clearly shows the simple layout

fitted with a large vernier dial while the aerial condenser (on the left) has only a small knob.

The reason is that, once the set has been roughly calibrated, searching is best carried out by critical control of the anode condenser, while the aerial condenser is swung throughout its entire range until the desired signal is picked up.

Constant Readings

Except for very small variations caused by differences in wiring, the anode condenser readings will always be the same no matter what aerial is used.

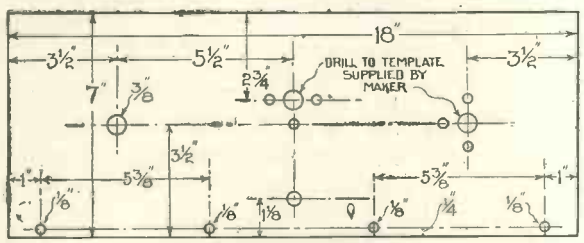
The knob on the right of the panel is that for the reaction condenser, while the very small one directly underneath the anode condenser is the on-off switch.

The adoption of these simple controls (it should also be remembered that no neutralising is required with the screened-grid valve) and the simplicity of the layout make the Screened-grid Four one of the easiest four-valvers it is possible to construct, and as such it will immediately appeal to a large number of listeners who want to start right off with a powerful set.

Full-size Blueprint Available

No difficulty at all should be experienced if a full-size blueprint layout, drilling guide, and wiring diagram is used; such blueprints can be obtained for half-price, that is 9d., post free, if the coupon on page iii of the cover is used before June 30.

Address your inquiry to Blueprint Dept., WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4, and ask for blueprint No. W.M. 77. Although a blueprint is recommended for the sake of facilitated construction its use is not essential, and all the necessary details are reproduced in these pages.



Details of front panel, not required if a blueprint is used

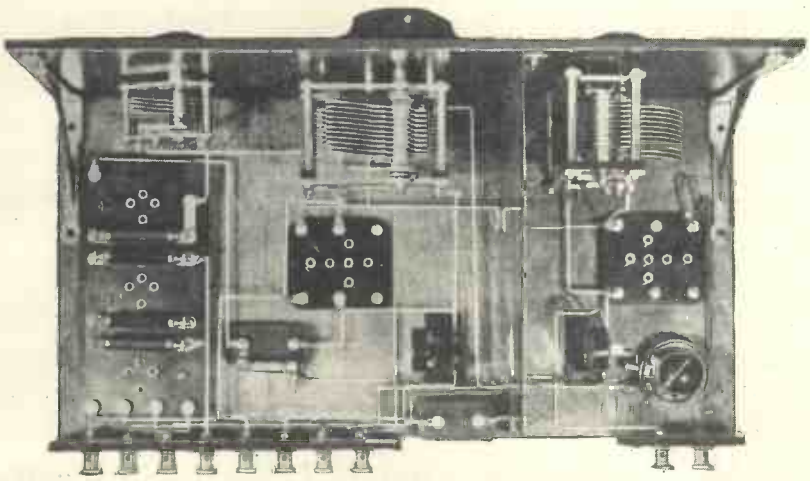
As soon as all the components have been got together work can be started on building the set. First, drill the panel and mount thereon the two .0005-microfarad variable condensers (noting that the frame of one is fixed horizontally and of the other vertically), the reaction condenser and the push-pull on-off switch.

Hole for Screened-grid Valve

Next, fix the panel to the baseboard by means of the brackets and screw the copper screen on to the baseboard. This is provided with a circular hole 1½ in. in diameter, the centre of the hole being 2½ in. from the base board and 2 in. from the back edge of the screen.

The baseboard components can now be screwed into position. On the right of the screen, looking from the back of the set, are one part of the screened-grid valve holder, the rheostat and a six-pin coil base. The small terminal strip can also be placed in position.

All the rest of the components are placed to the left of the screen. From right to left (still looking from the back) they are the second half of the screened-grid valve holder, the 2-microfarad blocking condenser, the six-pin base for the anode coil, the grid leak and condenser and the three-valve resistance-coupling unit. The large terminal strip can also be



Plan view of the Screened-grid Four, which shows the disposition of the components

A Powerful Yet Simple Receiver

screwed to the left-hand end of the baseboard.

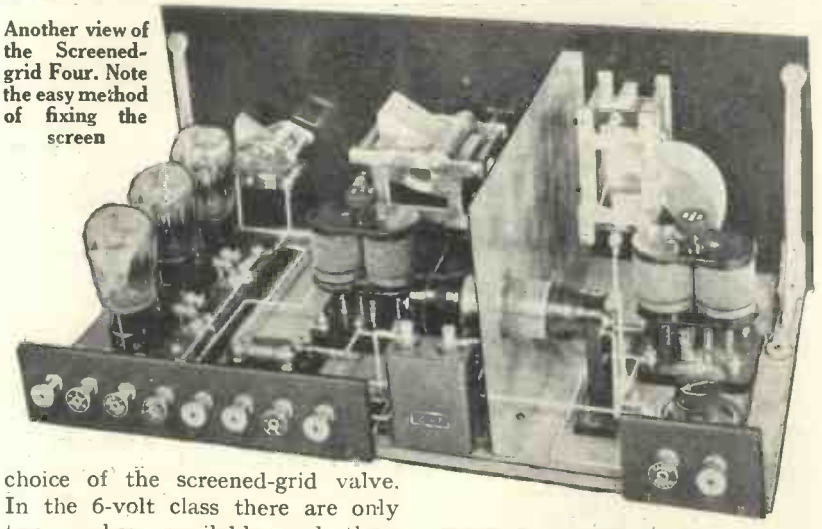
In mounting the grid leak it is most important to see that it is not placed directly in parallel with the grid condenser. In the photographs it appears to be so placed, but one of the clips is made of ebonite and there is no electrical connection between the leak and condenser at that end.

Simplified Wiring Process

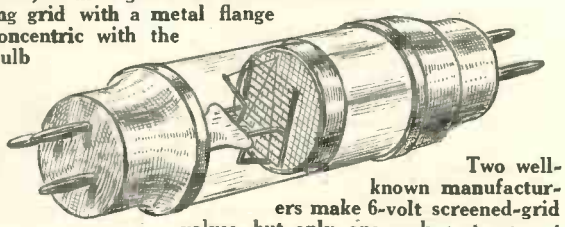
Wiring-up can be started as soon as everything has been fixed firmly into position; for this operation the blueprint will be found especially useful. On this and on the wiring diagram reproduced on page 419, it will be seen that each terminal point of every component is marked with a small letter of the alphabet.

These letters indicate in which order the components should be connected up. First connect together, with one wire or as few wires as possible, all those points marked *a*; next, connect all those points marked *b*; and so on throughout the alphabet, until the wiring is completed, up to the letter *s*.

Suitable valves for use in the Screened-grid Four are indicated in the table reproduced on page 422. There is no difficulty about the choice of the screened-grid valve. In the 6-volt class there are only two makes available and these two are identical. At present only one valve manufacturer is marketing any 2-volt screened-grid valves.



Another view of the Screened-grid Four. Note the easy method of fixing the screen



To the left are seen the filament and operating grid; on the right is the circular screening grid with a metal flange concentric with the bulb

Two well-known manufacturers make 6-volt screened-grid valves, but only one maker at present markets a 2-volt valve

The detector valve should have an impedance in the neighbourhood of 80,000 ohms (not higher), while the impedance of the first low-frequency amplifier should preferably be much lower, although it is resistance-coupled.

A valve with a very high impedance will not have sufficient grid swing and the best results will be obtained with a valve of 20,000 to 30,000 ohms impedance—an ordinary high-frequency amplifying valve.

Super-power Valve for Last Stage

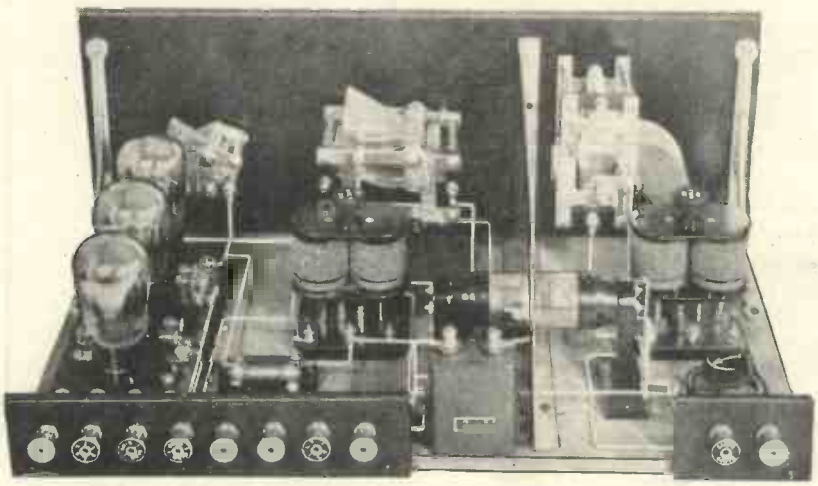
For the last stage a super-power valve should be used, with an impedance below 8,000 ohms, the lower the better as long as the high tension supply will stand the heavy current needed.

To test the receiver place the valves in their respective holders (the positions are clearly indicated on the blueprint and layout diagram), insert the coils in their sockets and connect up the required voltages. To H.T.+1 connect 80 volts, to H.T.+2 120 volts, to G.B.—1 about 3 to 4½ volts negative and to G.B.—2 anything from 6 to 18 volts, depending upon the type of valve used.

On Verge of Oscillation

Pull out the knob of the filament switch and turn the knob of the reaction condenser until that slight rustling or hissing is heard which indicates that the set is on the verge of oscillation.

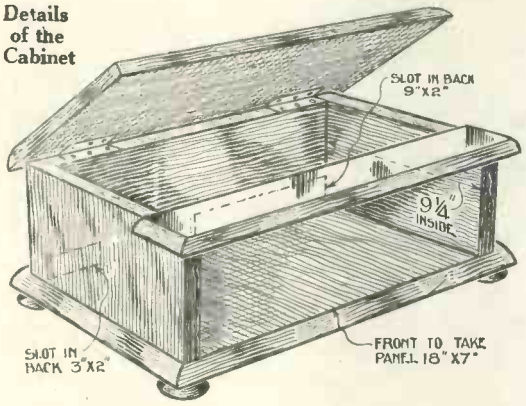
Move the anode condenser (centre dial) slowly round, degree by degree, at the same time searching more rapidly with the small knob of the aerial condenser. As soon as a station is picked up re-adjust the reaction



This view shows the Screened-grid Four ready for use with the valves and coils in position

The Screened-grid Four *(Continued)*

Details of the Cabinet



condenser and also the voltages applied to the screening-grid and to the grids of the low-frequency amplifiers.

Controlling Selectivity

The selectivity of the set can be controlled by altering the tapping to the aerial coil; the lead attached to the aerial terminal can be connected to either No. 3 or No. 4 terminal of the six-pin base. Both connections should be tried to find out which is best.

Astonishing Results with Small Aerial

With a powerful receiver of this type it will be found that even a short aerial (with an efficient earth) will give astonishing results—at least to those who have not used a screened-grid valve before.

In this connection readers are referred to details of the Chummy Four which appear on other pages of this issue. In that case a screened-grid valve used in conjunction with a small frame aerial has been found to give amazingly good results.

So great is the amplification obtained with a screened-grid valve that on an outdoor aerial of normal size the set seems to be unselective. Actually it is not unselective, but the reception of distant stations at increased strength makes it appear so.

Indeed, a receiver such as that described here will do on a short aerial, even if it be indoors, what a good "ordinary" five-valver can only just achieve with a really good aerial.

Some experimenters consider that really good results cannot be obtained with a screened-grid valve unless it is almost entirely enclosed in a metal box. While this may be true to some extent when ordinary coils are used, it certainly does not apply with astatic coils. Readers may rest assured that with coils of this type and the simple screen shown the Screened-grid Four is giving the best performance obtainable from the new valves with great ease of construction.

Readers are cordially invited to send the WIRELESS MAGAZINE reports of what they can achieve with this excellent four-valver. Names and addresses will, if desired, be withheld from publication.

Valves to Use in The Screened-grid Four

Make.	H.F. Amplifier.		Detector.		1st L.F.		2nd L.F.	
	2-volt.	6-volt.	2-volt.	6-volt.	2-volt.	6-volt.	2-volt.	6-volt.
B.T.H.	—	—	B210H	—	—	—	B215P	B4
Cosmos	—	—	—	SP50B	—	DE50	SP18RR	SP50R
Cossor	SG 210	—	210 RC	610 RC	210 LF	610 HF	220P	610P
Ediswan	—	—	—	—	HF210	ES5HF	PV2	PV610
Marconi	—	S625	DEH 210	DEH 610	HL 210	DE5B	DEP 240	DEP 610
Mullard	—	—	PM1A	PM5B	PM1HF	PM5X	PM 252	PM 256
Osram	—	S625	DEH 210	DEH 610	HL 210	DE5B	DEP 240	DEP 610
Six-Sixty	—	—	SS 210 RC	SS 6075 RC	SS 210 HF	SS 6075 HF	SS 215 P	SS 610 P

COMPONENTS

1—Ebonite panel, 18 in. by 7 in. (Redferns, Becol or Will Day).
2—.0005-microfarad variable condensers (Cyldon, Dubilier or Ripault).
1—.0001-microfarad variable condenser with small dial (Cyldon, Igranic or Success).
1—On-off filament switch (Lotus, Benjamin or Lissen).
1—Vernier dial (Burndept, Igranic or Formo).
1—Screened-grid valve holder (Parex, Burndept or Marconi).
2—Six-pin coil bases (Lewcos or Colvern).
1—15-ohm baseboard-mounting rheostat (Gecophone, Igranic or Lissen).
1—3-valve (2-stage) resistance-capacity coupling unit (Graham-Farish).
1—.002-microfarad fixed condenser with insulated series clip (Dubilier).
1—2-megohm grid leak (Dubilier, Mullard or Lissen).
1—2-microfarad fixed condenser (Dubilier, Lissen or T.C.C.).
2—Terminal strips, 9 in. by 2 in. and 3 in. by 2 in. (Redferns, Becol or Will Day).
10—Terminals, marked: Aerial, Earth, H.T.+1, H.T.+2, L.T.+, L.T.—, G.B.—1, G.B.—2, L.S.+, L.S.— (Eastick).
2—.25-megohm grid leaks (Graham-Farish).
2—2-megohm grid leaks (Graham-Farish).
1—Pair panel brackets (Camco, Magnum or Bulgin).
1—Cabinet with 9 in. baseboard (Caxton).
2—Short-wave six-pin binocular coils (Lewcos BAC_5 for aerial and BAR_5 for anode).
2—Long-wave six-pin binocular coils (Lewcos BAC_{20} for aerial and BAR_{20} for anode).
1—Copper sheet, 9 in. by 6 in. with flanges for fixing (Parex).
4—2 ft. lengths insulated wire (Glazite).
2—Dial indicators (Deckorem or Belling-Lee).
1—2-in. dial for aerial condenser (Cyldon or Will Day).

DON'T OVERLOOK THE SPECIAL GRAMO-RADIO SECTION IN LATER PAGES OF THIS ISSUE

Moving-coil Loud-speakers

The moving-coil loud-speaker in the Science Museum at South Kensington

Practical Points in Design and Operation Explained by the Well-known Authority, N. W. McLachlan, D.Sc., M.I.E.E., F.Inst.P.

DURING the past two years the standard of loud-speaker reproduction has improved considerably, due to the introduction of the coil-drive system.

Following the demonstration of a coil-drive loud-speaker by the author before the Radio Society of Great Britain in January, 1926, and the installation of a replica in the Science Museum, this method of reproduction has found its way into every experimenters' laboratory. This instrument is shown photographically in Fig. 1.

Care Necessary in Design

Although the coil-drive loud-speaker seems so simple and comparatively easy to make, care must be exercised in the design to secure good tonal quality. It is quite impossible to make a good loud-speaker by simply using any moving coil and any cone at random.

In fact it is quite fair to say that the coil-drive loud-speaker is a simple invention, but an instrument which is difficult to design correctly. There is no absolutely correct design, because whatever proportions are given to the coil and cone, there is a certain degree of inaccuracy in the reproduction.

Marked Peculiarities

Although a well-designed instrument is far in advance of the average loud-speaker now on the market, there are clearly marked peculiarities in the reproduction of speech and pianoforte music. These effects can be attributed to imperfections in the diaphragm or cone which is used.

By varying the size of the coil or the type of paper used in constructing it, the imperfections are merely shifted from one part of the musical scale to another.

Owing to the relatively small stiffness of paper, it is difficult to formulate a theory on which to base the design of a conical diaphragm. One must, therefore, have recourse to experimental work. In this case, the best plan is to have two loud-speakers in order to make immediate and direct comparisons, by using a change-over switch. This is absolutely necessary, since the ear, not being a good measuring machine, readily forgets what happened a few minutes ago.

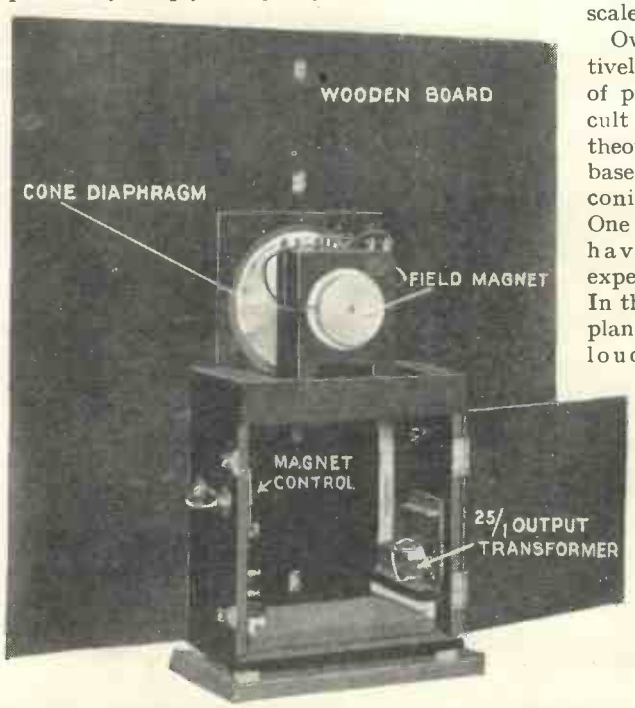


Fig. 1.—Loud-speaker described by author in "Amateur Wireless," July 24, 1926

In this article, I propose, therefore, to discuss in a simple manner some of the conditions which govern the design of the coil and diaphragm of a coil-drive loud-speaker.

Simplifying the Problem

So far as the coil is concerned, we have fair guidance from theory, and this simplifies our problem considerably. Fig. 2 shows diagrammatically, a power valve with a coil-drive loud-speaker connected to its anode circuit. No transformer is shown, since it is assumed that a high-resistance coil of many turns is used.

Now we can simplify Fig. 2 if the valve is replaced by a resistance equal to its internal or A.C. resistance, in series with an A.C. generator. The reader will naturally expect the remainder of the circuit to stand as it is in Fig. 2. That assumes the coil to act merely as an inductance having a certain resistance. This is shown in Fig. 3.

Where the Assumption is Wrong

In practice such a procedure is quite wrong, as I shall now proceed to show. When the coil, as shown diagrammatically in Fig. 3a, moves backwards and forwards in the magnetic field, it cuts lines of force

Moving-coil Loud-speakers *(Continued)*

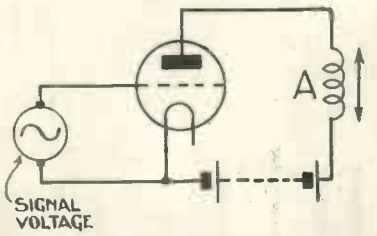


Fig. 2.—A = Coil moving in magnetic field. In practice the anode feed current to the valve is not allowed to pass through the coil A filter circuit is used as shown in Fig. 2a so that alternating current only passes through the coil

and generates a back E.M.F. This can be considered as a motional E.M.F. and will cause a reduction in the alternating current supplied by the power valve.

Components of Back E.M.F.

This back E.M.F. has two components, (a) one which multiplied by the coil current gives the power radiated as sound, and (b) another which is 90 degress out of step and contributes nothing to the output. It can be regarded as a "wattless" component, and its chief function is to cause trouble by reducing the coil current at low frequencies.

When the action of the coil moving in the magnetic field is analysed by the aid of mathematics, some interesting facts appear. It is found that the circuit of Fig. 2 can be represented by that of Fig. 4. Here the coil is replaced by (1) an inductive resistance equal to that of the coil at rest; (2) a resistance corresponding to the energy radiated as sound, and known as the radiation resistance; (3) a condenser, known as the

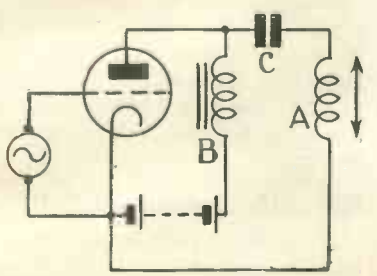


Fig. 2a.—A = Moving Coil. B = Iron-cored inductance. C = Condenser to prevent D.C. passing through coil A

motional capacity. Items (2) and (3) are solely due to the motion of the coil in the magnetic field.

If we examine Fig. 4 carefully we shall find a number of interesting things in connection with our loud-speaker design.

A condenser is known to impede low frequencies but to readily pass high frequencies. Since there is a condenser in series with the valve in Fig. 4, it is clear that the current will be reduced at low frequencies. In other words the bass register will be reduced.

We also see that since there is a condenser and an inductance in circuit, these will resonate at a certain frequency. At this frequency

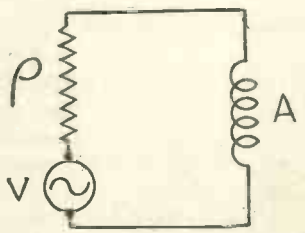


Fig. 3.—ρ = Internal resistance of valve to alternating currents. A = Moving Coil. V = Fictitious alternating current generator

the circuit will act as a pure resistance and the coil current will be a maximum. This is an electro-mechanical effect, that is the inductance is the electrical part and the motional capacity the mechanical part.

No Pronounced Peak in Curve

Although the current is a maximum, the curve has no pronounced peak, in fact, it is very flat as shown in Fig. 5.

Again, when the frequency is well above the electro-mechanical resonance point, the inductance will impede the flow of the current. The higher the frequency the smaller the current.

Thus our investigation has revealed the following basic facts:

1.—The bass is reduced, due to the motion of the coil in the magnetic field.

2.—The current has a maximum value at some intermediate frequency (usually between 300 and 500 cycles).

3.—The upper register is reduced, due to the coil inductance.

The problem which now confronts us is quite clear, so what are we going to do about it?

Provided we know how to calculate the motional capacity and the coil inductance, we can find our design data. What we require is a large capacity and a small inductance.

What We Want to Avoid

By using a very strong magnetic field, and a large number of turns on the moving coil, we get a large working force and, therefore, a large output. But the stronger the field, and the more the turns, the greater is the back or motional E.M.F., the *smaller* the motional capacity and the larger the inductance. This is precisely what we want to avoid.

Therefore, both the magnetic field and the number of turns must be reduced, which entails a reduction in output from the loud-speaker.

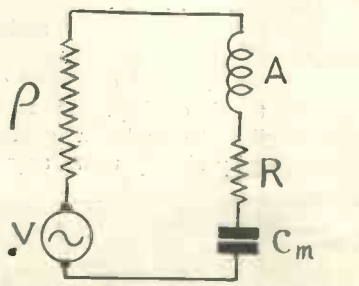


Fig. 4.—ρ = Internal resistance of valve. A = Inductance and resistance of coil when stationary. R = Radiation resistance due to energy radiated as sound. C_m = Equivalent capacity due to motion of coil in magnetic field. V.= Fictitious alternating current generator

The actual values of field and turns are fixed from a consideration of the internal resistance of the power valve.

Same Current at All Frequencies

Looking once more at Fig. 4, we see that if the resistance of the valve is large enough to swamp the impedance of C_m at low frequencies and of A at high frequencies, the coil current will be substantially the same at all frequencies. This, then, is our object.

But, it is necessary to compromise

Special Article by N. W. McLachlan, D.Sc., M.I.E.E., F.Inst.P.

to an extent, since too few turns and a weak field will reduce the output from the loud-speaker to an impracticable value. In practical work I have found that a coil 2 inches in diameter having 800 to 1,000 turns of No. 46 gauge or No. 47 gauge enamelled wire is highly satisfactory.

Strength of Magnetic Field

The strength of the magnetic field should be 8,000 to 10,000 lines per square centimetre. This is best obtained by using a pot of cast steel. In my opinion and experience cast steel is much better than cast iron, because it has a much higher magnetic permeability.

This means that the magnetising force in a steel pot is concentrated at the air gap, (where it is required most), only a small amount being necessary to drive the magnetism through the steel.

Since we depend upon the internal resistance of the power valve to preserve the coil current fairly constant at all frequencies, it is essential to know what valve to use for the best results. When a coil of 1,000 turns is employed, the power valve should have an internal resistance of from 3,000 to 5,000 ohms. A valve of the Marconi or Osram DE5A type is a happy mean, since its resistance is 4,000 ohms. Operated on a mains supply of 200 volts, one of these valves will give adequate strength for all ordinary purposes.

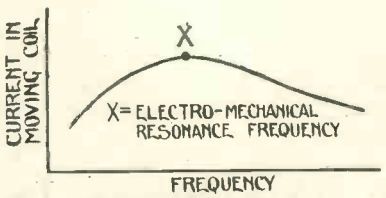


Fig. 5.—Relation between current and frequency

Securing Greater Strength

To secure greater strength, two valves can be used in parallel, but it will be quite evident that the upper register and the bass will be reduced relative to the middle register. In practice, although this rounding off is quite noticeable to the expert, it is not really serious.

So far we have found the diameter and number of turns on the coil. What about its weight?

The coil should be as light as convenient, but it must be mechanically rigid to avoid bending and rattling and loss of output in consequence. An average weight for the coil alone is from 5 to 8 grams, this including the former (if any) on which it is wound.

Having settled the coil, we pass on to the most difficult issue of the design, namely the diaphragm. Now whatever size or quality of paper is used, the diaphragm will have some defect. Moreover, the problem resolves itself into finding the best size of diaphragm for pleasing reproduction and ample intensity or output.

Here we have a rough guide from theory. Suppose we try a small cone, say 3 inches in diameter, what will happen? Well, it is quite clear that the area of the cone is so small that to produce equal loudness, it will have to move to and fro over greater distances than a cone, say, 6 inches in diameter.

In moving a greater distance, the small cone will travel faster than the larger cone. But the E.M.F. induced in the coil, due to its motion in the magnetic field, depends upon the speed of movement. The greater the speed, the larger the back E.M.F. and the *smaller* the motional capacity. Thus there will be a greater reduction in coil current at low frequencies, with a small cone than with a large one. So far as high frequencies are concerned, there will be little difference in the two currents, provided the coils are identical.

Thus we conclude that owing to excessive motion, a small cone will be accompanied by a reduction in low-frequency current.

So much for the electrical side of the matter. We must now consider the cone as an apparatus for converting electrical energy into sound.

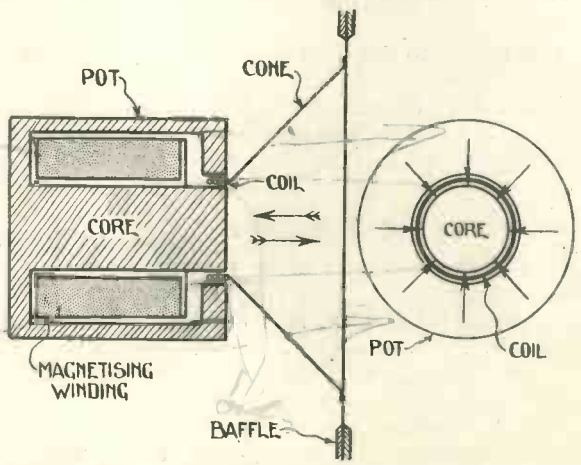


Fig. 3a.—The arrows indicate the direction of the radial magnetic field. The coil moves in and out of the pot and cuts the field in so doing.

More Sound from Small Cone

Apart from considerations of coil current, it can be shown that a small cone radiates more sound than a large one when the driving force *is the same in both cases*. But when the cone is driven by a coil, the problem is quite different. With a small cone we have already seen that the low frequency current is reduced, but there is another reduction due to the weight of the coil being relatively large compared with the weight of the diaphragm.

For example, suppose the coil weighs 7 grams, then a cone 3 inches in diameter, will weigh about 1.5 grams, i.e. the coil is 3.5 times the weight of the cone. On the other hand a cone 9 inches diameter would weigh about

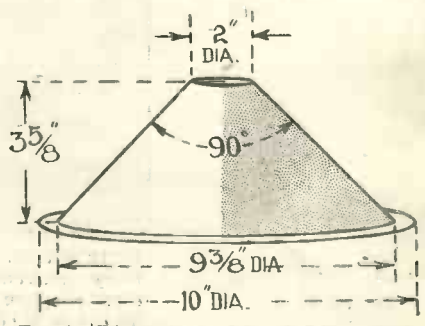


Fig. 6.—Dimensions of a suitable conical diaphragm

Moving-coil Loud-speakers *(Continued)*

12 grams, or nearly twice that of the coil.

Due mainly to this dead weight of the coil, but also to the reduced current, the output of a small cone at low and middle frequencies is appreciably less than that of a larger cone.

Not As Simple As It Appears

The reader may now argue that we are heading straight for a very large cone to get a really good "grip" of the air. But we must tread warily, because things are not quite so simple as appears on the surface.

Let us consider a cone whose diameter is 18 inches. The to and fro movement will be very small compared with that of the 3-inch cone. We should, therefore, expect a good bass register since the current due to the motion of the coil will not be affected to any extent.

At this juncture we must introduce an important aspect of the acoustic side of the problem.

Mass of Air Carried with Cone

When a cone moves backwards and forwards, it carries with it a certain mass of air. The larger the cone, the greater the mass of air it carries with it. Now the mass of air moved increases much more rapidly than the diameter of the cone. For example, at low frequencies the air-mass for the 18-inch cone is 16 times as great as for the 3-inch cone. This air-mass must be added to the mass of the cone.

It is this air-mass which is partly responsible for the reduction in output of a really large diaphragm at low frequencies. At the middle and higher frequencies, the behaviour of a large diaphragm is too complex for analysis here. The result depends upon the material, the thickness and the shape of the diaphragm.

Strange Behaviour of Large Cones

In certain tests I have conducted, from time to time, large cones behave in a peculiar manner and exactly the opposite of what one generally expects.

The output of a large cone is usually less than one of moderate size. There is a certain size of cone which yields a good acoustic register and a reasonable output. Different experimenters get various results, according to conditions. As the outcome of a large number of experiments with cones of varying size, I have found the dimensions of the conical diaphragm shown in Fig. 6 to give good results for use in a room of average size. It has substantially the same proportions as the one I designed for the Science Museum, as indicated in Fig. 1.

Perhaps a few remarks on mounting the cone may be of interest. All manner of materials have been tried for the peripheral support, for example, kid leather, chamois leather, thin paper, rubberised silk, stockinet, and thin rubber sheet.

No Satisfactory Material

None of these are satisfactory acoustically, and mechanically. An inelastic material like leather necessitates a device for centering the coil to prevent rattling on the pole pieces, unless a rather large air gap is used. This is most marked on the pedal notes of the organ. The coil, if not centered, moves sideways as well as axially.

Since the leather does not stretch sufficiently, a visible vibration is produced which usually causes rattling on the pot.

With a Centering Device

When the centering device is not employed, thin rubber is probably the best material. Owing to secular changes, the degree of tautness of the surround varies, and the coil may require re-centering from time to time. Rubber never lasts more than about eight to twelve months, but personally I prefer to use it without a centering device, despite the slight inconvenience of re-centering every two months or so.

The axial motion of the cone at 50 cycles being 400 times that at 1,000 cycles shows the necessity for providing a sufficient degree of freedom in the support to give the low notes, especially for large intensities, for example, the pedal organ, where the amplitude may exceed 1 millimetre.

Outdoor Wireless Is Really Great Fun!

Every amateur could learn many interesting things about reception if he took a set out in the country with him sometimes

It is a wonder what good results some improvised arrangements do give and it is really good fun thinking out new stunts. Why don't you try it?

Good results can be obtained even with a crystal set and a low aerial—if you have patience!

The PLAY'S THE THING IN BROADCASTING!

By GERTRUDE LAWRENCE,
the Famous Actress

Miss Gertrude Lawrence

A QUESTIONNAIRE addressed to a great many people on the subject of their inner motives for getting married once produced the most surprising results. Why do people get married? "Because they are in love," would be the conventional answer, and yet when the question was actually put confidentially to a number of husbands and wives their replies were widely and extraordinarily divergent.

Few Gave Expected Answer

Some admitted marrying for money, others to get a home, some because they thought they ought, and so forth, quite a modest proportion giving the ordinary expected answer.

Probably the result of asking people just why they go to the theatre would be equally surprising. Superficially it seems that the main attraction of the theatre is the play, but an analysis of the real motives of theatre-goers might reveal that they purchase their stalls and dress circle seats for a variety of other reasons.

It would not surprise me if some people were to confess that they go because in certain circles it is a fashionable thing to do; or that they are interested in the dress display both before and behind the curtain, or because they like the atmosphere of the theatre or the charming personality of one of the players. All of these are perfectly legitimate and above-board reasons for frequenting the theatre.

Effect of Subsidiary Arts

The circumstances surrounding the stage play happen to be such that a number of subsidiary arts help considerably to make or mar it. On the stage "the play's the thing" only to a limited extent, for many other factors contribute in an important degree to its success or failure.

It depends partly at least on the efforts of the scene painter. How many plays have gained materially by the spectacular element in the scenery? Visible beauty and effectiveness in this respect is a decidedly important element in the pulling power of any show, particularly in recent times, when it has become more and more intrusive.

Then there is the lure of the costume play, dependent to a degree upon the skill of the costumier, and, similar in kind, the modern comedy of manners, which is frequently a sort of mannequin parade as well as a show. How many theatre-goers are persuaded to book seats for a certain show, not because of the play itself, which occupies quite an inferior position in their minds, but because they know So-and-so will appear in it?

Many Considerations Apart from Play

I am not suggesting for one moment that there is anything wrong in the magic drawing power of the stars in the theatrical firmament; I merely state it as a fact in support of my contention that in any given theatrical venture many considerations apart from the worth of the play itself are responsible for support or neglect on the part of the public.

The inconspicuous position allotted to the author's name on the average playbill of to-day bears me out very eloquently. On the programme his name quite frequently appears in the same sized type as is used for the announcement that the cigarettes are supplied by Messrs. Blank and Blank.

All this is to emphasise the fact that the broadcast play is such an entirely different proposition.

Imagination All Important

It owes nothing to the scene painter The imagination is one's scenic artist, and possibly more expert than anyone actually engaged in the profession. It owes nothing to costumier or wig maker; here again the imagination may be a very efficient substitute. It has to do without facial gesture and mannerism and the magic of personality.

One of the truths revealed by broadcasting is that it reduces all actors and actresses to a common denomination. Your established actress possibly "gets over" the ether only a little, if any, better than the raw novice. There is not room for many stars in broadcasting.

Little Use for Stage-craft

Few of the tricks of stage-craft are of any avail; stage technique is of little use. Radio drama knows only a very short tradition; it is undeveloped and swiftly producing a technique of its own.

The Play's the Thing in Broadcasting ! (Continued)

The only way you can appeal to a radio audience, as I can see it, is by virtue of the play itself. You lose most of the adventitious aids of the stage artiste and, moreover, you are up against other difficulties, for the lack of scenery, gesture, visible performers and personality make a radio drama more difficult to follow—yet with an audience less inclined to concentrate than the audience in a theatre. In the home there are, of course, distractions and interruptions which would never occur in a theatre.

Thus the radio play takes us back even further, as it were, than the early drama which dispensed with scenery. It dispenses, not only with scenery, but also with visible actors and actresses. It is drama pure, simple, and unadulterated.

An "outside broadcast" amplifier such as might be used for relaying a play from a theatre

Twofold Results of Radio

The results will, I imagine, be twofold. Primarily there will arise a new race of playwrights with new ideals and methods consequent upon the limitations and conditions peculiar to broadcasting. They will be great experimenters. Although radio drama is as yet in its infancy, there is no doubt that present difficulties can and will be overcome.

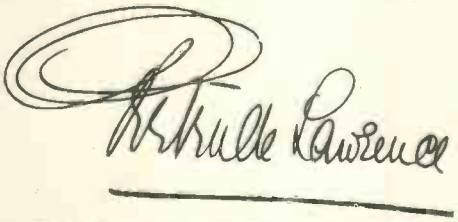
Of course, until radio dramatists have learnt by experience to perfect their art there are bound to be many radio revivals of past classics. The reasons for this are fairly plain. In the first place one of the main objections to the broadcasting of unfamiliar plays is the difficulty listeners find in following them completely and intelligently. This difficulty is very satisfactorily overcome by broadcasting old favourites which listeners will have no difficulty in following on account of their familiarity.

This will also mean that the best of the world's plays will be heard by countless thousands who are not already familiar with them, but who will be sufficiently interested to wish to see the play performed in its natural atmosphere on the legitimate stage. But the plays chosen will have to be good ones to make the experience of listening to them worth while for those not hearing them for the first time.

New Plays

Coincident with the broadcasting of these "revivals" will be the production of new plays by dramatists who have recognised that in broadcasting "the play's the thing"; and incidentally they will do something towards rescuing the playwright's name from the obscurity into which it has been thrown by contemporary theatrical developments.

Possibly they will live to see it once again get the limelight which it deserves.



"ECCENTRIC" LOUD-SPEAKERS

IN nearly every loud-speaker, either of the cone or pleated diaphragm type, the magnetic movement is connected at the exact centre of the diaphragm.

There is no real reason why this should be so, and those who are making up experimental loud-speakers may care to try the effect of placing the reed or other actuating mechanism "offset" from the centre.

The result obtained will depend largely upon the material of which the cone or pleated diaphragm is constructed. In theory, though, the effect should be to reduce the natural period of vibration of the cone.

In brief, the cone should combine the resonance periods of all diaphragms having radii from the least to the greatest of the actuating mechanism offset.

The improvement should be most noticeable with diaphragms of not too thick or rigid material. Q.

DOES YOUR R.C. SET "MOTOR-BOAT"?

FOR simple and straightforward sets the "detector and the resistance-coupled L.F." combination is ousting the "detector and the transformer-coupled L.F." arrangement.

There is, however, one little trouble which may possibly be experienced with R.C. sets, namely, that an annoying popping noise is experienced when critical reaction control is being effected.

The noise is somewhat similar to "motor-boating" due to L.F. oscillation, but is not, however, the direct product of audio-frequency interaction. In most cases it is due to H.F. currents getting past the choke, which is usually placed in series with the anode resistance.

A simple and effective cure is obtained by placing a grid leak in the short lead from the grid side of the coupling condenser to the actual grid. A value of about .5 to 1 megohm is usually sufficient for this "choking" resistance, and its duty, of course, is to keep stray H.F. currents from affecting L.F. amplification. U.

Half Hours with the Professor

ANOTHER CHAT ON LOUD-SPEAKERS

"IS there anything in this column-of-air business, Professor?" asked Amp one day.

"What a question to ask!" exclaimed Megohm. "What 'column-of-air business' are you talking about? Do you mean, is there such a thing as a column of air? because if you do, here is one," and he held out his hand.

Amp's Astonishment

Amp eyed the Professor with his mouth open.

"Here you are," said Megohm, "will you have it wrapped up or take as it is?"

"Take what?" stammered the boy.

"The column of air. Here it is on my hand." Seeing the boy's utter astonishment, he dropped his hand to his side and laughed. "I suppose what you really want to know is something about the air column in connection with loud-speakers; is that it?"

"Yes, please, Professor, if you can spare the time."

"Well," resumed the other, "there is not very much to explain. Any object like a diaphragm or one's hand will support a column of air and, if you set it in motion, you will cause the air to vibrate. But I can see that you are not convinced about the existence of this column of air. Let me show you." The Professor thought for a moment.

With the Aid of a Cycle Pump

"Did you come on your bicycle?" he asked at length.

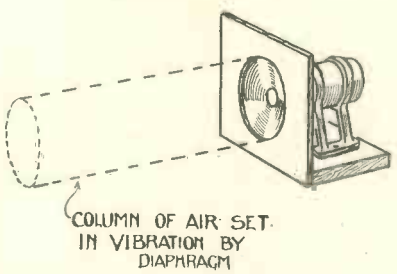
Amp nodded. "Well," he said, "step along and fetch me your pump."

The boy, wondering what on earth the Professor was up to now, scuttled away to get it.

"Here you are, Professor," he gasped breathlessly, a few moments later, bursting into the laboratory with the pump in his hand.

"Good," said Megohm. "We will now try a very simple experiment."

So saying, he took the pump and pulled out the plunger and held it upright. The plunger very slowly descended. "Now," he said, "that plunger is simply falling down very slowly owing to its weight. There is a certain amount of friction inside, which makes it return very slowly,



How loud-speaker diaphragm moves column of air

as you see. There is on top of this plunger a column of air, but there is also underneath it another column of air and the two pressures equalise so that there is no resultant force other than the weight of the plunger.

"Now if I push this plunger right down, I exclude all the air from underneath."

Amp nodded his agreement.

"Now," resumed Megohm, "if I place my finger over the bottom end of the pump and pull the plunger out, I prevent any air from getting in underneath. In these circumstances, I have to lift the plunger against the pressure of the column of air and you will find that it is considerable. Moreover, when I let it go, it returns to its original position with a snap." He suited his words to the action. "You try it for yourself."

"Oh, but that's because of the vacuum," interrupted the boy, in a superior tone.

Vacuum Does Not Exercise Force

"The vacuum is simply the action of the air pressure underneath. The vacuum itself does not exercise any force, but as we have removed the force from the underneath of the plunger, the air column on top pushes it down. That is the proper way to look at it. Now you can see why, when I held my hand out, I was really holding up a column of air for your inspection, only as there was another column immediately underneath, there was no force on my hand and I was able to hold it quite easily."

"But," objected Amp, "where does the loud-speaker come into it?"

"If I raise my hand," continued the Professor, "I lift that column of air, and if I raise it sharply, I do more than just lift it. I produce an actual compression of the air just above my hand. This causes the air to move upwards which, in turn, produces a compression of the air a little bit above and so on, so that the impulse will travel right up the column.

Production of Sound

"Similarly if I drop my hand, I produce a reduction of the pressure which causes a reverse effect to take place. Consequently, if I continue to move my hand up and down, I produce a series of vibrations of the air column above and below my hand. If I could do this rapidly—which I can't—you would hear a sound."

Read the Special Gramo-Radio Section of this Issue!

Half Hours with the Professor (Continued)

"Then is that how a loud-speaker works?" inquired Amp.

"Exactly," was the answer. "We have a diaphragm which is caused to move up and down more or less rapidly, and in doing so, it actually produces vibrations in the column of air above or in front of the diaphragm. You can actually feel it in some cases. For example, look at this."

A Moving-coil Loud-speaker

He led the Amp to a moving-coil loud-speaker in the corner of the laboratory. "I will connect this to a source of supply giving a low frequency." So saying, he connected the instrument to an oscillator, and switched on the current, when a low booming sound was heard from the loud-speaker. "Now," he said, "if you stand in front of this, you can feel that column of air vibrating."

"By Jove, Professor," exclaimed the boy, "you can too! But I never noticed that before."

Relative Amounts of Work

"You won't notice it in ordinary circumstances. At high frequencies it is only necessary to cause the column of air to move very short distances backwards and forwards, because we are moving it very rapidly. If I lift a weight of 10 pounds one foot I do 10 foot-pounds of work; but, if I like, I can lift five weights of two pounds each, one after the other, and I shall still do the same amount of work. Just in the same way, if we cause the column of air to vibrate very rapidly, we need only cause it to move quite a short distance, whereas if we move it more slowly, we must move it a greater distance in order to do the same amount of work."

Moving Column Same Distance

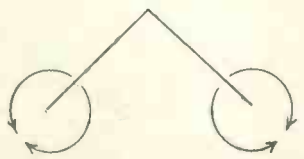
"But why should you do the same amount of work?" objected Amp. "I mean, wouldn't you get the same effect if you moved the column of air the same distance in all cases?"

"No. The actual intensity or strength of sound that you hear depends upon the work done. If we put equal inputs into the loud-speaker at different frequencies, then if we wish to get equal volumes of sound—which we must do for distortionless reproduction—then we must do the same amount of work in each case."

Amp pondered this for a short while. Finally, he said: "Then I suppose that the lower the note, the more the diaphragm will have to move?"

"That is exactly right," agreed the Professor. "As you get lower and lower in the audible scale, so to produce the same intensity of sound, you must make the diaphragm vibrate more and more.

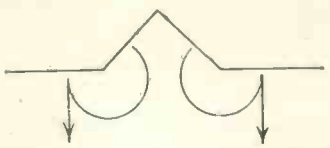
"That is the trouble with the ordinary type of loud-speaker. When it gets below a frequency of 300 or 400 cycles per second the diaphragm is physically incapable of moving the required distance, and, therefore, although it will vibrate at the very low frequencies, the actual energy of sound produced is quite inadequate and in consequence the low tones are lost."



With a simple diaphragm the low-tone radiations come off both sides and interfere

"Is that why they use these moving-coil loud-speakers?" queried Amp.

"Yes, that is the principal reason. You have seen how very free the diaphragms of these loud-speakers are and you can also see how great is the possible movement. This one, for example," he went on, going up to the model previously exhibited, "this one you can push in and out nearly half an inch. You can actually see it moving when you get down to very low frequencies."



The addition of a baffle causes the low tones to be radiated properly

So saying, he switched on the oscillator once again and ran the frequency down until the diaphragm could be seen moving in and out. Indeed the movement was so much that it seemed that it would almost come adrift.

Equal Energy Over Whole Scale

"With an instrument of this type," resumed Megohm, "we are able to produce sufficient movement of the diaphragm at these low frequencies to radiate an equal amount of energy to that at the top end of the scale. You will be able to hear this for yourself, as I run down the scale."

So saying, the Professor tuned the oscillator to a high note and gradually ran down the scale to the very lowest, the intensity of the sound remaining very much the same the whole way.

"Compare that with this," said Megohm, changing over to a small type of horn loud-speaker. "Quite apart from any resonance effects which you may notice, you will see that although the low tones are reproduced they are much weaker in comparison with the others and therefore in the reproduction of an orchestral piece they would be lost."

Big Board Round the Cone

Amp grinned delightedly at the experiment. "Thank you, Professor," he said, "that seems to make the position very clear. I wish you would tell me, though, why you have to use that big board round the loud-speaker—the moving-coil one, I mean."

"That," said Megohm, "is known as a baffle. On these low tones, it is found that the sound waves which come off the front and back of the diaphragm interfere with each other. You will see that there is not only a column of air in front of the diaphragm, but also at the back and these are both set in motion."

Amp Understood That!

Amp nodded, as he usually did when he understood any particular point.

"At low frequencies these two effects interfere with each other and prevent the actual sound from being radiated into the room. Hence we put a large baffle in between the front and back of the diaphragm,

Another Chat on Loud-speakers

making it, as far as possible, continuous with the loud-speaker itself. This prevents the interference from taking place and the low tones will then be radiated properly."

"Listen to the difference," he added, switching on the oscillator once again, and tuning it to a low note. "You can hear the volume of sound which you are obtaining here. I will now remove the baffle and you will observe the result."

Strength Decreased Considerably

He did so and at once the intensity of the sound fell away markedly and was only a fraction of its former value. Replacing the baffle at once brought the strength up again.

"Thus you will see," he continued, "that it is necessary to have some means of screening the front from the back. You can do this either with a large baffle board or by enclosing the loud-speaker in a suitable cabinet."

"Will any sort of box do?" asked the boy.

"It should preferably be open at the back in order to avoid box resonance. Alternatively, the box itself can be lined or packed with cotton wool in order to damp out any resonance effect. Otherwise, there is a danger of obtaining a rubbing or hollow noise."

"It sounds very interesting," pondered Amp. "Does that only apply to moving-coil loud-speakers?"

"No. It applies equally to any horn or large-diaphragm loud-speaker. Indeed, many a cone-type loud-speaker is quite poor unless it is fitted with a baffle or housed in a suitable cabinet."

"I see. I remember Henry had an ordinary cone loud-speaker and he drilled a lot of holes in the back. I thought he was spoiling the whole thing, but he said it made it better."

Minimising Box Resonance

"That is quite possible," agreed Megohm, "for it would minimise any tendency to box resonance which had previously been present. Anyhow there we are and now you know all about loud-speaker design. I shall expect you to send me a complimentary sample when the new Amp loud-speaker comes on the market."

Amp grinned. "Shurrup," he said. "I only wish I could design one, but the trouble is I forget it all as soon as I get out of this place."

Professor Megohm also discussed loud-speakers with Amp in May last year. Look out for their half-hour together next month!

Why Not Public Broadcasting?

CARDIFF has started to develop its orchestral arrangements along municipal lines. As a result of this, it is possible that, whenever an orchestral broadcast of more than usual importance is due to take place, the public will be given the opportunity either of hearing the programme via radio, or of going to some local hall and both watching and listening to the performers.

Hearty Recommendation

This is on somewhat similar lines to the public National Symphony concerts organised from time to time in the London district by the B.B.C. That on nearly every occasion the halls have been packed with listeners (many of whom have had radio sets at home, but who preferred to listen direct, for a change) is hearty recommendation for public broadcasting.

It makes one wonder whether we in this country will in time follow the lead set by a number of American broadcasting organisations. In the States it is no unusual thing for studio performances to be open to the public, and Melbourne, Australia, also has an outsize in studios in which semi-public broadcasts can be given.

What is needed is not an extension of the idea of inviting half a dozen or so friends to a small studio to hear one particular performance. The laughter and applause of this tiny band of listeners is distracting to the thousands who hear the combined noise broadcast.

What *is* a scheme worth considering is an extension of the National Symphony idea, whereby broadcasts are given in large halls, owned *pro tem.* by the B.B.C., to which itinerant listeners may go if they please.

"Quick, Harry, put it together—Father's coming!"

On many previous occasions the advantages of giving broadcast artistes an audience to which to perform have been pointed out. Public broadcasts, with thousands of visible listeners, would re-create that old concert-hall feeling, to which genuine artists would respond. It is a mistake to say that studio broadcasts, in which no audience is present, overcome "stage" fright. "Mike" fright is far worse.

An Occasional Change

We cannot overlook the fact that the active efforts of the B.B.C., good as they are, have not yet killed the cinema, the theatre, and the concert hall. Even the most confirmed radio men choose one of these entertainments as an occasional change from "listening to the unseen."

If the B.B.C. cared to offer visual entertainment (broadcasting the performances, of course), it could add still further to its coffers and would give listeners a new avenue of entertainment. The authorities should consider the suggestion. QUEUE.

Assembled and Tested by the "Wireless Magazine" Technical Staff

A COIL-DRIVEN LOUD-SPEAKER WITH PERMANENT MAGNETS

Completed loud-speaker—with Edward's baffle

ONE of the greatest disadvantages of the ordinary coil-driven loud-speaker is that a comparatively large current is needed to excite the field coil in the iron magnet pot.

It is true that either electric-light mains or an accumulator can be used as the source of supply, but many amateurs have no access to the former and cannot afford to run a large 6-volt battery just to work a loud-speaker.

Use of Permanent Magnets

These listeners are not entirely debarred from using a coil-driven loud-speaker, however, for a number of firms are now marketing instruments provided with permanent magnets which can be operated by just connecting them to a receiver in the ordinary way.

So that it can adequately cater for all of its readers, therefore, the WIRELESS MAGAZINE has assembled and tested one of these permanent-magnets loud-speakers. This article explains exactly what the amateur has to do for himself and what is done by the makers—who in this case are Messrs. Baker's of Selhurst.

Impossible to "Make" One

In the first case it should be clearly pointed out that it is beyond the average amateur to actually "make" such a loud-speaker as that illustrated in these pages. All that the amateur can do is to buy the castings and simply assemble the moving coil, cone diaphragm and baffle.

These, then, are the only points that can be explained in this article and all that the available blueprint shows.

It will be noticed from the photographs that the magnetic field is obtained by mounting four U-shaped magnets with their ends placed in juxtaposition. These magnets, which are as large in size as those utilised in motor-car magnetos, produce a strong enough field to give the required movement to the coil attached to the diaphragm.

Side view of the loud-speaker showing size of permanent magnets

As far as the WIRELESS MAGAZINE Technical Staff is aware, Baker's of Selhurst are the only firm making a permanent-magnet loud-speaker with this type of magnet, although there are some other types available, made up with ordinary bar magnets fixed together something in the form of the more usual "pot."

The parts that can be obtained from Baker's are the magnet system with the frame for mounting the cone, the moving coil, the material on which to mount the diaphragm and the paper for the diaphragm itself.

The magnet-system and frame are, of course, standard for this type of instrument, but it is possible to vary the remainder of the necessary parts considerably.

Different Moving Coils

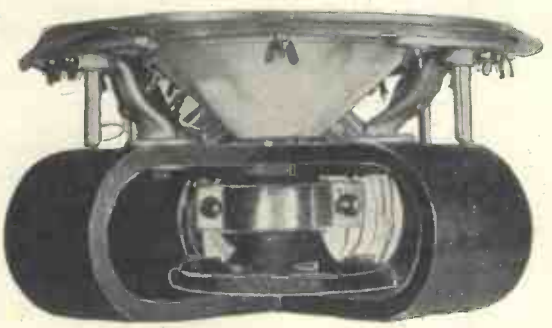
For instance, moving coils are available with various resistances. The WIRELESS MAGAZINE Technical Staff has tried a number of coils with this particular loud-speaker and has found, unless a special output transformer is used, that one with a resistance of 1,400 ohms is the best.

The choice of material for suspending the diaphragm is not quite so easy. It is possible to use rubber, oiled silk or chamois leather.

Oiled Silk Easiest to Work With

After considerable experiment, the WIRELESS MAGAZINE Technical Staff has come to the conclusion that oiled silk is the easiest with which to work, although, as a matter of fact, J. H. Reyner, our Technical Editor, prefers leather and Dr. McLachlan, the authority who contributes a special article on page 423, likes rubber best. Readers are recommended to try all three materials for themselves.

When all the parts have been obtained the first thing is to form the



Plan view of the loud-speaker. Note the positions of the cone and magnets

cone diaphragm; the dimensions of this are indicated on the blueprint and on the reduced reproduction in these pages.

Copies of the full-size blueprint can be obtained for half-price, that is 6d. post free, up to June 30, if the coupon on page iii of the cover is used. Address your inquiry to Blueprint Dept., WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4. Ask for blueprint No. W.M.75.

Sticking the Cone

When the cone paper has been cut out, stick the overlapping edges together with Seccotine or Croid and allow to dry.

Next stretch the supporting material in the frame itself between the cardboard rings supplied. After slightly flattening the edges of the cone all round with a small piece of wood apply Seccotine or Croid and place the cone carefully in the centre of the supporting material. A small weight can be placed on the top of the cone to keep it flat while drying.

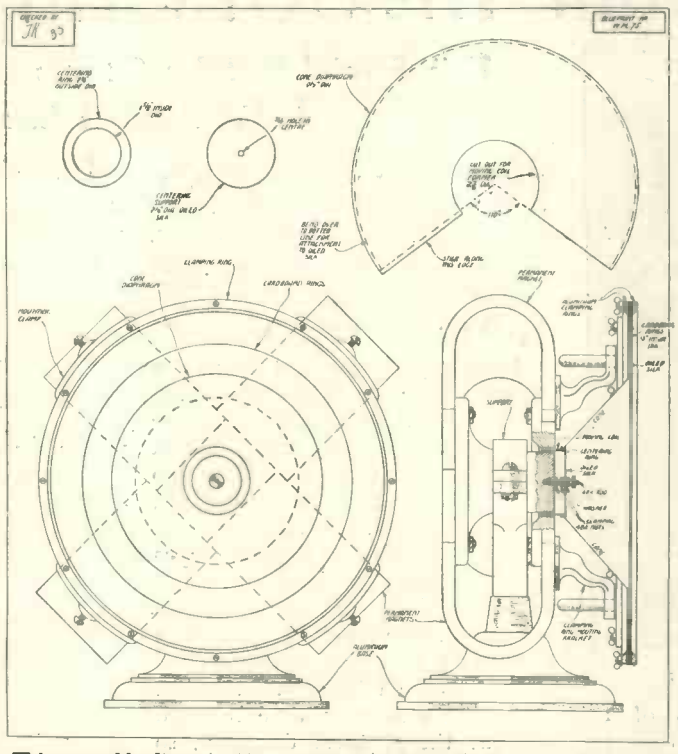
As soon as the cone has become firmly affixed to the supporting material, stick the moving coil in position by applying adhesive to the outside of the former. Care should be taken to see that the coil is square with the face of the cone.

Now, carefully cut away the centre part of the supporting material to within ⅛ in. of the edge of the cone so that the latter is open. The loose edge left after cutting should be stuck to the cone for extra strength. Do not cut the material that hangs outside the frame.

Forming the Centering Piece

The centering piece should now be formed. This is shown in the blueprint and consists of a small ring of cardboard over which is stretched (and stuck) a disc of oiled silk, which has a hole exactly in its centre, through which the centering rod can pass. (The size is 4BA). This centering piece is stuck to the edge of the moving-coil former, inside the cone.

Clean out the air gap so that it is free from dust and metal filings and centre the moving coil in the opening as accurately as can be done by eye. Final adjustment can be carried out by means of the special centering device. For this operation patience is needed!



This assembly diagram (the parts cannot be made, but must be bought) can be obtained as a full-size blueprint for half-price, that is 6d., post free, if the coupon on page iii of the cover is used before the end of June. Ask for blueprint No. W.M.75

When the coil is centered accurately, the whole diaphragm should move freely to and fro by just blowing on it.

To use the loud-speaker connect the leads from the moving coil to the two terminals on the frame and these in turn to the output of the receiver to be used.

It is essential for good results that not the slightest trace of distortion be present in the receiver and that adequate power is given by the output stage. A choke output circuit, final push-pull stage of amplification, or transformer output is essential. Several output circuits are shown on pages 342 and 343 of the May issue.

Output Valves

The last valve must have an impedance of 5,000 ohms or *less*; it is best to use two such valves in parallel. Suitable valves are as follows, in order of make, type, filament voltage and impedance:

Cossor—410P, 4, 5,000; 220P, 2, 5,000; 610P, 6, 3,000.

Cosmos—SP50/R, 6, 4,500.

Ediswan—PV610, 6, 4,200.

Marconi—DEP610, 6, 4,500; DE5A, 6, 4,000; DEP240, 2, 3,000.

Mullard—PM252, 2, 3,800; PM256, 6, 3,500; PM254, 4, 3,500.

Osram—DEP610, 6, 4,500; DE5A, 6, 4,000; DEP240, 2, 3,000.

Six-Sixty—SS425SP, 4, 3,600.

Front view of the loud-speaker without baffle

This coil-driven loud-speaker with permanent magnets needs no current to operate it except that ordinarily obtained from the output of the set in use

Use of Baffle

In order that the bass be reproduced at its best, it is, of course, essential to use a baffle. This point is explained for the novice on page 429. One suitable type of baffle is shown by the photograph on the opposite page.

It is desirable that the baffle should have a reasonably large area and a board about 4 ft. square is found to give excellent results. The size is not critical, but the baffle should be kept as large as is practicable under the circumstances.

A board about 2 ft. square will be found quite good in an ordinary room.

Wireless Magazine, June, 1928

J. H. Reyner, B.Sc., A.M.I.E.E., says

More About The SUNSHINE FIVE

This Special Portable Set was Fully Described in the Previous Issue

Listening at Lyme Regis

ONE of the blessings of the movable Easter is that the weather is usually fine. In fact, I believe there have only been one or two occasions in the present century when this has not been the case. Anyhow, banking on this as a reasonable prospect, we took the road on the Thursday before Easter with the intention of spending a few days in Somerset and Dorset. The Sunshine Five was included as part of the baggage for two reasons.

Enjoyment

In the first place, my Scottish holiday last year convinced me of the enjoyment which one can obtain with a portable receiver. Those readers who followed my account of that tour will remember that I had to go to the trouble of rigging a small aerial each evening but, even so, the pleasure obtained was considerable.

On this occasion I was hoping that no such attention would be necessary and that the set would give us music wherever we went. This, indeed, constituted the second reason for taking the Sunshine Five with us, as I was desirous of ascertaining its performance on a holiday of this type.

Up to Expectations

I may say at once that the results were very pleasing and up to my expectations. At no point was there the slightest difficulty in obtaining a programme, and in many cases two or three programmes were available, particularly after dark.

We travelled down the first day as far as Devizes in Wiltshire. Tea was taken by the roadside and the set was brought into commission for the first time, this being at a distance of fifty miles from London. London, Daventry, and 5GB were received without the slightest difficulty, so that test number 1 obtained full marks.

When we reached the hotel at Devizes, we spent our evening listening to Charlot's hour from Daventry 5XX, and a test showed that 5GB was receivable at equally good strength. London at this distance (90 miles) could just be heard, but I should not consider the reception good.

Operators at the Burnham Wireless Station display keen interest in the "Sunshine Five"

As we left Devizes next morning, it was not possible to test daylight range, but my later experiences indicated that equally good reception on the two stations quoted would have been possible during daytime. The morning transmission from Radio-Paris, however, was obtainable without difficulty at a fairly good strength.

Further Afield Still

The next few days were spent in and around Burnham-on-Sea in Somerset. Here excellent reception was obtained from Daventry 5XX and from Cardiff, which is between twenty and thirty miles away. I was disappointed here to find that the reception of 5GB was poor; and, indeed, I could not tune him in at satisfactory strength. This caused me some misgiving, for the distance from Daventry is only a little over 100 miles, and I anticipated a better range than this.

I paid a visit, however, to some old friends—the operators at the Burnham Wireless Station (with the erection of which I had been associated when I was in the Post Office). I thought that they would have some knowledge of local conditions, and they told me that the reception of Daventry Experimental in the Burnham district was unaccountably poor.

No Defect in the Set

The trouble was noticed on the ordinary sets employed by people in the vicinity, so that my failure to receive this station at good strength was not due to any defect in the receiver. This was subsequently borne out by the results obtained in other districts.

Incidentally, the operators were very pleased with the performance of the set, particularly having regard

to its portability and compactness. One of the photographs reproduced herewith shows a critical examination of the receiver in progress, but I am glad to say that the set was passed as Class A by unanimous vote.

Daventry at Good Strength

From Burnham as a centre we made excursions as far as Clevedon in the North and Taunton in the south-west and at both of these places Daventry Experimental appeared once again at good strength so that this bears out the suggestion that local conditions render its reception poor in the actual Burnham district. 5XX and Cardiff were also received at these places.

In returning from Clevedon the road through Cheddar was taken, but instead of descending the well-known Cheddar Gorge, we took the route through Burrington Combe. Here, despite the presence of high cliffs on each side, good reception was obtainable.

On Easter Sunday we made an excursion to Brean Down where we again obtained excellent reception—both from Cardiff and 5XX—of the service relayed from York Minster. This was despite the fact that we were right under the base of the cliffs.

A Pleasurable Meeting

I had the pleasure here of meeting a holiday-maker from the Birmingham district, who was much interested in the reception which, indeed, was so loud that it attracted his attention as he walked by. He consented to allow me to take his photograph beside the receiver and we spent an interesting morning together.

Unfortunately, I forgot to ask his name, but if he should see this article, and would like a reproduction of the photograph, I should be pleased to send him one if he will write to me.

Rather Tricky Reception

On the same occasion, a little later during the morning, I tuned in Hilversum and Radio Paris, but the reception of these stations was a little tricky and required care. During the evening reception was also obtainable at good strength from Bournemouth which is about 60 miles away.

So far we had only been able to test on Daventry at a distance of a little over 100 miles, but on Easter Monday we journeyed across country to Lyme Regis on the South Coast. We found a suitable site for tea half-way up the cliff overlooking Charmouth, a few miles from Lyme Regis and here we had a wonderful view over the sea in both directions.

The distance from Daventry here is 130 miles and we were again somewhat under the lea of the cliffs as can be seen from the photograph, for we were not completely on the top. The reception from 5XX, however was excellent and I was not able to notice very much difference in the volume due to the extra thirty miles. We were entertained during tea with the Children's Hour, including, as far as I remember, a thrilling story concerning a haunted mansion.

After tea, I hunted round to see what else was available and obtained Daventry Junior, Cardiff and Bournemouth all at good strength. The latter stations are fifty miles from the point at which we were listening and, as this was a daytime range, I felt that the receiver was indeed "pulling its weight."

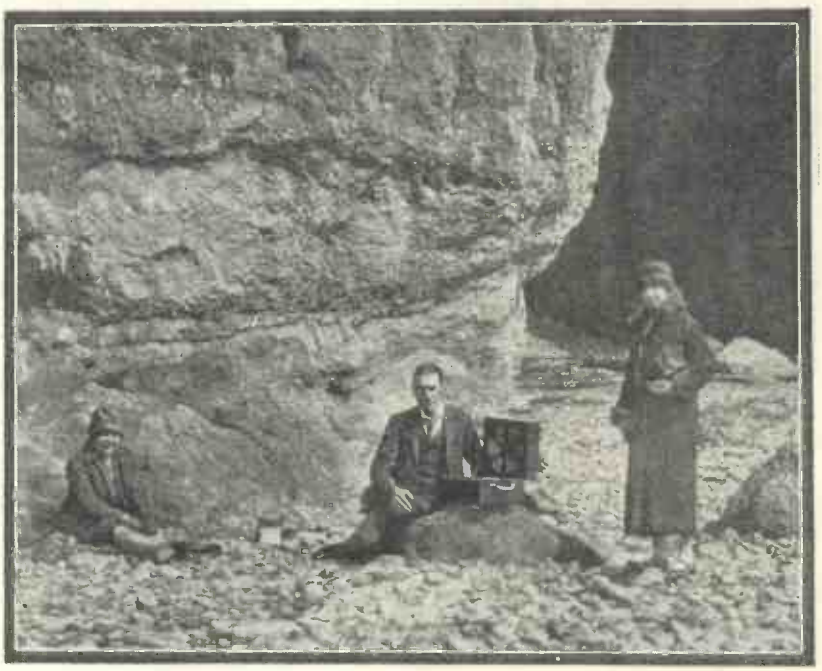
Satisfied with First Trial

On the whole, therefore, I feel satisfied with this first trial of the receiver under practical conditions. No adjustment of any sort had to be made, but I would point out the necessity of using the correct types of valves as specified in last month's article.

The valves were actually packed with cotton wool to avoid jarring during transit, and they gave no trouble throughout the tour. The set was transported in its horizontal position so that the accumulator was normally the correct way up.

No Acid Spilt Whatever

It was, of course, tipped on its side when actually carried by hand from place to place, but when at rest it was left in such a position that the accumulator was the correct way up. Examination of the receiver at the conclusion of the tour indicated that no acid whatever had been spilt, so that on this account, as well as on that of the performance, the receiver had behaved quite satisfactorily.



At Brean Down excellent results were obtained

As I mentioned in the original article, I propose to make occasional tours in different parts of the country, with a view to finding what the performance of the receiver is under varying conditions and these results will be published from time to time.

WHAT STATION WAS THAT?

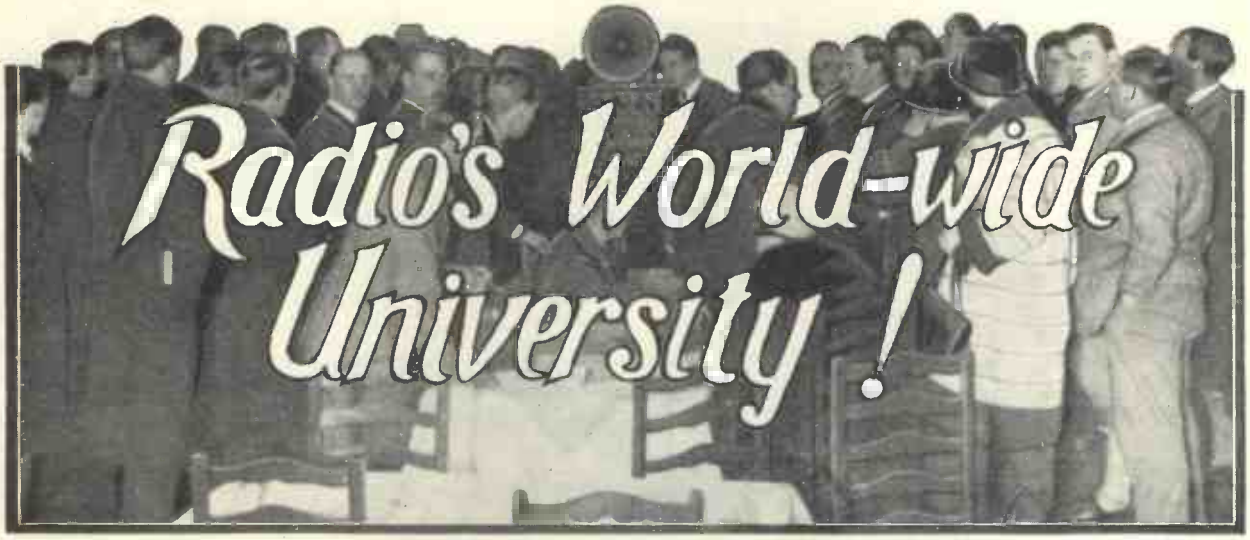
The Editor of the "Wireless Magazine" has made arrangements to assist readers who are in difficulty over the identification of broadcasting stations they receive.

Each query should give as many particulars as possible (such as time, date, wavelength, language, and distinctive call or signal) and should be accompanied by the coupon on page iii of the cover and a fee of one shilling) postal order or stamps).

Address each query to "Station Identification," "Wireless Magazine," 58/61 Fetter Lane, London, E.C.4.

Wireless Magazine. June, 1928

Specially Written for the "Wireless Magazine" by B.B.C. Officials



Radio's World-wide University!

LISTENERS have heard a good deal in the past year and a half about education by wireless and the radio university of the future; in fact, have been told frequently that the wireless university is on the way.

As a consequence, a feeling has sprung up in certain quarters that it is necessary to watch closely any tendency to force the educational element in broadcasting on the public at the expense of the purely recreational programme.

In Response to a Definite Demand

The educational aspect in the B.B.C. programmes does not arise from any desire on the part of the B.B.C. to force education on listeners, or from any sense of superiority, but is in response to a definite demand by the bodies responsible for adult education for programme time. Such service as broadcasting can render to education in this way cannot be avoided by the B.B.C.

The instrument which the broadcasting authorities control is essentially one for the reproducing of sound at a distance; this includes not only music, but anything connected with the spoken word. The inevitable result is that a certain similarity is bound to be apparent in broadcasting programmes all over the world.

In England and America

In England we have our Ministry of Health talks, while in America health talks are broadcast by the big commercial organisations. One New York station comes out avowedly sympathetic to education with its "Air College" in conjunction with New York University, while another competes with courses arranged in conjunction with Columbia University. Broadcast lectures are sometimes provided for correspondence classes and the members have their papers corrected for a fee.

The German stations live up to the view expressed by Dr. Hans Bredow, Secretary of State, namely, that "Next to the school and the printing art, broadcasting is perhaps the best means of influencing the cultural status of a people." The broadcast talks include lessons in English, Spanish, Italian, French, and Esperanto. Other subjects are art, women's work, shorthand, astronomy, law, literature, and even physics.

Many Health Talks for Teutons

With his characteristic proclivity to discuss human anatomy and its frailties, the German listener likes especially to hear talks on disease; therefore some stations broadcast advise on the care of the lungs, on the cause of rheumatism and its treatment and other diseases of the joints. They even broadcast descriptions of lunatic asylums.

In Holland considerable attention is paid to the education of the large nomadic population which spends its life on the canals, and most of the boats have listening sets. Languages, shorthand, book-keeping, and singing lessons are broadcast regularly, as well as religious instruction.

The French stations broadcast instructions in English, Esperanto, Spanish, economics, and children's studies, and talks from the College de France. Belgium, Spain, Czecho-Slovakia, and Yugo-Slavia, too, run regular series of educational broadcasts; practically all Continental broadcasting stations make a speciality of lessons in English.

Growth Not Fortuitous

This growth of the educational tendency in broadcasting is not fortuitous. It is all part of what one might regard as the pre-ordained mission of wireless; and the B.B.C. was undoubtedly a pioneer in the work of creating the demand which is now calling for something more than has been provided in the past by the University, the college, and the organised tutorial class.

The view used to be freely expressed that broadcasting was simply a new toy and that it would cease to interest when the novelty had worn off. That was an opinion which gave the officials at Savoy Hill cause for much serious reflection during the years 1922-1924.

No Divided Counsels Inside

Fortunately, while the advice received from outside showed enormous divergencies as to the way in which broadcasting should be conducted, if it were to live, counsels inside the B.B.C. were not divided, and the staff of those days wholeheartedly followed its chief, Mr. Reith, in his campaign against the critics who would have confined the new industry to a form of light and scrappy entertainment.

One round-table conference of the handful of people who were responsible for the early programmes stands out vividly in the memory. A budget of criticism was under discussion and one salient argument was being deeply pondered.

Gramophone Experiences

It was this: "Be guided by the experience of the gramophone companies. In a quarter of a century's contact with the public they have found it unprofitable to produce large numbers of records which will play for more than about five minutes. This shows that the public will not stand for attempts on the B.B.C.'s part to inflict on listeners instalment, or series, programmes.

Light Entertainment Wanted

"It isn't a question whether you should have one speaker giving a course of talks, or many speakers giving many talks; but, rather, whether you should have a whole series of talks at all. We want light entertainment when our day's work is done and we sit in an arm-chair with pipe going full blast and feet encased in easy slippers. Leave it to the writers of serious books to produce something which will 'call old men from the chimney corner and children from their play.'"

This attitude was backed up by other critics who said that they noted in the programmes that one speaker was to give a talk on the Houses of Parliament. "How will he manage to get up there?" And that a noted scientist would speak on "The Moon." "Easily your most novel broadcast to date. Give us plenty of this sort."

Vein of Cynicism Not Uncommon

Naturally this vein of cynicism has not been uncommon at any time since the inception of broadcasting; but the B.B.C. decided to go ahead with its experiment in evening continuation work and adult education, because, while it had had many criticisms, it had also received a host of congratulations on the efforts to make of broadcasting an important link in the national life, a means of raising the general level of culture, and a medium of entertainment.

Where the B.B.C. did not see eye to eye with the critics of its policy was in the definition of entertainment. The Hadow Committee, in the year 1928, expresses an opinion which has been held at Savoy Hill for five years and more. It is that it is impossible to draw a hard-and-fast line between recreation and education.

Some members of the public will declare that listening to a revue or musical comedy is their idea of recreation; others will regard a symphony orchestra broadcast as both recreation and education; while others will confine their definition of entertainment to general talks, debates, and readings—whatever, in fact, keeps them in touch with current affairs and modern thought.

The latter category provides, at a moderate estimate, some £30,000 a year in licence fees, and thus holds a fairly substantial stake in broadcasting. Its views and requirements, therefore, merit some consideration.

An Open Question

There is probably some feeling that, pending the provision of alternative programmes, broadcasts of a more distinctly educational type should be avoided; but it is an open question whether the mass of listeners would really wish that anything of an informative kind should be entirely omitted from the general programmes.

Rather, while we are awaiting the coming of the regional stations, with their alternative programmes—a project which may not fructify completely for three years—the line of development, and one which will probably most satisfactorily meet the wishes of the bulk of listeners, will be in the direction of providing general programmes that are educative in the broadest sense; programmes that will give the best in music, drama, and literature, with, of course variety entertainment and light music occupying their rightful place.

Share of General Broadcasts

Until some individual stations, or a definite wavelength, can be set aside for a really educational course, general talks and more formal educational matter must occupy some share of the general broadcasts, and a part, at least, of this material will continue to be given in the general programmes, even when an alternative scheme is in being.

The officials at Savoy Hill cannot visualise the general acquiescence of listeners in the disappearance of Sir Walford Davies, Sir Oliver Lodge, or Captain Eckersley from the mass programmes, and yet those three would form a substantial backbone for any educational programme.

More Funds Needed

The first step towards the elaboration of a systematised scheme of education by wireless relates to finance. The greater its activities, then, the more vital the need of the B.B.C. for adequate funds wherewith to carry out its plans.

Wireless Trade Figures

SOME—extraordinary, one might almost say incredible, figures are being quoted with regard to the wireless trade of the United States of America.

Last year, so these figures proclaim, the total volume of wireless business done in the States was to a value of no less than one hundred and ten million pounds, a value which makes wireless rank as the sixth amongst the industries of the country.

Some idea as to the magnitude of this figure may be obtained from the fact that it represents an amount of over a pound per head of the entire population of the United States.

This tremendous volume of trade has been built up in seven years. In 1921, the wireless trade of the United States amounted to a mere four hundred thousand pounds. The following year, multi-valve sets, including neutrodyne sets, caused a great increase in wireless business and the trade figure for wireless rose to a value of twelve million pounds.

Great Increase In Four Years

In 1923, the trade figure for wireless was thirty millions; in 1924, seventy millions; and in 1925, eighty-two millions. In 1926, the figure did not fall far short of a hundred million pounds. In 1927, the figure, as we have seen, was well above the hundred million mark.

Don't you think we are justified, not only in congratulating our American cousins on the great development of their wireless trade, but also on the admirable way in which they compile trade figures relating to that trade? AERIAL.

In this Article DAVID LYSTANER Records Some of His

Aerial Adventures!

A crystal set with a low aerial!

FOR the last few years I have been keenly interested in the experimental side of wireless, and I have carried out a considerable amount of experimental work in reception.

Now, I possess two records of my work. The first, a written record, is to be found in various notebooks. The second, a record on a larger scale, is to be found on the shelves and floor of an attic which the vulgar would call a wireless junk room, but which I prefer to call my wireless store-room.

Tremendous Enjoyment

Looking through my written records recently, and casting a reminiscent eye round this wireless store-room of mine, I seemed to realise to the full what a tremendous amount of enjoyment I have had out of my adventures into the realms of experimental wireless.

The thought came to me that if I described some of my wireless adventures others might be encouraged to try similar adventures, and, in so doing, derive an amount of enjoyment comparable in size to that which I have derived from my experimental work.

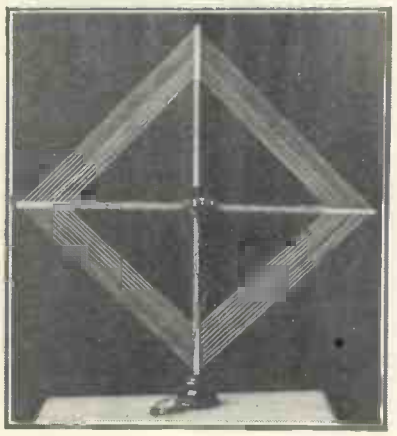
Things I Have Done Myself

In giving an account of my adventures, I am concerned with work I have done myself, with things I have observed, and with little discoveries I have made. It is, therefore, much the easier thing for me to do to let my account take the form of a personal narrative.

I apologise for this, and I feel sure that I shall be forgiven for adopting what is to me the most convenient mode of expression for my present purpose of trying to encourage others to attempt similar work.

A miscellaneous collection of insulators on a shelf in my wireless store-room reminded me what a good time I have had with experimental work on aerials. Never, since I first started wireless, have I been a one-aerial man. In addition to my permanent aerial, I always have two or three other aerials of a distinctly experimental type hanging about the house or garden somewhere. It is with these odd aerials, here to-day and gone to-morrow, that I have had my most interesting aerial adventures.

Perhaps I have enjoyed myself the more with these odd aerials of mine



One of the author's frame aerials

when I have got off the beaten track in aerial design and have attempted the seemingly impossible with some strange, law-defying freak aerial.

I remember one such aerial I constructed—some time ago now—in my garden. This particular aerial was erected in a great hurry, and not only was it of curious shape, but it was not properly insulated.

I ran the wire of this aerial from a convenient tree at the end of my garden to a bedroom window on the garden side of the house. This would have been all very well had there not been a tall tree in the middle of the garden directly in the run of my wire.

Seeing that my aerial wire was bound to foul this tall tree, and having neither the time nor the courage to cut away the offending branches, I obtained a long clothes prop and a pair of steps. Climbing the steps, I got the aerial wire in the fork of the clothes prop and pushed the wire as high up in the offending tree as I could reach.

An Inverted-V Aerial

My aerial wire thus took the unusual form of an inverted *V*. The apex of the *V* was higher than any other point of the wire, and the wire passed over a small, high branch of the tree at this apex. Moreover, the wire was not in any way insulated from the branch it touched. The results I obtained from this non-insulated inverted-*V* aerial were surprisingly good.

If you are in a great hurry to erect an aerial in your garden at any time, you need not hesitate to throw a length of bare aerial wire over a tree. Try such a makeshift aerial sometime, and I think you will be surprised at the results you get from it.

Immune from Atmospherics

An aerial with which I once had an amusing adventure consisted of a length of aerial wire, ninety feet long, erected at a uniform height of seven feet above the ground. This aerial was really the last of three aerials I had erected at different heights above the ground to test the truth of the theory that a low aerial was more immune from atmospherics than a high aerial.

The first aerial of the three was erected at a height of twenty feet above the ground, the second at a height of twelve feet above the

Holding the aerial hoisting string

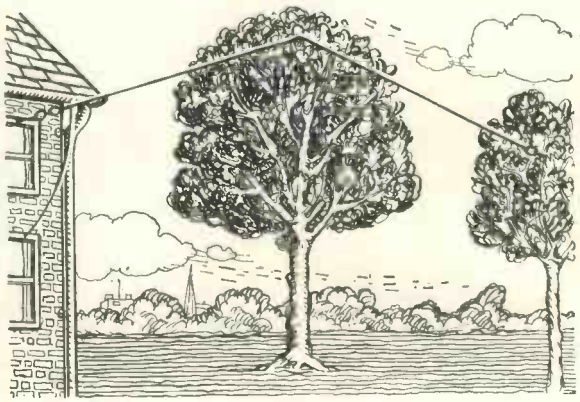
ground, and the third, as stated, at a height of seven feet.

Although I did not obtain any very definite results with regard to atmospherics, I certainly found that the lowest aerial had the quietest background. Indeed, that low aerial was remarkably free from the noisiness one generally associates with the average aerial.

Mistaken for a Clothes-line!

Now, the run of this low aerial took it over an enclosed space adjoining the kitchen. The height and position of the wire over this enclosed space, or "backyard"—to give it a name familiar to some of us—were such that a charwoman constantly mistook the wire for a clothes-line.

The good woman hung floor-rugs over the wire and, during the spasmodic and vicious beating process the rugs underwent subsequently, my low aerial was invariably brought down to earth. Since this charwoman seemed absolutely incapable of distinguishing between my low aerial and the legitimate clothes-line, I was compelled to move my low aerial to a quieter neighbourhood in order to obtain continuity in my experiments.



An inverted-V aerial

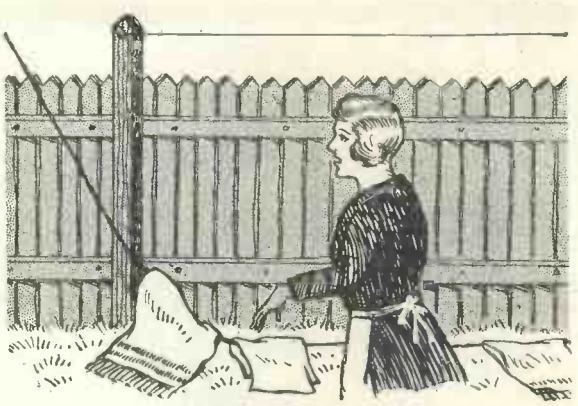
Let me tell you of an interesting aerial adventure of mine which concerned a very tall aerial mast. One fine summer afternoon, I happened to be walking out in the country near my home, when I came across a gang of telephone linesmen at work on the erection of a tall telephone pole by the roadside.

I watched the men dig the hole in the form of steps and I stood fascinated while they pushed the heavy pole up into a vertical position by means of their ladders. I even stood by while they fixed the guy ropes and filled in the hole.

Pole Arriving in My Garden!

As I walked away, I made up my mind that I would have a similar tall pole to replace the rather short aerial mast I had in use at that time. Would you believe it, that same night, as I sat in my easy-chair looking out of my window, I saw a huge telephone pole arrive in my garden, and the same gang of men to fix it for me? I was too comfortable to move so I watched those men erect my tall pole in record time.

Unfortunately, just before the guy ropes were secured in position——I woke up from my after-supper snooze, and that is the end of that little adventure to date.



The fall of the low aerial

I have not finished with the tall pole idea, though. I still have hopes that some day I shall be the proud possessor of a very tall aerial mast, one as tall as any telephone pole I have ever seen. When I do get that tall mast, I shall have climbing brackets fixed to it, all the way up, so that I can climb my mast just whenever I wish, like the engineers at a broadcasting station. What an adventure it will be when I first climb my tall mast!

Have you had much to do with frame aerials? There are four frame aerials in my wireless store-room. One of them is illustrated here. I have had some good times with that frame aerial when used in the ordinary way, and, here's an idea for you, when used in place of the usual inductance coil in a simple crystal set.

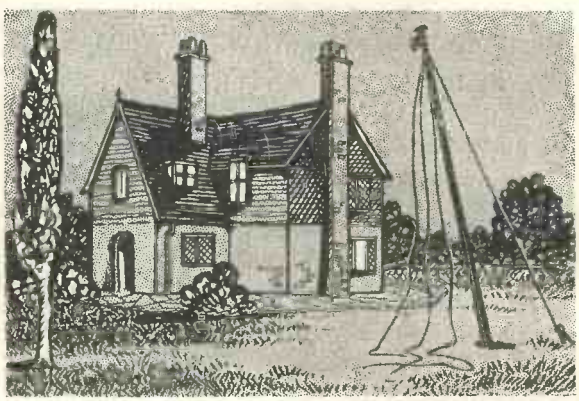
On one occasion I took that frame aerial outside the house and used it along with a valve set. When I placed the frame aerial flat on a corrugated iron roof, I obtained a considerable increase in signal strength over that obtained with the frame aerial on the roof in the orthodox upright position. The wire of the frame aerial did not touch the metal roof when the frame aerial was placed flat on the roof. I have no explanation to give of this rather curious result.

In the Open Country

I wonder if you have ever tasted the joys of wireless in the open country. If not, then wireless has some of its greatest pleasures still in store for you. Of all my wireless adventures, the best have been those with a temporary aerial erected in the field, by the wayside, on the top of the mountain and on the river.

Outdoor Radio Relief

Of all my wireless adventures, I would place first in order of recommendation, especially at this time of the year, my outdoor work with portable aerials and portable sets. If you get enthusiastic over this kind of work, you will not be long before you could fill a book with delightful accounts of your adventures with wireless out of doors.



Unfortunately before the guy ropes were secured . . .

The HOME and

Transportable :: Cheap to Build :: Efficient in Operation

EASILY CARRIED ABOUT

ANYBODY writing about a radio set that can be used out of doors at this time of the year, might be excused for some platitudinous remark about "a young man's fancy . . ."

Not Difficult to Transport

But no excuse need be offered for the appearance in the WIRELESS MAGAZINE this month of details of the Home and Garden Three, although, perhaps, the point may be emphasised that, with ordinary batteries, a super-man is not needed to transport it short distances.

Primarily designed for the reception of the local station and Daventry Experimental by any member of a family, the Home and Garden Three is not by any means limited to receiving only these two stations and under ordinary conditions it will be possible to pick up a number of Continental transmissions as well.

Cabinet in Two Portions

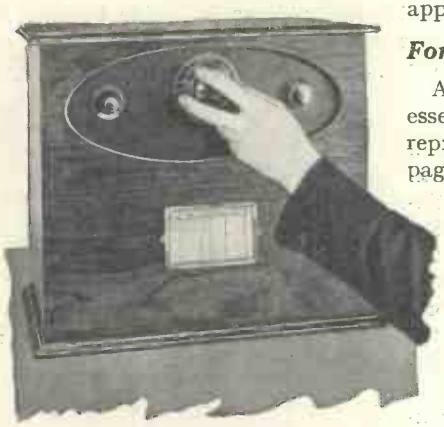
It will be observed that the cabinet is divided into two portions, the top part taking the receiver proper and the lower part accommodating the necessary batteries. The only external connections are leads through the back for the aerial and earth and a loud-speaker jack, the operation of which automatically switches on the valves.

As the set is intended primarily for short-range work, especial attention has been given to purity of reproduction. The circuit therefore, comprises an anode-bend detector with capacity-controlled reaction and two stages of resistance-capacity-coupled low-frequency amplification.

The reproduction of the circuit, which appears on page 442, will make everything clear. A tapped coil is used for aerial tuning, as this gives increased selectivity without the need for an extra tuning control.

Anode-bend Control

Fine control of the anode-bend detector valve is obtained by controlling the grid voltage by means of a potentiometer and battery used in combination. Between the negative end of the potentiometer and earth is connected a .01-microfarad by-pass condenser.



The dials from left to right are: anode-bend potentiometer, aerial condenser and reaction condenser

Resistance-coupling Units

Each resistance-capacity coupling is bought already as a complete unit and in this way the amount of wiring needed is appreciably reduced.

Note should be made of the fact that reaction will be unobtainable if the high-frequency choke used in the anode circuit of the detector valve is not a good one. The degree of oscillation obtained is controlled by a .0001-microfarad variable condenser, the coupling between the aerial and reaction coils being fixed.

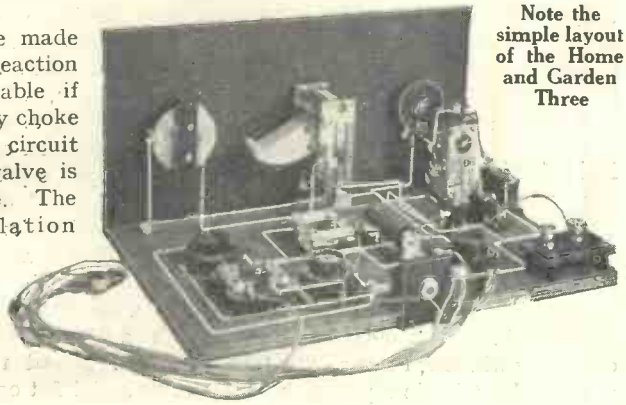
Provided the values are kept the same as those specified, parts of almost any make can be utilised in building the Home and Garden Three, although those who use a full-size blueprint will find the work very much easier if they use components identical with those in the original WIRELESS MAGAZINE set. A complete list appears on page 442.

For Half-price

Although all the essential details are reproduced in these pages, many constructors will prefer to work from a full-size blueprint. These can be obtained for half-price, that is 6d. post free, up till June 30, if the coupon on page iii of the cover is used.

Address your inquiry to Blueprint Dept., WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4, and ask for blueprint No. W.M.75.

It will be noticed that although the front of the cabinet has an oval opening a standard size of rectangular panel is used to save the need of cutting.



Note the simple layout of the Home and Garden Three

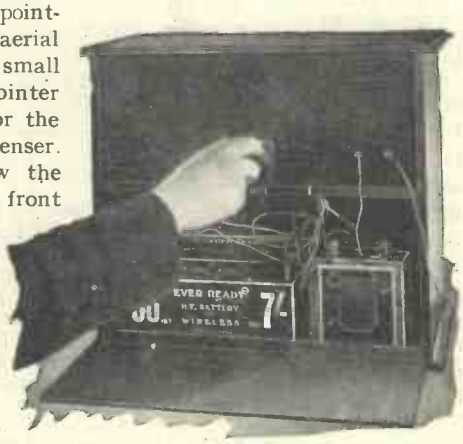
GARDEN THREE

Designed, Built and Tested by the "W.M." Technical Staff

This is a practical point that will be appreciated by those who desire to use few tools.

When all the parts have been obtained, drill the panel by using the blueprint as a template or marking out the dimensions indicated on page 443 and mount the potentiometer, aerial-tuning condenser, and reaction condenser, not forgetting to provide a dial pointer for the aerial condenser. A small knob with a pointer is suitable for the reaction condenser.

Now screw the panel to the front edge of the baseboard and place the rest of the components in position. First screw down the strips for the aerial and earth terminals and for the loud-speaker jack, though. (*See photographs*).



At the back is a loud-speaker plug, the insertion of which switches on the set

Positions of Baseboard Parts

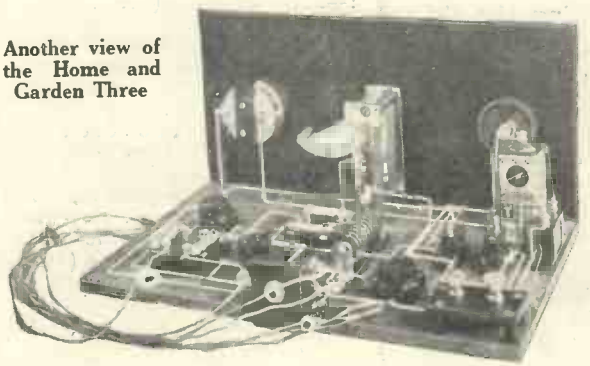
The baseboard components, looking from the back of the panel and reading from right to left are: The .01-microfarad by-pass condenser, 1½-volt dry cell, aerial coil holder, reaction coil holder, detector valve holder, high-frequency choke, first resistance-coupling unit, first low-frequency valve holder, and, in line, one behind the other, the second resistance-coupling unit and the holder for the final valve. When all these components have been firmly fixed in position, wiring up can be started and here the blueprint will be especially useful. It will be observed that each terminal point is marked with a small letter of the alphabet, these letters indicate which points should be connected together, and in what order.

For example, first connect together all those points marked *a* with one wire or as few wires as possible. Then connect those points marked *b* and so on, keeping to the proper alphabetical sequence.

Flexible Battery Leads

To each of the points where a battery connection has to be taken to the lower part of the cabinet solder a length of rubber-covered flex, provided at its free end with a wander plug or spade tag of the appropriate colour (black for negative and red for positive).

It is difficult to recommend coils of particular sizes for the aerial and reaction circuits as so much depends upon local conditions. Normally a No. 60 centre- or double-tapped coil in the aerial circuit will bring in London and Daventry Experimental, while a No. 40 or 50 can be used for reaction. For the long waves a No. 150 tapped aerial coil and a No. 100 reaction coil will normally be suitable. Either 2-, 4-, or 6-volt valves can be used as there is plenty of room in the lower part of the cabinet for quite a large accumulator. The choice must rest with the operator, as all are equally suitable.



Another view of the Home and Garden Three

Suitable 2-volt Valves

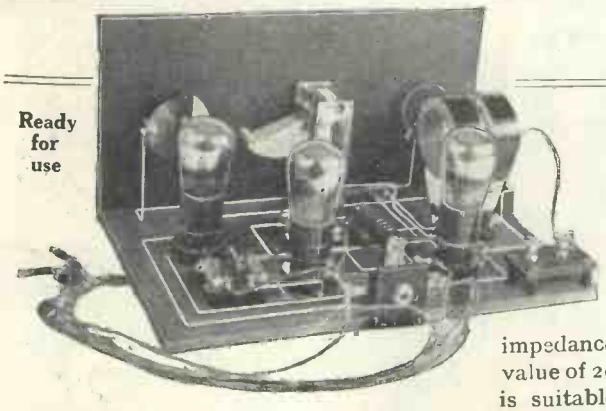
Of the 2-volt valves the following are recommended for the detector, first low-frequency, and second low-frequency positions:—

B.T.H.—B210H, B210L, B215P.
Cosmos—SP18B, SP18G, SP18RR.
Cossor—210RC, 210HF, 220P.
Ediswan—210HF, 210HF, PV2.
Marconi—DEH210, DEL210, DEP215.
Mullard—PM1A, PM1HF, PM2.
Osram—DEH210, DEL210, DEP215.
Six-Sixty—SS210RC, SS210HF, SS215P.

Suitable 6-volt valves, arranged in similar order to the above, are as follows:—

Cosmos—SP50B, DE50, SP50R.
Cossor—610RC, 610HF, 610P.
Ediswan—ES5HF, ES5HF, PV610.
Marconi—DEH610, DEL610, DEP610.
Mullard—PM5B, PM5X, PM6.

The Home and—

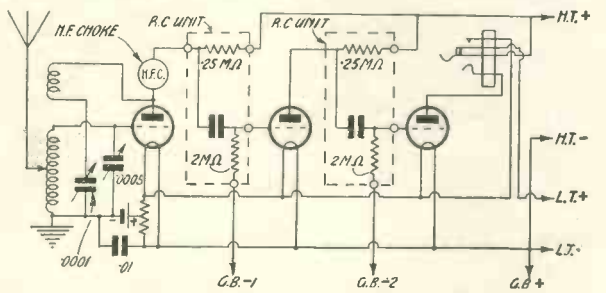


Ready for use

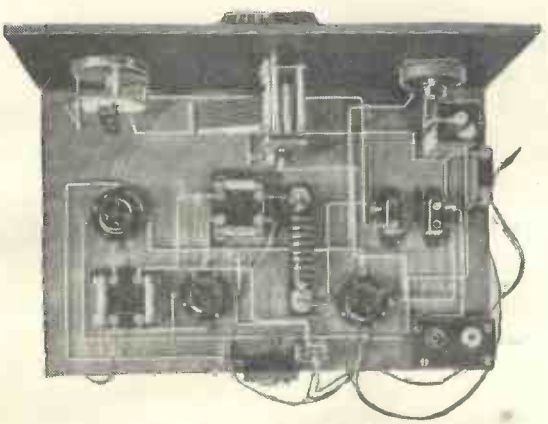
Osram—DEH610, DEL610, DEP610.

Six-Sixty—SS6075RC, SS6075HF, SS610P.

The first valve should, of course, have an impedance approximately one-third of the anode coupling resistance, which is 250,000 ohms. A valve with an impedance round about 70,000 to 80,000 is therefore best for the detector stage.



Circuit of the Home and Garden Three



Plan view of baseboard of the Home and Garden Three, showing disposition of components

Theoretically, a similar valve would be suitable for the first low-frequency amplifier, as this also includes a resistance-capacity coupling in its anode circuit.

Actually, however, such a valve has too restricted a grid swing, and greater purity of reproduction is obtained by using a valve with a lower impedance for this stage—a value of 20,000 to 30,000 ohms is suitable, but considerable latitude is permissible.

The last valve should have as low an impedance as possible, within limits; but it should certainly not be more than 8,000 ohms. A value round about 3,000 to 4,000 ohms will give greatly improved quality.

Constructors are advised to try out the set before it is placed in the cabinet in order to find the best battery voltages while everything is easily accessible.

Connect up the aerial and earth, put valves and coils in position (not forgetting the tapping point on the aerial coil) and push the loud-speaker plug into the jack.

To the low-tension terminals connect an accumulator of the same voltage as the valves to be used. To H.T.+ apply 120 volts, to G.B.—1 about 3 to 6 volts negative, and to G.B.—2 as much as 9 to 18 volts, depending upon what type of valve is used in the last stage.

Operating the Set

Turn the knob of the reaction condenser (right) until the slight rustling or hissing sound is heard which indicates that the set is on the verge of oscillation and in its most sensitive state for receiving signals.

Now manipulate the middle knob (which controls the aerial-tuning condenser) until a transmission is picked up, when the potentiometer should be adjusted for the best results. At the same time, the reaction condenser should be readjusted. The vanes should be kept as open as is possible consistent with sufficient volume.

Obtaining Greatest Purity

There will be no need to readjust the high-tension voltage, but the grid bias should be altered until the utmost purity is obtained. The more grid bias is used, of course, the lower will be the consumption from the high-tension battery. Whatever voltages are applied to the grids, however, practically no current whatever is taken from the grid-bias batteries.

When the set is working really well

COMPONENTS REQUIRED

1—Ebonite panel, 14 in. by 7 in. (Becol, Will Day and Raymond).
1—Station log (Deckorem).
1—.0005-microfarad variable condenser with vernier dial (Success, Cyldon or Dubilier).
1—.0001-microfarad variable condenser (Success, Cyldon Bébé or Igranic).
2—Single-coil holders (Lissen, Lotus or Magnum).
1—.01-microfarad fixed condenser (Dubilier type 620, Lissen or Mullard).
1—Panel-mounting potentiometer (Lissen or Igranic).
3—Anti-microphonic valve-holders (Pye, Lotus or Benjamin).
1—High-frequency choke (C.D.M., Wearite or Cosmos).
2—Resistance-capacity coupling units (Lissen, Dubilier or Carborundum).
2—Ebonite strips, 1½ in. by 2 in., and 2½ in. by 1½ in. (Becol, Will Day or Raymond).
1—Phone jack with filament switch (Lotus, Formo or Ormond).
1—Plug for jack (Lotus, Formo or Ormond).
1—1½-volt dry cell (Siemens type T or Ever-Ready type UW5).
2—Terminals marked :—Aerial, Earth (Eelex).
5 yards rubber-covered flex (Lewcos).
4—2 ft. lengths Glazite.
1—Cabinet with baseboard, 9 in. deep (Ambatielo).
2—Tapped aerial coils for both wavelength ranges (Atlas, Lissen or Lewcos).
2—Untapped reaction coils for both wavelength ranges (Atlas, Lissen or Lewcos).

—Garden Three (Continued)

it can be placed in the top part of the cabinet. All the batteries' leads are bunched together and taken through to the bottom by means of a slot cut in the shelf. The batteries can then be packed in any convenient way in the bottom of the cabinet.

Suitable Batteries for the Home and Garden Three

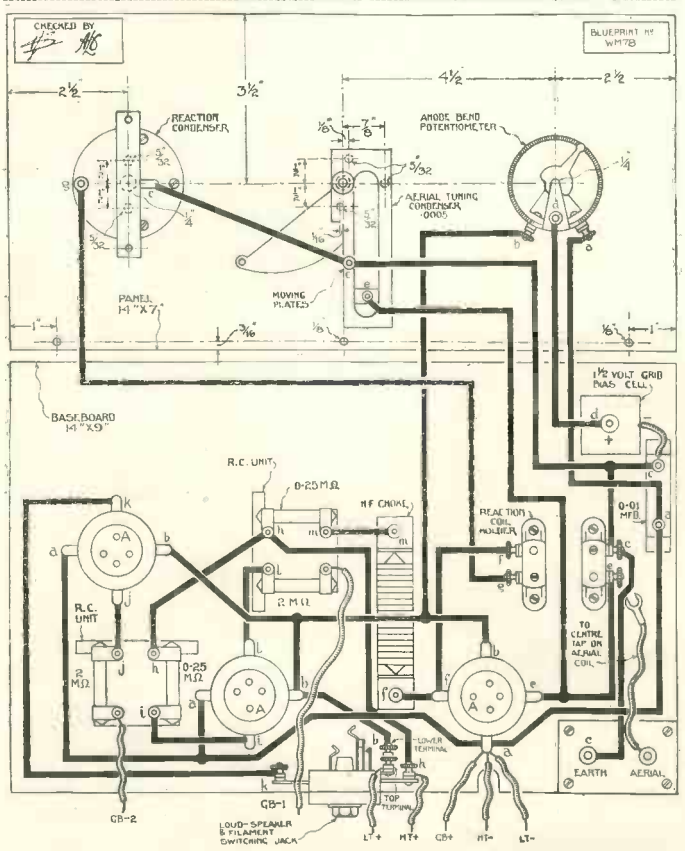
In our tests we used two Ever-Ready Popular type 60-volt batteries, an Ever-Ready 18-volt grid-bias battery, and an Oldham SMV4 2-volt accumulator.

For use in a garden it may be convenient to take a second lead-in from the aerial at the end remote from the house. When not in use this second lead-down wire can be tied round the mast itself. It should, of course, be of insulated wire.

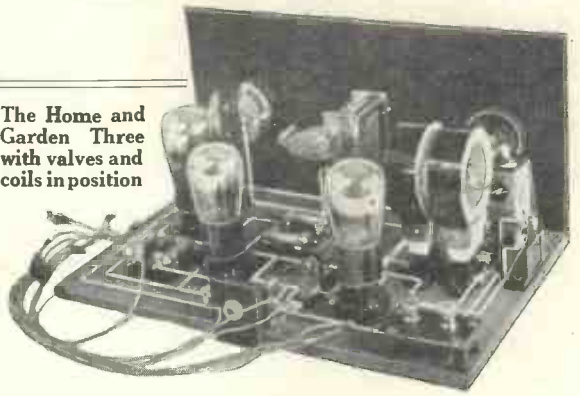
Results Obtained During a Short Test

Tested on a rather indifferent aerial about six miles from the London station, five stations could be obtained at loud-speaker strength with very good purity of reproduction. For this test an Atlas No. 60 centre-tapped coil was used in the aerial circuit and a No. 60 untapped coil for reaction (this is a little on the large size, as a matter of fact, and a No. 40 coil would be suitable).

These are the stations, with the readings of the tuning condenser, which will act only as a very rough guide:

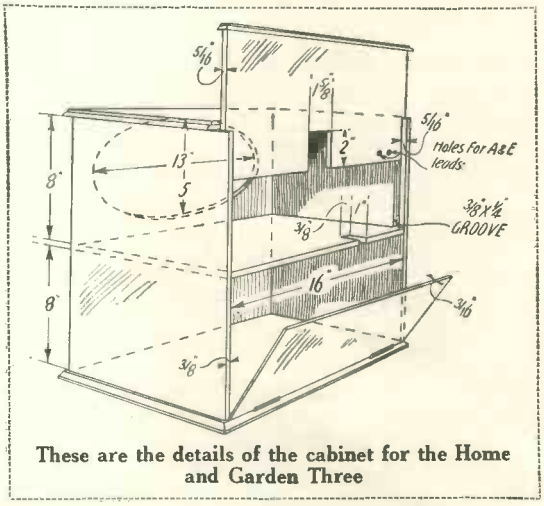


This layout and wiring diagram can be obtained as a full-size blueprint for half-price, that is 6d., post free, if the coupon on page iii of the cover is used before June 30. Ask for blueprint No. W.M.78



The Home and Garden Three with valves and coils in position

London, 361.4 metres, 75 degrees; Hamburg, 394.7 metres, 79 degrees; Frankfort, 428.6 metres, 83 degrees; Langenberg, 470 metres, 89 degrees; and Daventry Experimental, 491.8 metres, 91.5 degrees.



These are the details of the cabinet for the Home and Garden Three

Renovating Your Loud-speaker

WHEN they have been in use for some time, loud-speakers of the horn type tend to become shabby. They can, however, be renovated quite easily at a cost of sixpence or so, by re-enamelling with one of the quick-drying enamels now on the market. If the latter is carefully applied, the speaker will look as good as new.

In choosing the enamel, there is no need to stick to the original colouring of the horn. Manufacturers of loud-speakers naturally have to adopt one standard colour for enamelling their wares. But, of course, in re-enamelling your own particular instrument you can choose a tint to suit your taste or to harmonise with the colour-scheme of the room in which the speaker is used.

Cleaning Off the Old Enamel

The original enamel should be thoroughly cleansed to remove any grease or dust, and then a coat of the new enamel should be applied very carefully and evenly with a soft brush. The speaker can then be set aside to dry, but care should be taken to place it where no dust is likely to settle on the surface of the enamel during the process of drying. (W. O.)

My Experiences With The MUSIC CHARMER

By JOHN SIMPLE

This is the first of a number of elementary articles by a "low-brow" amateur who will write in the "Wireless Magazine" under the name of John Simple. From time to time he will tell readers of his practical experiences with different types of sets and special pieces of apparatus in an informative yet chatty way; this month he writes about the Music Charmer, that excellent three-valver described in March.

Beginners and other amateurs who have not had much practical experience in radio will find John Simple's "confessions" both interesting and helpful, for he writes with the understanding of one who has just passed out of the novice stage himself.

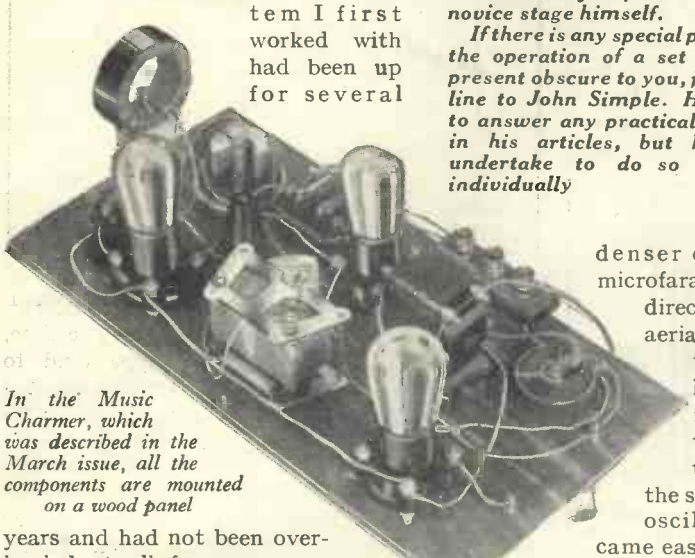
If there is any special point about the operation of a set that is at present obscure to you, just drop a line to John Simple. He will try to answer any practical questions in his articles, but he cannot undertake to do so by post individually

AFTER having used the Music Charmer for a couple of months or so with the object of seeing what it is like, I think that I can give a few hints on its successful operation to those WIRELESS MAGAZINE readers who have built it—and they number many hundreds.

Outdoor and Indoor Aerials

I have been able to try the set out on both an outdoor and an indoor aerial, while for the high-tension supply I have tried both dry batteries and a direct-current mains eliminator.

The outdoor aerial and earth system I first worked with had been up for several years and had not been overhauled at all for some considerable months. My first experience, therefore, on connecting up the set was to find that it would not oscillate at all, in spite of applying something like 140 volts to the high-tension positive terminal, which, it will be remembered, feeds the anodes of all three valves.



In the Music Charmer, which was described in the March issue, all the components are mounted on a wood panel

Series Condenser in Aerial Lead

Not wishing at the time (the weather, as usual, was none too inviting!) to overhaul the aerial and earth system, I tried the simple expedient of inserting a fixed condenser of .0003-microfarad capacity directly in the aerial lead between the lead-in terminal and the aerial terminal of the set. At once oscillation became easily obtainable and London fairly roared in on an Amplion horn loud-speaker.

That is one great disadvantage of modern sets incorporating capacity-controlled reaction, they do find out those bad aerial-earth systems so quickly and decisively, so my first advice to those who are not getting the results they think they should is to try the simple remedy I have already outlined.

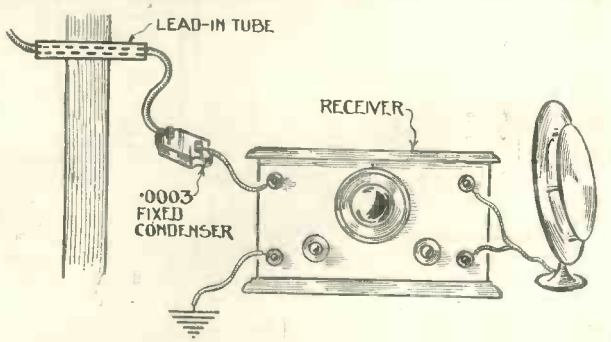
No Record Breaking!

Perhaps I should point out that during my tests I made no attempt to get a large number of foreign stations. My object all the time has been simply to get London and Daventry Experimental with the utmost volume and purity possible. These two stations, I find, give all the service one requires from the programme point of view, and if one has them both at one's disposal without difficulty, there is little object in receiving other stations.

These first tests with an outdoor aerial were carried out about eight miles from the London station in a part of Middlesex bordering on the Thames. Even at this distance no difficulty was experienced in cutting out London and receiving Daventry Experimental. A No. 60 centre-tapped Atlas coil enabled both stations to be received without either of them coming in right at the end of the dial.

Valves and High Tension

The first valves I tried were an Osram DEH210, DEL210, and DEP215 in that order, with about 130 to 140 volts high tension. I know



How to insert a series condenser in the aerial lead

that manufacturers stipulate a maximum voltage of 120, but it should not be forgotten that there is quite a considerable voltage drop because of the resistance of the component in the anode circuit of a valve. In this case they comprise: (1) the anode coupling resistance of 250,000 ohms, (2) the primary of the B.T.H. transformer, and (3) the loud-speaker winding.

This is the HL210, made by Marconi and Osram. It is a most useful general-purpose valve, having an impedance of 25,000 ohms and an amplification of 15

Using this combination of valves with the voltage mentioned, London was received at such strength as to be clearly audible all over a large house, and quite unbearable in the room in which the set itself was located. Daventry Experimental, of course, was not so loud, but even that was quite strong enough to be comfortable in the room. In both cases purity was very good indeed.

Little Hand Capacity

At one time I found a slight trace of hand-capacity effect, but without doing anything to remedy it, that seemed to go off, and I can only conclude that it must have been due to some temporary fault in the earth.

At first I used a 9-volt grid-bias battery, supplying 4½ volts to the negative of the first low-frequency amplifier and the full 9 volts to the final valve. Later, however, I found it better to increase the amount of grid bias very largely.

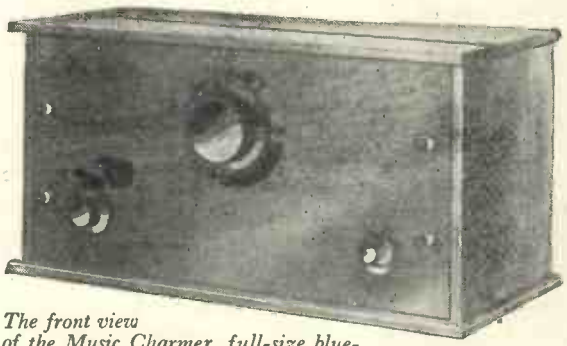
With An Indoor Aerial

During the past few weeks I have been using the Music Charmer in conjunction with an indoor aerial on the top floor of a house not more than three miles from 2LO. At first I used a spiral of wire stretched diagonally across the room, which gave a length, I suppose, of something like 16 or 17 ft., and used an adjacent gas pipe as an earth connection. With the same high-tension supply and valves as used previously, the reception of London was very good indeed.

Daventry Poor

Daventry Experimental, however, was disappointing, because, although it was there all right, tuning was so sharp with the short aerial that it was almost unreceivable. I thereupon scrapped the diagonal wire and led a length of No. 28-gauge double-cotton-covered wire right round the picture-rail in the form of a rectangle, supporting it by means of small nails knocked directly in the wood and twisting the wire round.

The beginning of the aerial, immediately above the set, was twisted round a metal curtain fitting without any attempt at insulation, and the other end brought direct to the set. At the same time I substituted an Atlas direct-current high-tension eliminator for the dry batteries I had been using and also used a Mullard P.M. cone loud-speaker.



The front view of the Music Charmer, full-size blueprints of which are obtainable for 1s., post free (No. W.M.60)

With these alterations I found little improvement in the reception of the London station, except for the fact that the Mullard cone loud-speaker gave better reproduction of the bass notes than had the horn type previously used. Daventry Experimental now came in quite well, although at nothing like the strength obtained with the outdoor aerial, and at present I am trying to arrange some form of indoor aerial that will give an even greater length of wire. At present the total length is not more than about 35 ft., which is hardly enough for the purpose.

As the negative main of the lighting supply is earthed, there was no need to insert a condenser in the earth lead, although this should always be done, of course, as a precautionary measure when an eliminator is first used. If it so happens that the positive main is earthed the effect of putting a direct earth on to the set itself would be to short-circuit the mains—and there would be trouble!

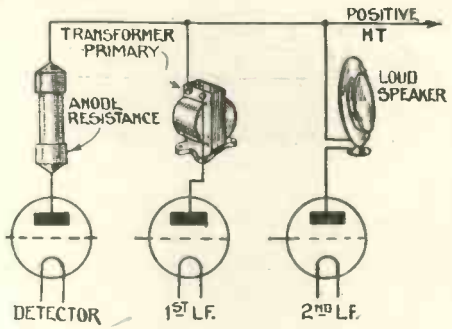
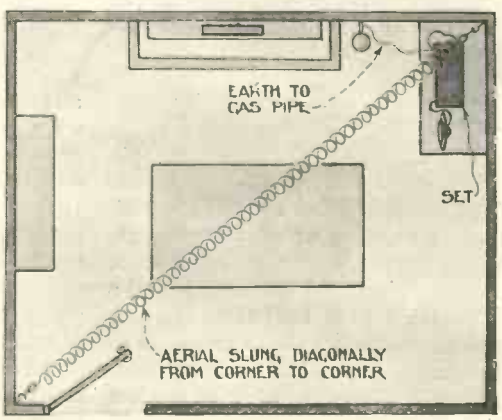


Diagram illustrating resistances in the anode circuits which cut down the high tension actually applied to the valves

A Bad Gas-pipe

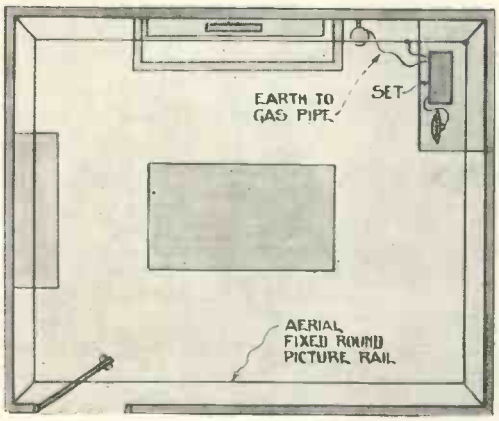
I soon found that the gas-pipe earth was so bad, that it made not the slightest difference, so at present the receiver is earthed simply through the medium of the negative main. Although the supply is of 200 volts, the maximum output obtainable from the Atlas unit is 120 volts, and this I have found ample for 2-volt valves.

During the last few days I have tried a number of various 2-volt valve



The first indoor aerial used by John Simple. It consisted of a spiral of wire fixed diagonally across the room. Although good for London it was not long enough to get Daventry Experimental well

My Experiences with the Music Charmer *(Continued)*



This arrangement of indoor aerial gave better results because it is longer. It consists of a wire nailed round the picture-rail

combinations, and my conclusions may be of interest to other users of this excellent little set. For the detector stage I have tried an Osram DEH210, which as an impedance of 75,000 ohms. Theoretically this is about right, for the valve should have an impedance approximately a third of the anode resistance, which, in this case, is 250,000 ohms. I have also tried a Cossor 210HF, which has an impedance of 44,000 ohms. This is a little on the low side, but gives very good purity, although at the expense of volume. However the diminution is not very great, and at present I am using the set with this valve.

Special "R.C." Valves

It should be pointed out specially that what is called an "R.C." valve has too high an impedance (usually) for this first stage, and unless the anode resistance itself is changed, no valve with an impedance of more than 80,000 ohms or so should be used.

Low-frequency Amplifiers

For the first low-frequency amplifying stage I have tried an Osram DEL210, a Mullard PM1L.F., a Mullard PM2, and an Osram HL210. Quality is best with a PM2, but there is little to choose between this and a PM1L.F. and a DEL210. This is accounted for by the impedances of the valve, for a PM2 has an impedance of 7,000 ohms, rather on the low side, while the DEL210 and PM1L.F. have impedances of 17,000 and 18,000 ohms respectively. Any good valve with an impedance round about this value is suitable. At some sacrifice of quality, but with a considerable increase of volume, a Marconi or Osram HL210 can be used for the first low-frequency amplifier. This valve has an impedance of 25,000 ohms and an amplification factor of 15.

For the final stage I have tried an Osram DEP214 (impedance 6,250 ohms). an Ediswan PV2 (impedance 6,700 ohms), a Mullard PM2 (impedance 7,000 ohms), and a Mullard PM252 (impedance 3,800 ohms).

Of these, the last, at any rate with a Mullard P.M. loud-speaker, undoubtedly gave the best results as regards purity, as one would expect, but I found that either of the other valves gave results which were good enough for all ordinary purposes, and I am not at all sure that under the conditions I was using the set it would have been worth while to have gone to the extra expense of a PM252 specially.

Essential for Great Power

Where the set is to be used with an outdoor aerial, and the volume likely to be considerably greater than I am getting with an indoor aerial, such a valve is almost essential, however.

It is difficult to gauge volume, as every WIRELESS MAGAZINE reader must know, but just out of curiosity I placed the loud-speaker outside on the window sill and shut the window. The house, which is an old-fashioned one, three storeys high, overlooks a typical London square, and at half-past eleven one bleak and windy night recently it was possible to hear loud dance music right at the end of this, some 150 yards away. I soon went back and took the loud-speaker indoors again, however, for fear of the possible wrath of neighbours! As far as I am concerned, the Music Charmer is a great set.

Microphone Memos

JUST as the broadcast listener must take certain precautions to get good reception so must the broadcaster give attention to special points. Here are a few of the instructions issued to every artiste by one American station:

Coughing, sneezing, clearing the throat, scraping the feet and other disturbances in the studio are annoying to listeners. The microphone is so sensitive that the slightest commotion may be transmitted to the unseen audience. Therefore, when the announcer calls "Quiet everybody," kindly comply.

Do not begin singing or playing until the announcer gives the signal.

Unless you have memorised your music, be prepared with an extra copy, as you do not stand near the piano when singing.

Do not get perturbed if the announcer motions for you to move nearer the microphone or withdraw, while singing.

Very loud singing or playing is objectionable, as it detracts from successful broadcasting, often producing a shattered effect. The best choral effects are obtained when each person sings in a subdued manner.

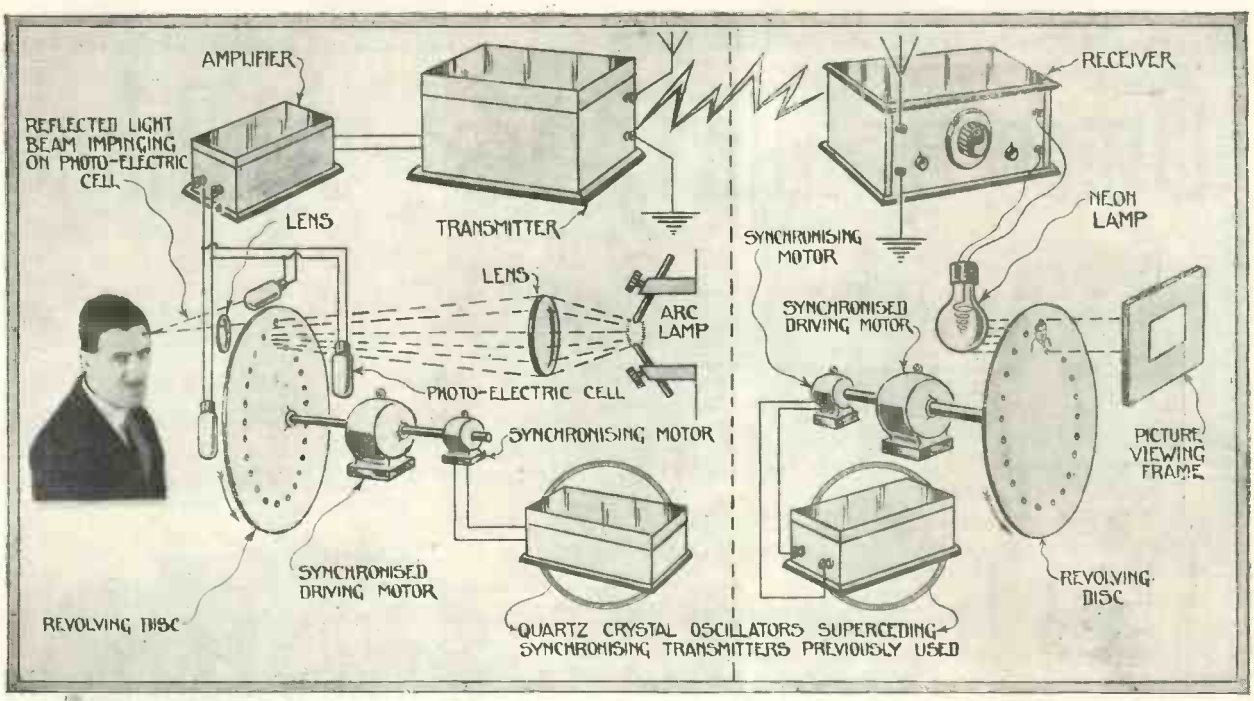
To pianists: Too much loud pedal spoils the rendition. The top of the piano should be left down, as the best broadcasting is accomplished when the instrument is closed.

You might memorise some of these points now in case you are ever called upon to broadcast! D. R.

Your Guide to British Valves

With regard to this table, which was published in the April issue of the WIRELESS MAGAZINE, readers are asked to note the following corrections:

Make.	Type.	Impedance.	Amp. Factor.	Filament Voltage.	Filament Current.
Osram ...	S625	175,000	110	6	.25
Marconi...	KH1	30,000	40	3.5	2.0
Osram ...	KH1				
Ediswan	R	25,000	7.5	4	.75
Marconi...	HL210		15	2	.1
Osram ...	DEL410	14,000	13	4	.1
Osram ...	DEL610	13,000	15	6	.1
Marconi...	KL1	3,750	7.5	3.5	2.0
Osram ...	KL1				
Marconi...	LS5A	2,750	2.5	5.25	.8
Osram ...	LS5A				
Cosmos ...	AC/R	2,500	10	4	1.0



A Television Difficulty Solved

The Need for Synchronisation Obviated

AN important step in the perfection of television has been made by the research workers at the Bell Telephone Laboratories in America. They have, in fact, obviated one of the greatest practical difficulties, namely, the need for synchronising the "scanning" discs at both transmitting and receiving ends.

Scanning the Picture

The principle of television is that a picture is "scanned" by a light point travelling all over its surface and a corresponding light point at the receiving end must be made to move over the surface of the receiving screen (or similar device) in exactly the same positions and at the same time.

This process is usually attained by a system of lenses and shutters at the transmitting end and at the receiving end, and considerable difficulty has been encountered by experimenters in so arranging things that the shutters at both ends work absolutely simultaneously.

If the shutters do not work in synchronism, of course, the picture at the receiving end is very badly distorted and may, in fact, not be recognisable as a picture at all.

Formerly synchronisation has been carried out by using carefully matched motors at each end for driving the scanning discs, and this necessitated the separate transmission of a synchronising wave which accurately controlled the speed of the motors.

Now, however, this need for elaborate synchronisation has been eliminated by the use of a quartz-crystal oscillator included in both the transmitting and receiving circuits. Most readers of the WIRELESS MAGAZINE already know that quartz crystals, ground down into very thin lens-like discs, will oscillate constantly at a particular frequency with practically no variation at all, the frequency of oscillation depending upon the size of the crystal used.

No Need for Separate Wave

Thus, by using two identical quartz crystals at either end of the television system it is possible to control the speed of the driving motors without the need for transmitting a synchronising wave as well as the true television wave.

The drawing at the top of this page shows in simplified diagrammatic form the system at present being tried out in the Bell Telephone Laboratories. It will be seen that each disc is driven by two motors, the smaller motor in each case being accurately controlled by means of the quartz-crystal oscillator; these small motors in their turn accurately control the speed of the large driving motors, and thus absolute synchronism throughout the whole system is ensured.

Great Practical Convenience

The obviating of the separate synchronising wave which was previously necessary is obviously a very great practical convenience and undoubtedly brings practical television a step nearer commercial perfection.

BM/PRESS.

Some of This Year's Portables

THE Henderson portable (seen on the left) is ideal as a room-to-room receiver. Simplicity of control was chiefly aimed at by the designers, and as there are only two dials they can be said to have been successful.
Special attention has been paid to the housing of the receiver. The standard model is supplied in a handsome mahogany cabinet, although other woods are supplied to order.
A complete Celestion loud-speaker is incorporated, and at least a dozen stations are usually available.
The name of the makers is W. J. Henderson and Co., Ltd., of 351 Fulham Road, South Kensington, London, S.W.10.

PARTICULARLY easy to carry because of its sensible shape and especially efficient in operation for a three-valver is the Massy portable.
As can be seen from these photographs, it is only 5 in. wide and hangs easily by the side when being transported. In London it receives Daventry Experimental very well—not at all a bad performance for three valves with a frame aerial. When open on a table the upper doors do not foul teacups and jam-pots—a point that will be appreciated by picnic makers.
The manufacturers are the Battery and Dynamo Co., of 124 North End Road, W.14.

THE latest Rolls portable, the Phantom Five (right), is very light and very compact—two features essential if the portable is to be really useful.
It can be used on both the long- and short-wave bands, and a large number of stations is always "on tap"—be it night or day.
There are only two controls, so that anyone can operate it. An additional advantage is that when the set is within twenty miles of the local station two valves can be cut out, thus giving appreciable economy in running.
The set is manufactured by Hoare & Jagels, Ltd., of 28-29 Great Sutton Street, E.C.1.

BELOW is seen one of the M.P.A. portable sets, of which a number of models are made. All are very neatly constructed and attractive in appearance.
This model incorporates one of the well-known M.P.A. loud-speakers and includes sockets for using an external aerial and earth system if desired.
The address of M.P.A. Wireless is 62 Conduit Street, London, W.1.

FOUR separate units go to make up the Igranic Neutrosonic Seven—the receiver, loud-speaker, batteries, and aerial all being housed in different cases (as seen on the left).
It is a "de luxe" receiver, which can be taken about in the car. Its range is remarkable, as many as thirty stations usually being available on the loud-speaker.
It can be obtained installed in a handsome cabinet which can be wheeled about the house.
The address of the Igranic Electric Co., Ltd., is 129 Queen Victoria Street, E.C.4.

A Further Tale of the Inimitable Scot by Richard Carol

Sandy and the Missen One

NOW folks, ye ken fine what I've done for wireless. In fack, though I'm a modest man as ye realise, I just admit that wireless would be in a gey bad way if it wasna for Clumtochty. And when ye say "Clumtochty" ye say "me," me being the pioneer that blazed the trail as ye might say. Ay, and a fine blaze it was, too. Three valves in the first week and providentially no' yin o' them mine.

But now nearly a' the folks are terrible enthusiasts 'specially them which has only aspired to crystal sets. Ay, they canna get awa frae their earphones. Concerts, high and low, varieties, revues, lectures, they listen to them a' for fear they dinna get value for their ten shillin's. The valvers are no' quite sae enthusiastic, them haein' to consider their accumulators which I wish they wouldna for *I* dae the chargin', baith varieties. However. . . .

Weel, ye'll understand I expeck fair treatment. And when folks I've introduced to the mighty mystrey gang and tell their friends a' about it and show them how to construct excellent sets like mine, I say it's no' fair at a'. I mean it's base and deceitfu' and, och, I canna get words to describe it. Sae ye'll understand ma attitude on the question o' Angus McWhirker.

Ye see, Angus is Maggie's brither by her first faythe. I mean by her faythe and her first mither, which deceased afore Maggie was born. Ay, that's it. And Angus had come to bide wi' his guidwife at Clumtochty, thinkin' he would be able to live cheaper, me being general provision merchant, ye see. At least, that's what I think and I tellt Maggie as muckle, and she said that sort o' thing was mebbe typical o' the McNabs, but it couldna be said o' the McWhirkers. And I said appearances was awfu' deceptive, ha, ha, in sardonic accents, and departed wi' a dramatic flourish for the Hieland Laddie.

But Maggie's an awfu' body for stickin' by her folk, nae matter if they're on'y related one side like Angus. And one night she entered the conversation which was *non est* as ye might say, me being deeply engaged in a familiar perusal o' the financial news.

"Sandy," says she, casual, "Angus is a great admirer o' yours."

"Oh," says I easy, "is that so? That's maist interestin'. He's got mair intelleck than I gied him credit for."

"Ay," says she, "and he's fair filled wi' wonder at the *amazin'* grasp ye've got o' this wireless."

"Is he now?" says I, lookin' up. For ye ken, it's no' everybody that's got the *ability* to appreciate ye're a sort o' genius at a thing, like me and wireless, and ye canna help feelin' a wee bit pleased when ye meet it even if it's name *is* McWhirker. Then I had a brilliant mental illumination.

"What's he wantin', Maggie?" says I wi' amazin' deduction.

Maggie looked up frae her darnin'.

"Angus, ye mean? Naething. He was jist sort o' interested in this wireless."

"He wasna by any chance wantin' a set, was he?" says I.

"Weel," says Maggie," he was—he was. . . ."

"Maggie, ye werena by ony chance suggestin' the possibility o' ma constructin' a set for him—without charge?"

Och, folks, if ye'd seen Maggie's face. Ye ken the sort o' look. Jist like when yer guidwife's askin' ye if she can buy a new hat and the lassie arrives at the door wi' it in a box.

"Weel," says Maggie, "I thought, Sandy, seein' it was Angus, ma brither ye might. . . ."

I put up ma hand imperiously.

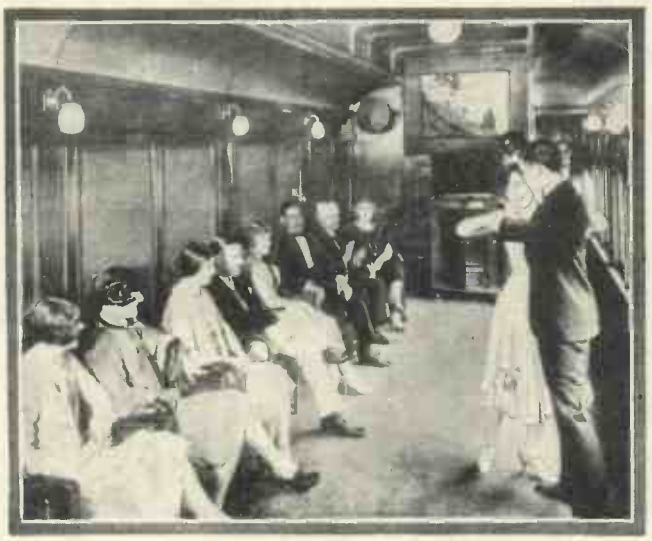
"Ye ken ma principles, Maggie, I'm a wireless expert and experts dinna dae things without remuneration. That's etiquette in the profession and I'm no' loosin' ma reputation for a McWhirker nor a McMucherty *nor* even a Carldoddie. I have spoke. Ye can convey ma sentiments to Angus McWhirker at yer leisure."

"But Angus . . ." starts Maggie.

"Enough," says I, "if Angus McWhirker is desirous o' tappin' the ethereal waves, o' bringin' learnin' and wisdom to his ignorant domicile, o' cheerin' his stuffed birds wi' the strains o' musical harmonies, let him consult me in ma capacity as expert, me, Sandy McNab and I'll be in the shop ony day he likes. Ye can add that ma charges are vera reasonable."

"It sounds fine," says Maggie wi' a shrug. "I suppose ye're quotin' frae yer wireless magazines. But ye're wastin' yer breath. If *you* dinna make a set for Angus, Angus'll no' hae wireless and you'll jist lose the profit on what ye might have sold him."

THE RAILWAY'S RADIO DANCE BAND



What will soon be an everyday occurrence

I cogitated for twa-three meenits.

"Ye're sure o' that, Maggie?" says I.

"Ay," says she.

"Weel," says I, "I'll no' deny it alters the *complexion* o' the situation, as ye might say. After a', I've got ma position to consider as pioneer as weel as expert. Ay, it's no' easy, no' easy at a'; but if a body's real keen on wireless, I must admit it seems ma duty to aid and assist him in such a laudable projeck nae matter if it *does* mean personal loss and considerable sacrifice. Besides, as *you* say, Maggie, he is a sort o' relation, and when a body's a relation ye sort o' make allowances. Ay, I'll dae it."

"He'll be awfu' pleased, Sandy, haein' an expert daein' it for him. And, ye ken, he'll be tellin' a' his visitors. It'll be a guid advertisement for ye."

Sae I made Angus a set and a fine set it was. And he paid for the components I employed, ma expert services being free as per arrangement wi' Maggie above. It had three valves and I christened it the Missen One, it being a circuit I'd specially designed for Angus as I tellt him several times. He didna understand why it should be Missen *One*, when it had three valves, but I explained maist lucidly that Missen was a general name for the circuits I invented and his number one o' the series and he was awfu' pleased about it.

But I've got to be a wee bit canny when Angus is visitin' me and see that ma set is no' workin' at full strength for mine's a twa-valver and Angus's is a three-valver sae it's got to sound louder nor mine. Which it wouldna if I didna effeck ma ingenious adjustment.

For, as I tellt ye, Angus's set is a Missen One—Missen' One, ye ken, though Angus doesna. Ay, I jist connected up his *second* valve wi' the loud-speaker and his third valve'll dae fine as a reserve for ma ain wireless set.

And by the time I've made one exchange and need anither, weel, mebbe providentially, his twa-valves 'll be near deceasin' sae he'll need three new ones which is to be expected in a three-valve set.

Ay, there's nae doubt about me being a wireless expert, eh?

What are the Right R.C. Values?

WHEN making up a set with one or more stages of R.C. amplification, you will find that, in general, it is most convenient to use ready-made anode resistance, coupling condenser and grid-leak units. These three components, of course, take the place of the primary and secondary windings of an L.F. transformer.

Some of these commercial units allow the standard resistances and condenser to be removed and others of different values substituted, if desired.

Trying Out Different Values

With special R.C. valves the substitution of different resistances may be beneficial, but few people can resist the temptation to try out different resistance and condenser values, where this is possible.

The question is, for most R.C. valves, what are the correct values of the coupling condenser and the anode and grid resistances?

Type of R.C. Valve Used

The anode resistance value is governed largely by the type of R.C. valve preceeding the amplifier stage. A general-purpose value is 250,000 ohms, that is, .25 megohm. Valves having an unusually high impedance can be used with an anode resistance of somewhat larger value, though quality may be impaired.

Theoretically there is no object in using a resistance more than ten times the valve impedance, for with this combination the theoretical maximum amplification is to be had. In practice a very much lower resistance than this is desirable, .25 megohm being suitable either for the stage of R.C. coupling following a detector, or for subsequent stages.

Thin and "Tinny" Reproduction

A useful value for the coupling condenser is .005 microfarad. Reproduction which is rather thin and "tinny" may be due to too small coupling condensers. There is nothing to be gained, though, by using condensers much greater than .005 microfarad.

Grid-leak Resistances

The correct value for the grid leak is, in theory, if not always in practice, governed by the value chosen for the coupling condenser. It will be obvious that there is a distinct relation between the constants of these two components in the grid circuit of the amplifier.

With a condenser of .005 microfarad a grid leak of 2 megohms is satisfactory for all-round work.

Reducing Grid Bias

If a somewhat higher value be chosen it may be found that the grid-bias voltage can be reduced a little. This is due to the fact that the increased leak value prevents the grid charge from passing to the filament, and consequently the grid takes up a slightly increased negative charge.

B. I. M.

Submarine Spotting by Radio

SPOTTING submarines by radio D.F. indicators is now a comparatively simple operation. The advantages of locating under-water craft by this means, in place of the former aircraft visual method, have been convincingly demonstrated, both in practice and in the serious game of war.

At many of the training schools instruments have been installed to give budding seamen at least a superficial acquaintance with radio direction-finding, and demonstrations of "listening-in" to submarines by radio telephony transmission are often given.

An Interesting Method

It is rather interesting to note the method employed at some schools, notably the Anti-submarine School at Portland, to give students an idea of the noises made by submarines when below the surface, without making an actual under-water test.

A number of gramophone records have been made of the "noises off," and these records can be reproduced through the medium of special earphones, so that an effect similar to that obtained with genuine D.F. apparatus results. Submarine spotting in safety, one might say!

M. L.

Wireless Magazine GRAMO-RADIO SECTION

GRAMO-RADIO is not a difficult term to understand; it means what it is—the combination of the gramophone with the radio set—a development that the WIRELESS MAGAZINE *welcomes and believes has come to stay.*

For many months now the WIRELESS MAGAZINE *Technical Staff has given special attention to the special problems of Gramo-Radio and how they affect the design of receivers for the dual use.*

Special Gramo-Radio Receiver

Last month constructional particulars were given of the Gramo-Radio Four, a receiver designed equally for radio work and also for gramophone reproduction.

The object of incorporating this special Gramo-Radio Section in the WIRELESS MAGAZINE *is to bring to the notice of radio enthusiasts some of the purely "gramophone" problems that will be met and explain how they can best be overcome.*

Attention is drawn, therefore, to two special articles which appear in the following pages.

Authoritative Articles for the Enthusiast

"The Choice of Records for the Gramo-Radio" is from the pen of a distinguished gramophone expert, for Christopher Stone arranges for the British Broadcasting Corporation their weekly concert of selected gramophone records. He is, therefore, perhaps, better qualified than any other critic for seeing things from the gramo-radio angle, for he has technical knowledge of both ends. Mr. Stone is also, by the way, the London Editor of "The Gramophone."

An Itonia portable gramophone used by the "Wireless Magazine" for test purposes. Although cheap it is very satisfactory

Another special article to which attention is drawn is that by H. T. Barnett, M.I.E.E., equally well known as a gramophone expert. "Getting the Best Results from Your Records" contains many useful hints for WIRELESS MAGAZINE *readers who intend to add an "electrical" gramophone to their radio installation.*

Amplifier for Any Existing Set

"The Gramo-Radio Amplifier" is suitable for use in conjunction with almost any receiver not at present incorporating sufficient low-frequency amplification. Its addition will ensure an adequate distortionless output to work the largest of loud-speakers.

We believe that the inauguration of this special Gramo-Radio section will be appreciated by all readers of the WIRELESS MAGAZINE *and that it adequately fills a gap that has hitherto existed in radio journalism.*

Is There Anything Special You Want to Know About Gramo-Radio?

Whatever point you want to know about Gramo-Radio consult the "Wireless Magazine" Technical Staff. For many months they have kept abreast of this latest development and can reply to any query that may be raised in connection with it.

If your pick-up does not give the results you think it should—if your amplifier is not quite distortionless—in fact, if you are in trouble of any sort, the Technical Staff can put you on the right track.

So that the Staff is not absolutely overwhelmed with queries (and to avoid the trouble of answering any of a frivolous nature, which results from a free service) a nominal fee of 1s. is charged for each question asked.

Write your query or queries (not more than two can be answered for each reader) on one side of a sheet of paper and send it, together with a stamped addressed envelope, a postal order for 1s. and the coupon from page iii of the cover, to Gramo-Radio Queries, "Wireless Magazine," 58/61 Fetter Lane, E.C.4.

THE CHOICE OF RECORDS FOR THE GRAMO-RADIO

An authoritative article by CHRISTOPHER STONE, who arranges the weekly recital of gramophone records transmitted from the London station. He is also the London Editor of "The Gramophone"

SINCE I have had the privilege or broadcasting some short programmes of gramophone records on Tuesday evenings from Savoy Hill, I have seemed to detect two currents of thought in the rather formidable volume of correspondence which these recitals have provoked.

Improved Recording

Mr. X writes, as a rule: "I had no idea that gramophone recording had improved so greatly; your programme last night came through splendidly, and it was just as if the performers were actually in the studio."

Mr. Y writes of the same programme: "The transmission last night was deplorable; the orchestral record in particular, which is one of my favourites and is superlatively good on my Coster's Choice, model 606, sounded hopelessly muddy. No one can get an idea of the real quality of records from these wretched transmissions. You had better stop them."

A Little Algebra!

One does not have to know much algebra in order to deduce that X = wireless enthusiast, and Y = gramophone enthusiast. X has not got a gramophone, but has an extremely good receiving set; Y has a good gramophone, but an indifferent receiving set, which he only uses in lieu of an evening paper.

After being on the staff of an exclusively gramophone magazine for the last five years, I am very grateful for the invitation of the WIRELESS MAGAZINE to address a few words to X—and I quite expect that if they catch the eye of Y also he will feel impelled to write to me again. I know the Y type pretty well.

There are still plenty of listeners who write to ask me what make of gramophone is used at Savoy Hill, because it sounds so much better than the table grand which they have at home.

But, as a matter of fact, the B.B.C. has been using an electro-magnetic pick-up for the broadcasting of records for over three years; and now in Studio No. 5 there is an old H.M.V. console model with two turn-tables and pick-ups, and a switch which connects either of them, or the microphone over the reading desk, with the control-room. For three years.

In the United States

And for nearly as long a time nearly every phonograph in America has been combined with a radio set, as a matter of course, though in this country the Amplion unit was alone in its glory for what seemed ages. This, of course, was not for electrical reproduction, but merely to use the gramophone amplifier as a loud-speaker.

But the public seemed definitely to dislike the combination of wireless and the gramophone. It took sides, almost with defiance. It saw that the gramophone record was expensive, had a horrid scratch, and was as restless as an invalid, always wanting to be turned over every few minutes; or else it saw that the wireless set was always out of order when most wanted, and that when it was in order it emitted the most unreasonable jumble of second-rate music and impossible talks.

Speaking generally, it did not choose to see that the two things were ideally supplementary to each other, mutually neutralising drawbacks and combining advantages.

Time passed very quickly. The gramophone borrowed microphone recording from wireless with thrilling results, and the B.B.C. rapidly improved the standard of means and matter in its programmes.

The Hand of Friendship

The prejudices of the die-hards began to weaken, but it was not till the comparatively recent commercial production of electric pick-ups that both sides began to extend the tentative hand of friendship—the gramophonists to admit that they wished they knew something about wireless, and the radiolists that they could afford to buy gramophone records.

Admittedly the electrical reproduction of sounds which have been electrically recorded is a logical development, though I know that some of my friends still deny this.

The pick-up is the logical development, just as the film-record is a logical development of the disc record. But it is not to be supposed that the pick-up or the film-record will spring fully armed from the brain of any laboratory-Zeus.

Still Need for Improvement

It is not, happily for me, my business to say anything about the various kinds of pick-ups at present on the market; but as a gramophonist I may be allowed to say very firmly to you wireless enthusiasts that your idea of good reproduction is not yet ours, and that you will have to improve your apparatus very considerably before you can reproduce our favourite

records as faithfully, as consistently and as economically as our non-electric gramophones can.

The Panatrope, with its Rice-Kellogg coil-driven loud-speaker, seemed at first to make every gramophone hopelessly antiquated but it has never yet completely won over the purist.

Question of Cost

Moreover, it was, and still is, too expensive for most of us; and the fact remains that the apparatus for electrical reproduction necessary in order to compete with a good gramophone in quality, as well as in volume, costs more than the gramophone.

However that may be, I am assuming that you have somehow or other attached an old gramophone —a motor, a turn-table, and a pick-up—to your receiving set and have succeeded in getting good results on your loud-speaker from your old gramophone records.

The next thing is to begin a record collection, and it does not take you long to discover that *this* is what is going to run you into a heavy expense. It is almost inevitable; but the great object should be not to waste money by buying records which will be failures or by allowing your pick-up to wear them out prematurely.

The record catalogues of the recording companies are rich to overflowing with the most enticing varieties of "title and contents," and anyone who comes freshly to them will be bewildered.

Possible Combinations

Let me warn you that a great deal depends upon your pick-up and your amplifier or loud-speaker. No list that I could give you would be good on every combination. A Phonovox and a horn, a Crosley Merola and a cone loud-speaker, a Brown and a moving-coil instrument, for instance, would give very different reproduction of such records as the great Cavalleria Rusticana, Easter Hymn, and the Aida Triumphal March (Parlophone records), or George Thill in the Flower Song from Carmen (Columbia) or Rachmaninoff's record (H.M.V. DB1016) of Schubert's Impromptu in A flat. It depends upon the difference of response to higher and lower frequencies.

Similarly the Pathé-Actuelle records, which on most gramophones have a peculiarly acrid flavour, are found to reproduce on certain electrical combinations more successfully than almost any other make. And the upshot of this is that neither I nor anyone else can give a list of records which can be safely recommended for all varieties of electrical reproduction, from a technical point of view.

Here are a few records which have had an especially successful transmission from 2LO:—

Blue Danube and Tales from the Vienna Woods, waltzes (*J. Strauss*). Philadelphia Symphony Orchestra. H.M.V. D1218 (6s. 6d.).

The Whistler and His Dog and **Warbler's Serenade.** Arthur Pryor's Band. H.M.V., B2373 (3s.).

Triumphal March from *Aida* (*Verdi*). Parlophone, R20018 (6s. 6d.).

Hear My Prayer. Temple Church Choir. H.M.V., C1329 (4s. 6d.).

Le Cygne (*Saint Saens*) and **Londonderry Air** (*Chopin*). Felix Salmond (cello). Columbia, L1958 (6s. 6d.).

The Song of the Volga Boatmen and **Monotonously Rings the Little Bell.** Don Cossacks Choir. Columbia, 9085 (4s. 6d.)

Sixth Hungarian Rhapsody (*Liszt*). Mischa Levitzki (piano) H.M.V., D1383 (6s. 6d.).

Parted (*Tosti*) and **O Lovely Night** (*Landon Ronald*). Doris Vane (soprano). Columbia, 9283 (4s. 6d.).

The Song of the Flea (*Moussorgsky*) and **Drinking** (*In Cellar Cool*). Capiton Zaporojetz. Columbia, L1991 (6s. 6d.)

O Sole Mio and **Souvenir** (*Pazeller*). Dajos Bela Orchestra. Parlophone, E10617 (4s. 6d.).

Invitation to the Waltz (*Weber*) Philadelphia Symphony. Orchestra. H.M.V., D1285 (6s. 6d.).

Parla (*Arditi*) and **The Gypsy and the Bird** (*Benedict*). Galli-Curci. H.M.V., DA928 (6s.).

A Brunswick Medley. Rex Evans "announcing" a star programme. Brunswick, 20056 (4s. 6d.).

Two Black Crows, Mack and Moran. Columbia, 4441, 4616, 4686 (3s. each).

The Singing Lesson—laughing record. Parlophone, E5500 (2s. 6d.).

But, on the other hand, from the more or less musical point of view, there is a good deal that may usefully be said to the novice.

Let him, to begin with, acquire the complete catalogues of Brunswick, Columbia, Edison Bell, H.M.V. and Parlophone records; catalogues of other makes can be examined later. In these five he will find very nearly every title that has been recorded. If he is still under the domination of American songs and dance tunes he will find in each of these catalogues the cream of American recordings.

Already Heard by Wireless

But it is more likely that he will turn to the dance bands already familiar to him on the wireless—Fred Elizalde and his music (Brunswick), the Savoy Orpheans (H.M.V.), Debroy Somers (Columbia), Alfredo and his Band (Edison Bell), and so on.

Naturally very many of the most successful singers and instrumentalists of the B.B.C. programmes have also been to the recording studios; and where one has heard a particularly pleasing performance, whether by the B.B.C. Symphony Orchestra or on a cinema organ or a cathedral organ and choir, it is always worth while to ascertain whether the same performance is not available in a more lasting form on a gramophone record.

Records of Broadcasters

Clapham and Dwyer have recorded for Parlophone and Columbia, Mabel Constanduros for Edison Bell, John Henry for H.M.V., Ord Hume and Kel Keech for Brunswick, and the excellent skit, "London and Daventry calling" (H.M.V. C1251), by the Savoy Orpheans, should be in the collection of all who can appreciate it.

But—still speaking very generally—I suggest that, except for special reasons, the wireless enthusiast should try to resist the temptation to acquire for his gramophone the replicas of what he hears from Savoy Hill.

He should go further afield and seek for the treasures in the record catalogues which he cannot get on the wireless. He should look for the performances of standard

The Choice of Records for the Gramo-Radio (*Continued*)

works by orchestras, singers, and instrumentalists, who for one reason or another do not broadcast in this country. Only thus can he prevent his taste from becoming stereotyped.

Some Good Orchestras

The Philadelphia Symphony Orchestra under Stokowski; the Berlin State Opera Orchestra, under a variety of conductors; the New York Philharmonic Orchestra under Toscanini; the Concertgebouw Orchestra of Amsterdam under Mengelberg, should be heard as well as our Hallé Orchestra and London Symphony Orchestra and Queen's Hall Orchestra, and Royal Albert Hall Orchestra, and B.B.C. Wireless Symphony Orchestra, under their various conductors.

Then there are the Dajos Bela Orchestra and the Edith Lorand Orchestra in the Parlophone list, which never make a bad record and seldom a hackneyed one; and the superb Marek Weber in the H.M.V. catalogue.

It is safe to say that for the serious musician, the lover of chamber music, the Beethoven or Brahms, or Wagner or Schubert devotee as well as for the moderately musical person (who ranges from Ketelbey, Moszkowski, Weber, Rossini onwards) and for the dance-maniac and cutie-sweetie votary, there are enough first-class records available to ruin anyone who does not pay super-tax.

And then opera—this is the richest vein of all. Melba, Elisabeth, Schumann, Olszewska, Chaliapine, Keipura, and others of their calibre, may occasionally be heard on the wireless; but these are only a handful out of the scores of international celebrities whose quintessential performances are at the disposal of the gramophonist.

Criticising With Discretion

Small wonder that, fed and trained by operatic records of this quality, he finds the broadcast operas thin fare and is fit to criticise a Covent Garden gala performance with discretion.

Or, at the other end—or somewhere near it—of the scale, consider the gramophone records of military bands, brass bands, and what the Americans call concert bands. Most of our famous bands have made records, and many of them have broadcast from time to time; but no one who is an expert in these matters should rest till he has heard the records of Creatore's Band (H.M.V.), the American Legion Band (Zonophone), Sousa's Band (H.M.V.), Arthur Pryor's Band (H.M.V.), and Walter B. Rogers and his Band (Brunswick).

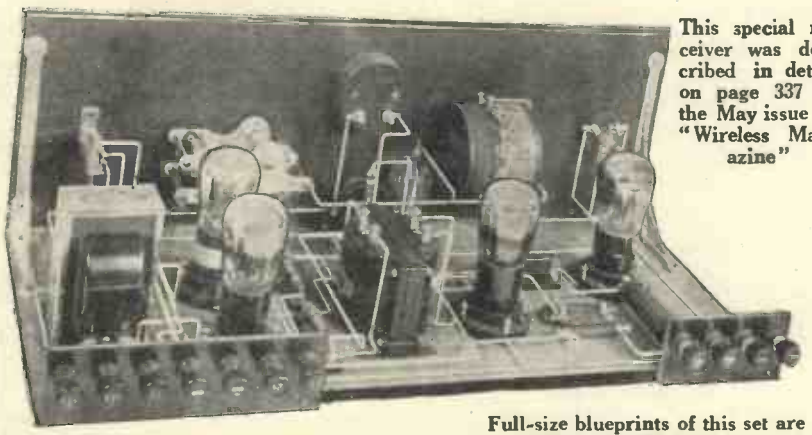
Enthusiastic Letters

When I broadcast a programme of these American band records I received more enthusiastic letters than about any other of my short recitals.

I have no time to speak of organ records, piano, violin, cello, string quartet, or vocal or choral records. In fact, I have only touched the very outside fringe of the subject.

But my hope is that the liaison between wireless and the gramophone will increase rapidly with mutual benefit, and that I may be allowed to go on helping listeners to choose the best records for pick-ups by the most practical way of all—the broadcasting of records from Savoy Hill.

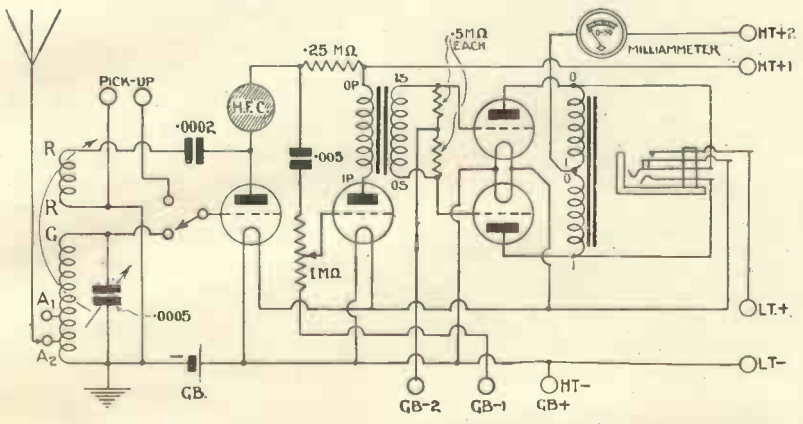
Build the Gramo-Radio Four!



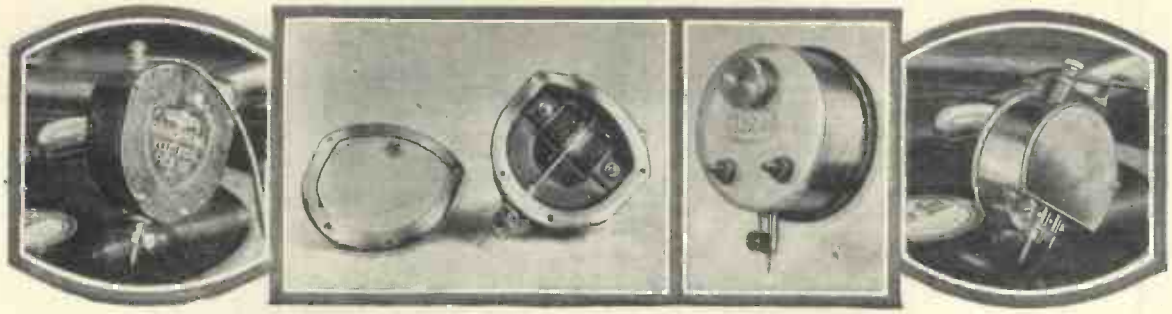
This special receiver was described in detail on page 337 of the May issue of "Wireless Magazine"

Full-size blueprints of this set are available for 1s. 6d. post free. Ask for No. W.M. 70

GREAT POWER OUTPUT WITHOUT DISTORTION



Here is the circuit of the Gramo-Radio Four. Note the position of the electrical pick-up



Outer and Inner Views of Magnum Pick-up | Lissen Unit | Brown Pick-up

How the Pick-up Does Its Work

By D. SISSON RELPH

EVERY listener knows that a loud-speaker works by virtue of a varying electric current from the output stages of the receiver causing a diaphragm of some sort to vibrate and so produce air waves which are audible to the air.

Problem of the Pick-up

The problem of the magnetic pick-up is almost an exact reverse of this process, for in this case we have to convert mechanical vibrations (corresponding to the movement of the diaphragm) into electrical variations which can be applied to the input of an amplifier.

On this page are reproduced diagrammatic sketches of an ordinary sound-box and a magnetic gramophone pick-up. It will be interesting to examine these in some detail to see how far they are similar in operation.

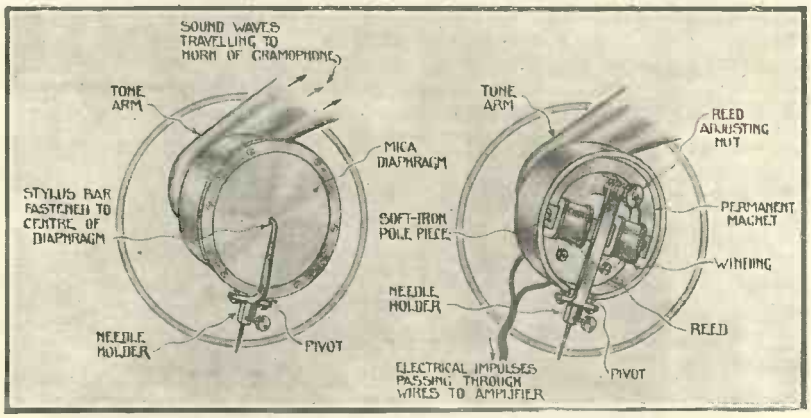
Soundbox Essentials

A gramophone sound-box consists in essential of a *needle*, a lever, called the *stylus bar*, which is anchored to the centre of a *diaphragm*. The needle, of course, runs in the groove of a record, and the "hills and dales" in the groove naturally cause movement of the needle and, consequently, of the stylus bar.

As the stylus bar is not pivoted at its centre, it will be clear to most readers that the movement of that end attached to the diaphragm is very much greater than the actual movement of the needle point.

But as one end of the stylus bar is anchored to the centre of the diaphragm (which is usually made of mica), this is caused to vibrate and produce air waves which travel up the tone-arm to the horn of the loud-speaker. These waves, moreover, are amplified to some extent by the shape and dimensions of the horn itself.

The difference between such a sound-box and a magnetic pick-up is that in the latter case the stylus bar is replaced by a similar flat steel reed and an electro magnet system such as is employed in an ordinary earpiece takes the place of the diaphragm.



Diagrammatic sketches showing differences between sound-box and magnetic pick-up

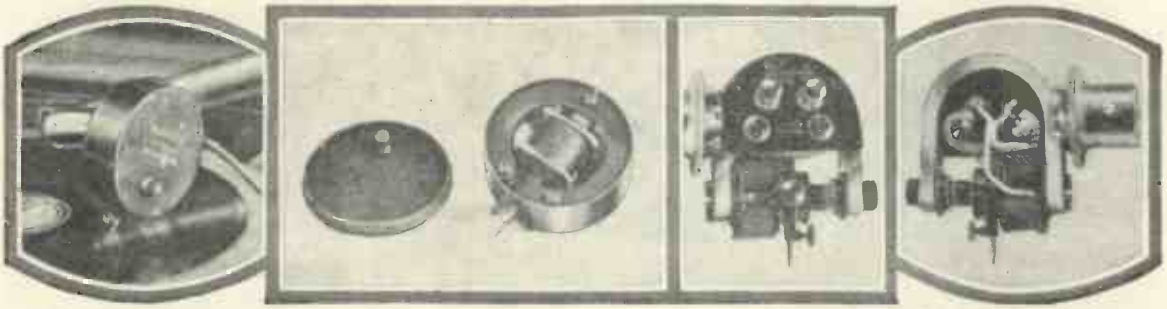
Movement of the Reed

It will thus be clear that the movement of the needle will produce corresponding movements of the steel reed within the magnetic field produced by the permanent magnet incorporated in the pick-up. The movement of the reed in the magnetic field will cause small current variations in the winding placed round the pole pieces of the permanent magnet, and these impulses are passed through a flexible lead to the input of the amplifier.

There are thus two obvious requirements in any magnetic pick-up. The magnet system must be as powerful as possible and the coils round the pole-pieces must be of such a resistance that the maximum possible current flows in them for any given variation in movement of the reed.

Obtaining Powerful Fields

Normally there are two methods of obtaining a powerful magnetic field in a pick-up; one is to increase the size of the magnet as far as is practicable, and the other is to make the air gap between both pole



Outer and Inner Views of Marconiphone Unit

Two Views of the Woodruffe, marketed by Celestion

pieces and the steel reed as small as possible, as in this way the magnetic field is concentrated at the point where it is most required.

Fitting Tone-Arm

A number of pick-ups of various manufactures are illustrated in these pages. Most of them will fit the standard tone-arm incorporated in the majority of gramophones, but with some makes a special adapter is necessary. There is one other rather important point to be watched in regard to magnetic pick-ups, and that is the damping of the reed.

It is obvious that the mechanical inertia of a thin steel reed will not be as great as that of a mica diaphragm clamped all round the periphery.

If the reed were mounted without any kind of stiffening being applied by means of springs or rubber buffers, blasting would occur in the amplifier every time a loud note occurred in the record, and in all the good pick-ups some form of damping the reed is introduced.

Pick-ups are made with both high and low resistances. Normally a high-resistance pick-up can be connected directly between the grid and filament of the first amplifying valve without the need for using an input transformer, but in the case of low-resistance pick-ups it is necessary to use such a transformer. In this case the pick-up is connected directly to the primary and the secondary winding is connected between the grid and filament of the first amplifying valve.

One pick-up on the market is electrostatic instead of electro-magnetic in action and relies for its operation on the change of capacity produced by the movement of the needle. This pick-up is provided with three leads, two of which are connected between the grid and plate, and the third to the negative point of the filament.

A number of manufacturers supply adapters with their pick-ups so that these can be plugged directly into an existing set. In most cases the adapter takes the form of four pins arranged to fit a standard valve holder and this adapter is plugged in position in place of the detector valve.

Retaining the Detector Valve

In one case the adapter is arranged so that the valve that it would normally replace is inserted in the top. This is particularly useful for plugging in the detector stage of an existing receiver, for in that case the detector valve can also be used, as an amplifier with, of course, improved results. Normally inserting the adapter in place of a valve cuts out one valve of the receiver, which is a disadvantage where only a small set is in use.

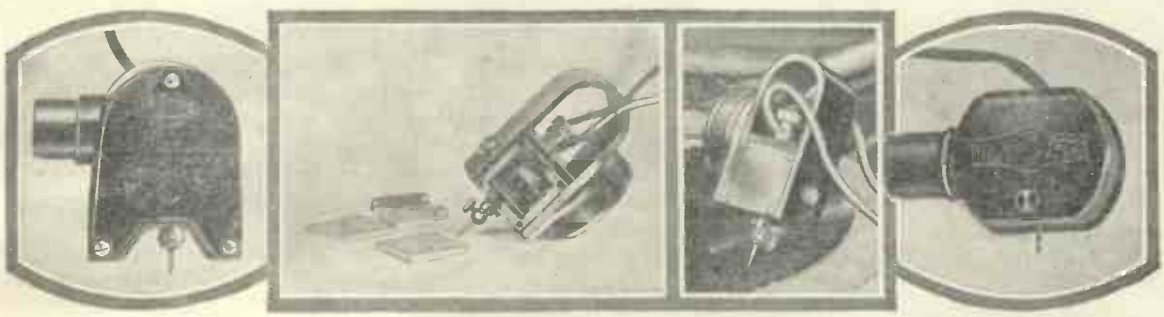
Although a *powerful* receiving set is not essential for reproducing gramophone records electrically, the output of the final amplifier must be *distortionless*. For this reason, at least, one really good super-power valve must be employed.

Adding an Amplifier

If your set does not already incorporate a low-frequency stage (or stages) beyond reproach you cannot do better than add to it the Gramo-Radio Amplifier (See page 458), which has been specially designed by the WIRELESS MAGAZINE Technical Staff to give the required output.

Another point to watch is the use of a good loud-speaker. With an old model of the horn type it is not likely that the results obtained will be as good as can be had from a fairly modern gramophone. The best results will be achieved by using a good cone loud-speaker, preferably of the coil-driven or moving-coil variety.

Pick-ups vary greatly in weight and, therefore, the amount of wear on the records is greater with some than with others.



Igranic Phonovox

Two Views of the Gecophone Magnetic Pick-up

Loewe Pick-up

SOME GOOD RECORDS FOR ELECTRICAL REPRODUCTION ::

REVIEWED BY H. T. BARNETT, M.I.E.E.

GRAMOPHONE records of recent issue, which by reason of their unusually dulcet quality are particularly well suited for reproduction electrically, even through cheap loud-speakers, have been in my thoughts the last few days and perhaps the following notes concerning some of them may be useful.

Not one is a "swinger," and all are vigorous in tone (feeble records *always* have bad quality) yet free from blast and give good performances of music of a kind that will please both the scholarly and the ordinarily well-educated audience.

It will be noticed I give a great preponderance to instrumental music. That is because one can play an orchestral record every week without tiring of it, whereas a vocal record will never come out except for someone who has not heard it before.

GRAND ORCHESTRA: *Hungarian Rhapsody No.* 2 (Liszt).—Played by the Philadelphia Symphony Orchestra. (6/6) H.M.V.

Solemn Melody (with grand organ) Walford Davies.—Played by the Hallé Orchestra. (6/6) Columbia.

Parsifal (with bass voice) (Wagner).—Played by the Berlin State Opera House Orchestra. (4/6) Parlophone, 85 City Road, E.C.

GRAND ORGAN: *Fantasia and Fugue on Bach.*—Played by Guy Weitz on the organ of Westminster Cathedral. (4/6) H.M.V.

SALON ORCHESTRAS: *Tosca*, selection.—Played by Marek Weber. (4/6) H.M.V.

Madame Butterfly, selection.—Played by Edith Lorand. (4/6) Parlophone.

O, Sole Mio, tango.—Played by Dajos Bela. (4/6) Parlophone.

PIANOFORTE: *On Wings of Song.* Played by Mark Hambourg. (4/6) H.M.V.

CHAMBER MUSIC: *Brahm, Piano and String Quartette* (four discs).—The National Gramophonic Society, 58 Firth Street, W.1.

The Horseman Quartette. One disc (4/6) Parlophone.

VIOLIN AND PIANO: *Sonata, Paganini.*—Played by Tosty Spiwakowsky. (4/6) Parlophone.

VOCAL: Italian Soprano, *Parla, Waltz.*— Sung by Galli-Curci. (6/-) H.M.V.

German Soprano, *Du Bist die Ruh.* Sung by Lottii Lehmann. (6/6) Parlophone-Odeon.

Boy Soprano, *I Waited for the Lord.*—Sung by Ernest Longn. (4/6) H.M.V.

Bass, *Song of the Volga Boatman*, with *The Mighty Deep* on the reverse.—Sung by Malcolm McEachern. (4/6) Columbia.

Popular Songs, *Would You?* (2/6) Winner.

Waltz Song, from Tom Jones. (3/-) Electron.

JAZZ (Exhibition): *Strauss Parodie.* (4/6) Parlophone. (Piano).

Flapperette.—Band and Piano. (1/3) Radio.

Dainty Miss.—Dance (3/-) Electron.

Burma Girl. (2/6) Parlophone.

Clowbrity-Clonk. (3/-) Electron.

SCOTS NUMBER: *My ain Wee Hoose.* (2/6) Beltona.

SECULAR ORGAN: *Oriental March.* (2/6) Winner and Beltona.

Russian Lullaby. (2/6) Winner.

PRACTICAL HINTS IN GRAMO-RADIO WORK

GENERALLY speaking, the gramophone pick-up may be likened to a microphone, such as is used for telephony transmission purposes, and as such requires careful consideration.

Suitable Amplifiers

The manufacturers of gramophone pick-ups can be relied upon to have done their duty in so far as the construction of the pick-up is concerned, but it must not be expected that they have designed their components to suit any and every form of amplifier.

It therefore behoves us to consider a few of the pitfalls into which the user of pick-up devices may fall if he be unwary. For instance, with some makes of unit it is absolutely essential to use a transformer between the pick-up and the amplifier.

Again, some pick-ups require the use of a constant load device connected in parallel with them to lessen the chances of distortion should a small grid current flow when a powerful variation is applied to the grid of the first amplifying valve.

Other pick-ups require the use of a volume-control resistance connected across them, but, generally speaking, this latter type of unit is supplied with a specially designed volume-control unit attached.

So far, only the more practical side of the device has been dealt with, but the reader will soon discover for himself, after using a pick-up for some little time, that the efficient working of such pieces of apparatus depends not only upon the units themselves and their associate circuits, but also upon the quality in the impression of the record being reproduced.

Users of the ordinary gramophone will verify the truth in the statement that one record will give rise to more "scratch" than another. This scratchiness in reproduction is a great bugbear, and one that has called for exhaustive inquiry by many eminent men in the United States, where the gramophone pick-up has been given great attention.

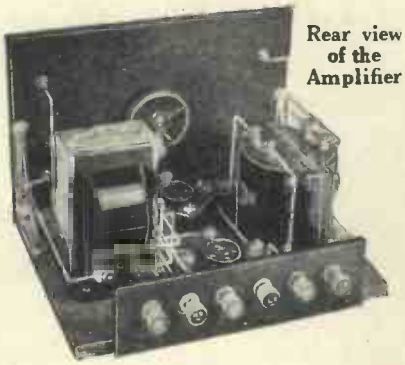
In this respect, we think that it would not be out of place to specify a means whereby much of the trouble due to scratch has been mitigated.

The most satisfactory method yet devised for the elimination of such noises is to shunt the pick-up with a circuit that will act as an acceptor circuit to audible frequency impulses and so by-pass them.

How to Make the Shunt

Such a circuit can be built up from a variable condenser of about .001-microfarad capacity and a suitable plug-in coil. The frequency of the scratch governs the size of the plug-in coil, but several large coils, ranging in size from a standard No. 400 to a No. 1,500, will soon enable the user to eliminate any noise with which he may be troubled.

L. A. CHAPMAN.



Rear view of the Amplifier

The Gramo-Radio Amplifier

Designed, Built and Tested by the "Wireless Magazine" Technical Staff

THERE is little point in reproducing gramophone records through the medium of a radio amplifier and loud-speaker unless the amplifier is absolutely distortionless and capable of giving an adequate output.

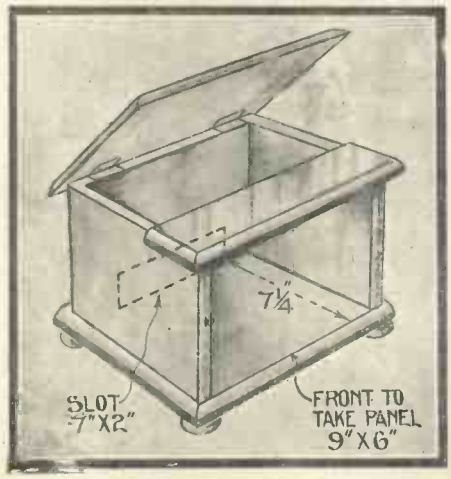
In this article is described a two-valve single-stage amplifier arranged on a special push-pull system.

It can be attached to any existing receiver in which high-tension negative is connected to low-tension *negative* and will give sufficient output to work even the largest of coil-drive loud-speakers, although it is, of course, suitable for use in conjunction with any loud-speaker.

If it is coupled to a set in which high-tension negative is connected to low-tension *positive* the accumulator will be short-circuited. It is not a difficult matter to alter any existing set however.

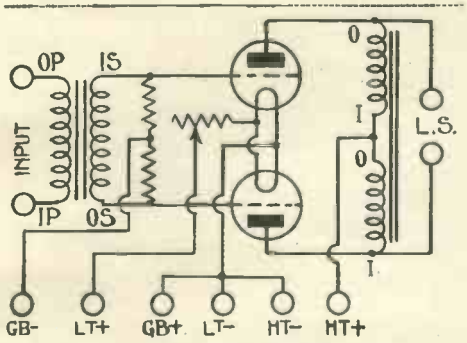
The principle of a push-pull amplifier is that the signal voltages are divided equally between two power valves.

This has the effect of converting two valves with not very large grid-swings into one valve with a great grid-swing and is, therefore, a more efficient arrangement than merely connecting two valves in parallel, which does not alter the characteristic of the amplifier except as regards output.



Details of the Cabinet

The method of splitting the feed to the grids of the valves is of some interest and can best be understood by a glance at the circuit diagram.



Circuit of the Gramo-Radio Amplifier

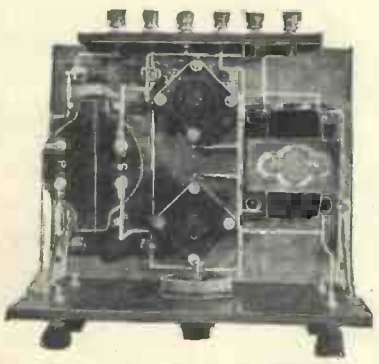
Instead of employing a special transformer with a centre-tapped secondary a standard transformer is used and the effect of a centre-tap obtained by placing two .5-megohm resistances across the winding and tapping off between them.

In this way, the load is equally divided between the two valves; in the anode circuit of each is one half of a double-wound low-frequency choke, the point between the windings being taken to high-tension positive.

It will be seen that no steady direct current for the high-tension battery flows through the loud-speaker windings as the resistance of one half of the choke and the valve is lower than the one half

COMPONENTS REQUIRED

- 1—Ebonite panel, 9 in. by 6 in. (Becol, Will Day, or Raymond).
- 1—7-ohm panel rheostat (Lissen, Igranic, or Benjamin).
- 10—Terminals, marked: Input, Input, L.S.+, L.S.−, L.T.+, L.T.−, H.T.+, H.T.−, G.B.+, G.B.− (Belling-Lee).
- 2—Anti-microphone valve-holders (Benjamin, Lotus, or W. and B.).
- 1—Low-frequency transformer, ratio 4 to 1 (Marconi Ideal, Igranic type CT or Mullard).
- 2—.5-megohm grid leaks with holders (Mullard, Dubilier, or Lissen).
- 1—Ebonite strip, 7 in. by 2 in. (Becol, Will Day, or Raymond).
- 1—Double-wound low-frequency choke (Igranic type CT, Ferranti type B1, or R.I. and Varley).
- 1—Cabinet with 7 in. baseboard (Pickett Bros.).



Plan view of the Gramo-Radio Amplifier

of the choke, the valve and the loud-speaker, which forms the alternative path.

Constructors are strongly recommended to use the components specified as it is most important for good reproduction that the special types of parts indicated should be used.

Full-Size Blueprint Available

All the essential details are shown in these pages, but for those who desire it a full-size blueprint, drilling template, layout and wiring diagram is available. This can be obtained for half-price, that is 6d., post free, if the coupon on page iii of the cover is used by June 30.

Address your enquiry to Blueprint Dept., WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4, and ask for blueprint No. W.M.72.

The only parts to be mounted on the panel are the filament rheostat and the input and loud-speaker terminals.

All the rest of the components are mounted on the baseboard. On

Front view of the Gramo-Radio Amplifier

the extreme right (looking from the back) are the two .5-megohm grid-leaks arranged one at each end of the low-frequency transformer. Next, in line, come the two valve holders and on the extreme left, the double-wound low-frequency choke.

As soon as all these parts have been firmly screwed down, wiring up can be started. This can be done quickest by reference to the wiring diagram or blueprint.

SUITABLE VALVES FOR USE IN THIS AMPLIFIER ARE INDICATED ON PAGE 433

It will be observed that each terminal point is marked with a small letter of the alphabet; these letters indicate which points should be connected together and in what order.

For instance, first connect together those points marked *a* with one wire or as few wires as possible; then connect those points marked *b*; and so on through the alphabet.

Any two similar power valves can be used in this amplifier; suitable types are indicated in the

Another view of the Gramo-Radio Amplifier with valves in position

article "A Coil-drive Loud-speaker with Permanent Magnets" on page 432. Readers are warned that the anode-current consumption will be heavy and for economical running a mains high-tension unit or a high-tension accumulator is most desirable.

Checking H.T.-Connection

Before connecting the amplifier to an existing set make sure that high-tension negative is connected to low-tension *negative* and not to low-tension positive (this point has been mentioned before, but is repeated because of the danger of short-circuiting the accumulator and permanently injuring it).

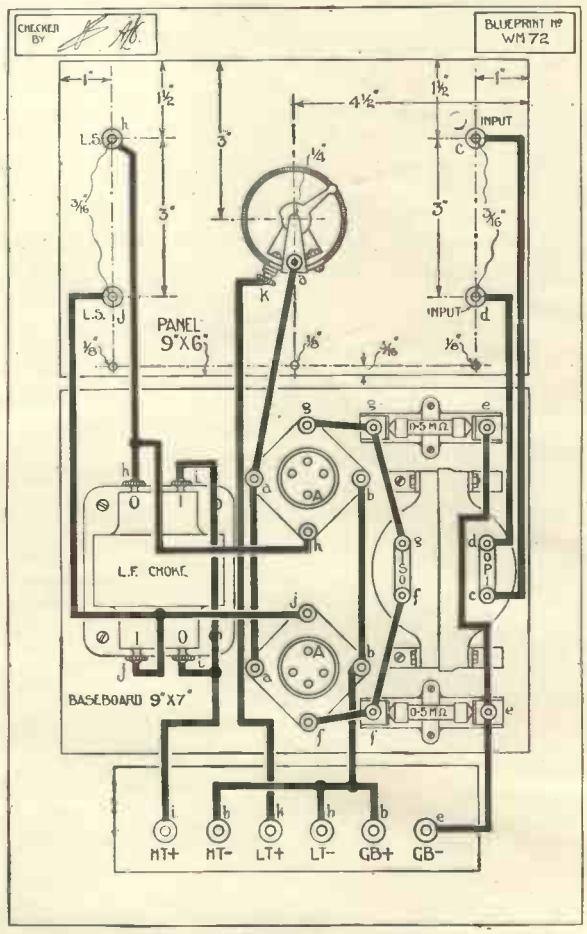
The amount of high-tension and grid-bias voltage will depend upon the valves used. Although most super-power valves are rated at 120 volts maximum many of them will stand as much as 200 volts without seriously shortening their life. Ordinarily as much high tension as is available up to that amount can be applied.

Suitable Grid Bias

At this anode voltage the majority of super-power valves need a grid bias of at least 18 volts and even more is necessary in most cases. For use with such an amplifier as this it is best to use a 36-volt high-tension battery tapped at every 3 volts for obtaining grid-bias.

Unlike a parallel-valve unit results will be very considerably impaired if one valve is removed from the amplifier and it is essential always to use two valves.

The use of such an amplifier as this will enable the operator to get really good results from his Gramo-Radio outfit without a great deal of trouble.



This layout and wiring diagram can be obtained as a full-size blueprint for half-price, that is, 6d., post free, if the coupon on page iii of the cover is used by June 30

Getting the Best Results from Your Records!

This article by a well-known gramophone expert, H. T. BARNETT, M.I.E.E., tells radio enthusiasts—and also some gramophone enthusiasts—things they do not know about the reproduction of records. Every "gramo-radio" man should find it invaluable

IN playing gramophone records, there are certain factors of great importance in reference to the quality of reproduction that will be obtained, and also bearing on the wear damage that may (under unfavourable conditions only) be produced upon the records.

Such of these factors as are common to the apparatus that must be used no matter whether the amplification be mechanical (gramophonic) or electrical (by means of one's wireless set) I propose to speak of as briefly as possible in these articles.

Choice of a Motor

In the first place, of course, the record must be driven (rotated) and gramophone motors must be sufficiently powerful to have plenty of energy to waste on the governor brake or else unequal turning movements may result in a drop of pitch when one comes to a really "juicy" patch in a first-class grand organ or full orchestral record.

The cheap motor in a portable gramophone will often suffice for driving at a steady speed a good surfaced 8-in. or 10-in. record, especially if the recording be not particularly vigorous.

But when it comes to playing a 12-in. H.M.V. grand organ record, such for example, as *Piece Heroique*, particularly if fibre needles are favoured, then only a powerful motor, such as is used in a high-class gramophone, can be expected to do the work properly.

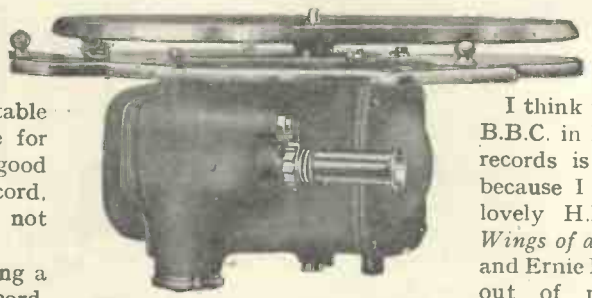
Some Practical Hints

However, if you already have a motor which you wish to use and that is causing pulling-up trouble, do not, at once, condemn it, but read what I shall have to say later on about *needle track alignment*, about *needle angle*, and about *needles*, and then quite likely, should you follow out my suggestions, you may find the trouble disappear.

If you have no motor and intend buying one get an engineering job, a solidly made thing with a good big spring or big springs; a lively motor, one that will not stop at once if the turntable be touched ever so lightly.

A 12-in. turn-table is better than a 10-in., because the fly-wheel effect of the larger table is most useful in overcoming the drag against the needle produced by sudden fortissimo passages high up in the scale.

Plenty of good motors are on the market, but I will mention two I have had in constant use for a long time and which have given no trouble whatever.



This is the Garrard motor referred to by the author

My large machine is fitted with a super-Garrard which it is a pleasure to use and a pleasure to wind. And my first machine is fitted with a much less expensive motor, the Collaro with one big spring.

Both these motors are British-made, the work of very clever engineers, and may be got from any reputable gramophone dealer.

Having provided yourself with a good motor to drive your records, the next thing to ensure is that the records are fit to be driven, and this brings me to my next subject, *Centration of Records*.

When hearing a record played, no doubt you sometimes have noticed a distinct wavering of pitch, a catawawling effect, synchronising with the rotations of the motor.

I do not mean those single variations of tone volume one gets from the rise and fall of a warped record lying unevenly on the turn-table, or in rare instances, through the turn-table itself being warped; but a far more unpleasant thing, due to one cause only, lack of co-centration between the spindle centre and the impressed-on record portion proper of the record disc.

If the motor spindle is too small (but this is a rare fault nowadays) it will be almost impossible to place a record on the turn-table so that it shall be correctly centred.

I think the machine used by the B.B.C. in London for broadcasting records is faulty in this respect, because I heard them playing the lovely H.M.V. record *O for the Wings of a Dove*, a few weeks ago, and Ernie Lough's sweet voice came out of my loud-speaker more reminiscent of pussy on the tiles than of the Temple Church.

I have this record and my copy is quite properly pressed so I fear I must blame Savoy Hill.

Rule for Spindle Size

I think a safe rule for motor-spindle size is that Winner records should go on them with no play whatever, and then with other records the amount of clearance will not be appreciably too great.

The common cause of trouble in this respect, I am sorry to say, is sheer carelessness on the part of the

record manufacturers, to ensure that the pressers are so mounted that the impressed record shall be truly concentric with the hole through the record disc.

One comes across the fault quite frequently in makes of all kinds and all prices. On an average, one side will be wrong in every three discs you buy; in some makes the proportion will be greater than this, in some less.

Best Batch I Have Had

The best batch of records I ever had was the set of ten 12-in. M.G.S. discs issued at the end of February; not a record was noticeably out of centre.

Out-of-centre records are generally called "swingers," because as they go round they cause the sound box to swing to and fro across the track. As it is impossible to avoid getting a "swinger" among your purchases occasionally, I will tell you how I cure those that come my way.

A Simple Remedy

Most of the leading manufacturers send me records for review and when a new group arrives I get out my pocket knife, open the small blade, and put it on the table, then I go on playing the records until I come to a "swinger." Now no one living can judge the quality of a record if it is swinging, so before I can review it it must be re-centred.

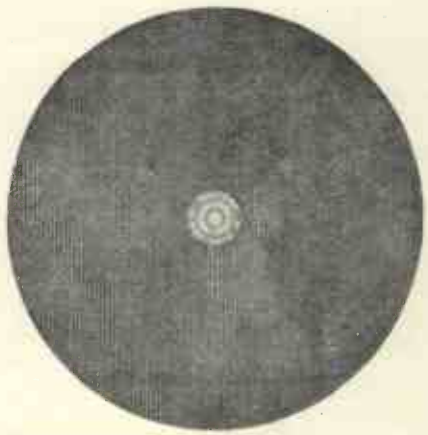
I stop the machine and push the record about on the spindle to see what clearance there is, if there is a little clearance, well and good, if none then some (only a little) must be made.

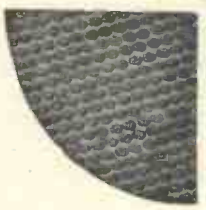
A few light sweeps of the knife blade round the edge of the centre hole will do this. Then I place the record on the spindle again, pushing it from the bottom edge against the spindle, what clearance there is then being all on the upper side.

If now the record runs truly I put a couple of scratches on the label extending from its bottom to the centre hole so that when I come to play this record again I shall know that I must *push it against the spindle in the direction shown by the scratches* so as always to get a correct reproduction.

If the record is not true when pushed from the bottom I try pushing it from the top, from the right, or from the left, or on half-way lines between these. One soon finds a place where there is "no error" or "*less error.*"

If the clearance is not quite sufficient for "no error" just a little scraping of the side of the hole that touches the spindle, when the record is at the position of "least error" must be done until, the happy "no error" setting is arrived at, and the label scratches may be put on.



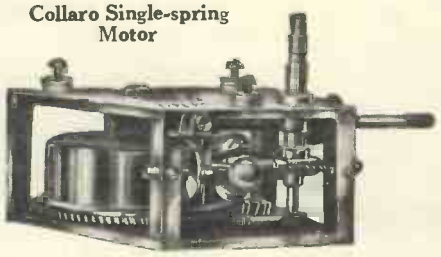


Beltona Non-skid Mat for Gramophone Turn-tables

Should one side of a record have to be re-centred by scraping then, of course, the other side must be tried and marked for centration, too, otherwise it might be thrown out of centre on some occasions (but not on others) as the clearance that is right for one side might be (and generally is) all wrong for the other.

I can re-centre and mark a faulty record on both sides in two minutes so you will see the job takes only about 1 per cent. of the time to do that is occupied in describing the very simple operation on paper.

Collaro Single-spring Motor



By-the-by—some turn-tables are covered with material on which a record can shift. If a record *can* shift it always will do so, and in the wrong direction, so I put a Beltona rubber non-skid mat on my turn-table to keep the record from departing from the way in which it should go.

These mats are quite useful things in other ways, they do not harbour dirt and transfer it to the records, and they slightly reduce surface noise.

Absolutely the most important point to look to when one is reproducing gramophone records is to see that the relative setting of the tone arm and motor on the motor board shall be such that when we are using the needles we prefer at the needle or stylus bar-angle we have decided to adopt, then the needle shall dip down truly in line with that part of the groove where the point touches.

In other words, what we have to *avoid* is getting the needle *wedged across* the groove, its point levered into and tearing the bottom of the groove on one side, the other side of the groove being damaged at the top by the canted-over side of the needle.

Risk of Record Injury

If this essential is not studied reproduction will be rough and grating, and a record may be so injured as to be useless after a single playing.

Five years ago when I coined this phrase (needle track alignment) and started to hammer the gramophone makers of those days (they ought to have been making perambulators or iron bedsteads) on the subject nearly every machine on the market would spoil a record at a single playing.

Eighteen Months Ago

After a time other writers helped me considerably, but it was not until eighteen months ago that the majority of expensive gramophones were made so as to be passably good in this respect. Even to-day a few expensive machines and quite

Getting the Best Results from Your Records *(Continued)*

two-thirds of the cheap machines are set out less well than they might be in reference to the length of tone arm used.

Length of Tone Arm

The longer the tone arm the smaller the error will be if it is set correctly, but with a tone arm length of nine inches between the base, centre and the needle-point, the amount of error need not be sufficient to damage the record so there is no need to use an extra long tone arm, but lengths shorter than nine inches should be avoided if possible.

The term tone arm used in these articles applies equally whether the arm be used to carry a sound-box or a pick-up.

Track alignment error is *nil* when the needle touches the record on a line extending from the spindle centre to the nearest point on the circumference (the radius line), the fore and aft line of the needle being at a right angle to the radius line.

Any deviation from the right-angle is error, and more than six degrees error at any part of the tone arm swing is dangerous.

Error on the inside of the record is more damaging than on the outside owing to the greater curvature in a unit length of groove, therefore it is best to set out our motor and tone arm so that the error shall be *nil* at a point two-thirds into a 12-in. record.

The error on the outside of a 12-in. record will then come out rather greater than on the inside, which is as it should be, because although the conditions will not be quite perfect for 10-in. records they are much less valuable than our 12-in. stock.

Measuring the Error

One can tell roughly whether the error is *nil* by making a hole through a sheet of paper, drawing a line straight across the sheet and passing through the centre of the hole.

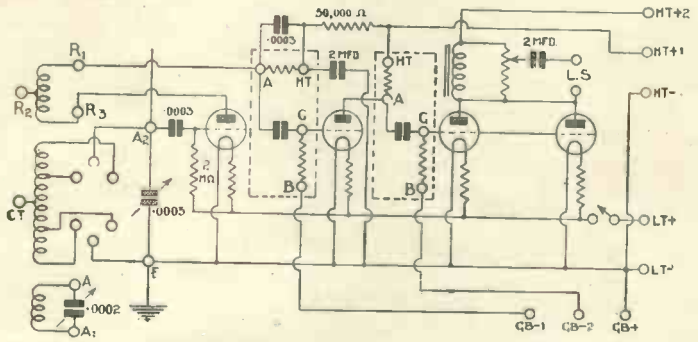
If this sheet of paper with the line on it then be put on the turn-table, so that the needle touches the line at a point coinciding with a two-thirds played record, it is comparatively easy to a practised eye to see whether the fore and aft line of the needle is at right-angles to the radius line.

In order to get the angle with absolute accuracy and also to tell precisely the degrees of error at the outside and inside of the track, a gramophone protractor has been designed by Mr. P. Wilson, and may be obtained for 1s., post free, from Gramophone (Publications), Ltd., of 58 Frith Street, W.1.

Correcting Faulty Tracking

Should a machine have faulty tracking it may sometimes be put right by altering the position of the motor. Sometimes the addition of a couple of adapters between the sound-box or pick-up and its socket on the tone arm will get over the difficulty. In bad cases and when the motor cannot be moved it may be necessary to get a new tone arm.

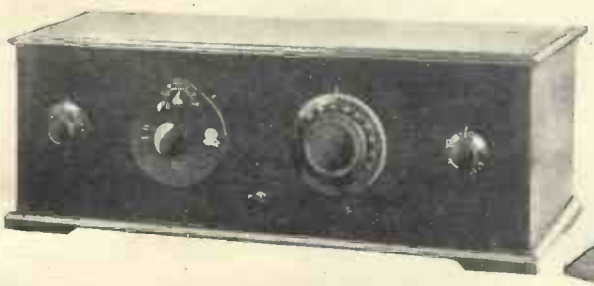
N.B.—Should the matter of this or of any subsequent article be unclear to any reader, I shall be pleased to reply personally to any inquiries addressed to me at the offices of the WIRELESS MAGAZINE, if complying with the rules outlined on Page 451.

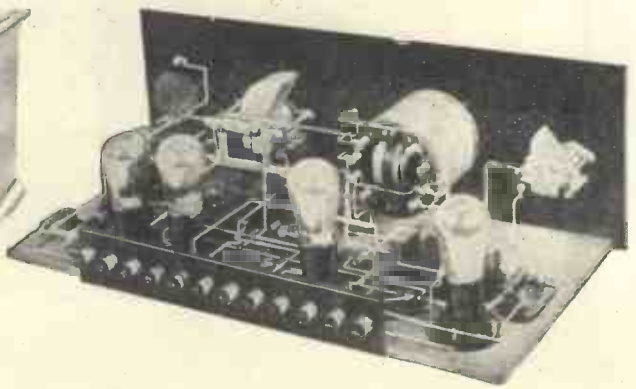


Circuit of the Trapped Three-Four, which incorporates two valves in parallel in the last stage.

Another Fine Set for Gramo-Radio Work!

The Trapped Three-Four, described on page 152 of the March issue of "W.M."





This receiver, which is capable of giving a large distortionless output, can be used for gramophone reproduction by putting a pick-up adaptor in the detector-valve holder. Full-size blueprints (No. W.M. 61) are available for 1/- each, post free.

BROADCAST MUSIC of the MONTH

Reviewed by STUDIUS

Moschetto and his orchestra at the Savoy Hotel

DURING May the programmes seemed to be given to experiments, rather than to a settled scheme of entertainment. We cannot object, however, as it is only by this means that the B.B.C. can find out what its public wants. A new-comer to the Musical Advisory Committee is Dr. Adrian Boult, a distinguished conductor who has already directed several concerts broadcast from Birmingham.

Adelina de Lara, pianist

London Activities

In London he has conducted many orchestral concerts at the Queen's Hall, and was responsible also for a series of concerts held at the People's Palace, Mile End.

What may be termed real musical "features" were the concerts of the first season of the National Orchestra of Wales, the last of which took place on May 17; Eda Bennie, a soprano of the B.N.O.C., Enid Cruickshank, a contralto, and Renee Sweetland, solo pianist, were among those who took part.

Samuel Clifford, of Bournemouth Municipal Orchestra

Interest, too, was attached to the concerts of the Worcestershire Association of Musical Societies, which broadcast from 5GB, three programmes from the Town Hall, Birmingham, on May 17 to 19. Conducted by Joseph Lewis and Dr. Adrian Boult, and Sir Hugh Allen, who conducted Handel's *Messiah*, these concerts were an outstanding event.

Vivienne Chatterton, vocalist

Amongst other really musical events the programme on May 20 devoted entirely to the works of Dame Ethel Smythe, to celebrate her 70th birthday, must be mentioned.

A First Performance

Included in the programme was the overture to *The Wreckers*, the first opera written by this composer. It would have been better if the entire opera had been broadcast, for it is finer than the other two chosen works, *March of the Women*, and *Mass in D*. The artistes chosen included not only fine singers, but famous broadcasters, namely Elsie Suddaby, Margaret Balfour, Parry Jones, and Herbert Heyner.

Last, though by no means least, may be mentioned the special programme given of the works of Sir Alexander Mackenzie, composer and late principal of the Royal Academy of Music.

Elsie Stell, violinist

Broadcast Music of the Month (Continued)

Left: Basil Maine, who talks on matters musical

Gertrude Lawrence, the well-known actress, contributes an article on page 427.

Below: Alice Vaughan, contralto

Most people will agree that for all practical purposes the performances by the great hotel and restaurant orchestras are the bright, and to many of us, the only bright spots of the week. Foremost among these are the broadcasts from the Savoy Hotel of Signor Moschetto, the famous Italian violinist, and his orchestra. An exquisite singing tone, allied to a technique finished and polished to an astonishing degree, make one keen to hear him in solos and a special recital too. His orchestra, too, is one of evidently picked artistes.

Joseph Slater, flautist

Other Melodious Orchestras

It has been good also to hear the orchestras under Frank Ashworth, now playing at the Hotel Metropole, Albert Sandler at the Park Lane Hotel, and M. Rene Tapponiere at the Carlton. All these, it should be noted, are playing melodious music and not jazz noises.

From the studios also many well-known concerted bodies of artistes have been heard. The Chaplin Trio, composed of the three sisters who played the old-world instruments viola d'amord, viola d'gamba, and the harpsichord, throughout the long run of *The Beggar's Opera* at the Lyric Theatre some three years ago, will be remembered also as very early broadcasters.

Gladys Noon, violinist

The Casano Octet, Victor Olof Sextet, Gladys Noon, with her own excellent string quartet, and Margaret Holloway, who first made the orchestras at Lyons Restaurant an outstanding feature, have all given pleasure during the month.

Operatic Performances

Listeners have had a wide range of operatic excerpts relayed to them from Covent Garden during this season, and in addition to those already given, the June transmissions include excerpts of *Samson and Delilah*, *La Boheme*, *Pagliacci*, *Cavalleria Rusticana*, *Manon Lescaut*. All these will be heard from 2LO, while 5GB will give us *Turandot*, *Otello*, *Madame Butterfly*, and *Don Giovanni* (Act II). *Manon Lescaut* and the Mozart opera *Cosi fan Tutte* in which Vivienne Chatterton and Lilian Stiles Allen, the famous oratorio singers, were heard, were produced in the studio.

Lilian Harrison, actress and singer

Too Many Foreign Languages

The vocal art has been well represented, but too many singers are still using foreign languages. Amongst the singers announced on Empire Day was Dame Clara Butt, from the Hyde Park Celebrations.

Dora Labbette, another well-known broadcaster, paid her first visit to the Newcastle studio this month, on the same occasion as the Nellie Chaplin Trio. Excellent singing has also been heard from Vivien Lambelet, Alice Vaughan, a fine contralto, Rispah Goodacre and Lillian Harrison, a young actress and singer who has made good in several theatrical successes.

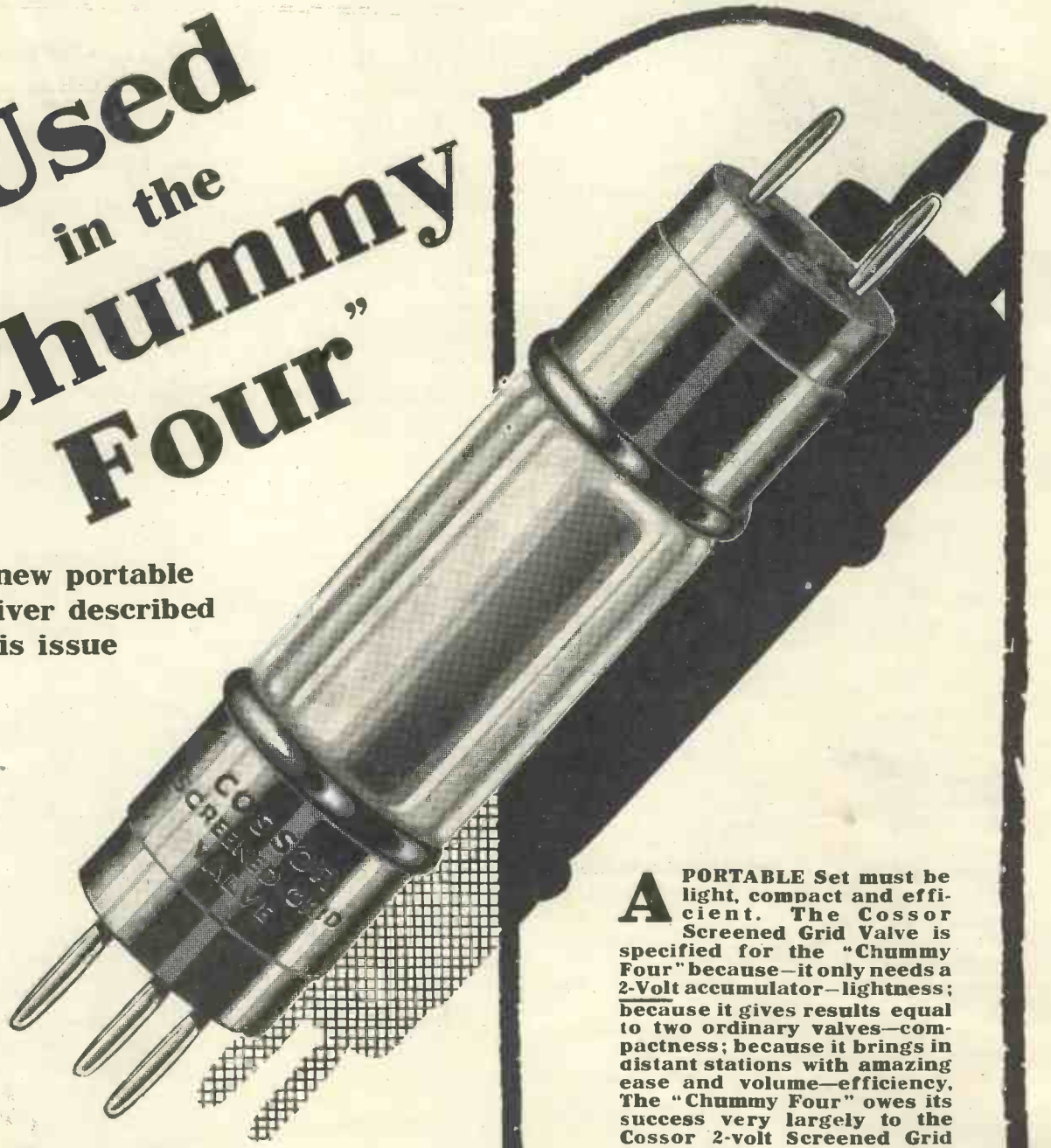
Yvette, entertainer

Rispah Goodacre, vocalist

(Continued on page 466.)

Used in the "Chummy Four"

The new portable Receiver described in this issue



A PORTABLE Set must be light, compact and efficient. The Cossor Screened Grid Valve is specified for the "Chummy Four" because—it only needs a 2-Volt accumulator—lightness; because it gives results equal to two ordinary valves—compactness; because it brings in distant stations with amazing ease and volume—efficiency. The "Chummy Four" owes its success very largely to the Cossor 2-volt Screened Grid Valve. Cossor Valves brought success to the "Melody Maker. Cossor Valves make any Set successful.

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Broadcast Music of the Month (Continued)

Margaret Holloway, violinist

A recent broadcaster is Kathleen Mitchell, who early specialised in the singing of Russian songs and German "lieder."

Though strictly speaking an operatic feature, the performance of the opera-oratorio *Oedipus Rex*, which was announced from 5GB on May 12, was made a vocal event by the inclusion of the famous artistes, Walter Widdop, of the B.N.O.C., as Oedipus, Astra Desmond (Jocasta), Roy Henderson and Hardy Williamson. The performance was conducted by Igor Stravinsky, the famous Russian composer, and the composer of the music, and was produced by the B.B.C.'s Dramatic Producer, R. E. Jeffrey.

Other vocalists of the month include Arthur Fear, an operatic singer, Leonard Gowings and Edith James.

Variety

Here we have had indeed many contrasts. The chief events were the re-appearance of an old favourite, Norman Long, and also of our friend Tommy Handley, under the "nom de guerre" of "Thos. Handleys," in a special programme and burlesque entitled *Innanninn*. John Henry and "Stainless Stephen" are always welcome.

The Charlot entertainments are improving in quality, and some pleasant interludes have been afforded by Yvette (one of the best of feminine entertainers), by Arthur Prince, the ventriloquist, and by a well-known pair of entertainers, Ernest Hastings and Nelson Jackson.

There is still room for improvement on the variety side; the predominance of negroid artistes, so-called, and the makers of jazz noises make many alleged variety programmes rather a feat of endurance than amusement.

Arthur Fear, vocalist

Famous Soloists

Many famous soloists have been heard, including Solomon, on whose pianoforte recitals no comment is necessary. The violinists include William Primrose, Daisy Kennedy, and one of the finest of our younger violinists, David Wise.

The pianists include Mrs. Norman O'Neill, whose special métier is Scarlattis and the old-world Italian masters, Miss Cecil Dixon of the B.B.C. staff, and Adelina de Lara. The last, a pupil of Clara Schumann, has appeared at most great European recitals and Courts, and has known many of the world-famous composers, including Brahms, Dvorak and Grieg. As a pianist Mdme de Lara ranks with the great artists of the world, and she has played with Joachin, Hausmann, Popper, and Lady Halle. She will doubtless broadcast again on future occasions.

A Flute, A Guitar, and Some Talks

Amongst other instruments heard during the month mention might be made of the flute in the hands of Joseph Slater, one of the earliest staff musicians of the B.B.C., and Emilio Pujol, said to be the best-known guitarist.

The talkers have, on the whole been interesting, especially Basil Maine on matters musical, George Grossmith on affairs theatrical, and Marjorie Simmonds, who gave a pleasant little talk from Bournemouth on the little-known history of the town.

STUDIUS.

THE CHAPLIN TRIO

Kate Chaplin *Nellie Chaplin* *Mabel Chaplin*

A Summer Reminder

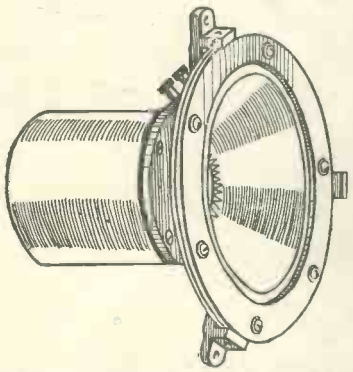
IN sultry summer weather any good aerial is likely to collect static charges of electricity that may spark to earth. To prevent any possibility of damage being done in this way, it is advisable to fit a small spark gap across the aerial and earth terminals of the receiver.

The use of a small gap (which can be obtained for a small sum from almost any radio dealer) will ensure that should a discharge take place from the aerial the current will not go through the receiving set and perhaps burn out the tuning coil—a thing which does otherwise happen on rare occasions.

D. S. R.

Kathleen Mitchell, singer

Further Points About the Moving-coil Loud-speaker



Magnet pot and cone of the moving-coil loud-speaker made by Vaughton's, of 88 Vyse Street, Birmingham. The frame incorporates a neat handle by which the instrument can be easily transported.

IN earlier pages of this issue detailed instructions have been given for building two moving-coil loud-speakers ("Making a 'Junior' Moving-coil Loud-speaker," on page 412, and "A Coil-drive Loud-speaker with Permanent Magnets," on page 432).

Similar Methods of Assembly

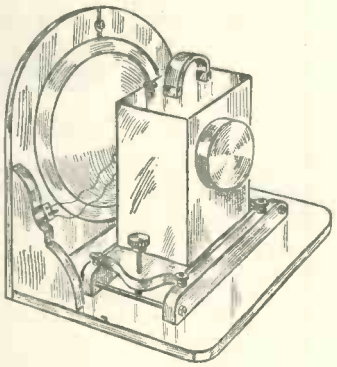
As a matter of fact, the details regarding the construction and mounting of the cones and the moving-coils apply to almost any type of loud-speaker. In these pages are illustrated a number of different sets of parts available for the home-constructor, and these can easily be assembled as indicated in the two articles previously referred to, provided that due allowance is made for differences in the sizes of the cones and of the moving coils.

Most manufacturers supply two models of their instruments, one operated from a 6-volt accumulator and the other operated from 200 to 240 volt direct-current mains. (It is not possible to run a loud-speaker from A.C. mains.) Most of the 6-volt magnet pots consume round about .75 ampere, and therefore a reasonably large accumulator is necessary for use in conjunction with them.

Small Current from the Mains

The amount of current taken from the mains by the 200-volt models is quite small, in most cases being less than .25 ampere. It will thus be apparent that it is no more expensive to run a moving-coil loud-speaker than it is to light an ordinary lamp.

This is the famous British Thomson-Houston R.K. model, marketed by the British Thomson-Houston Co., Ltd., of Crown House, Aldwych, W.C.2. The instrument normally incorporates a special power amplifier, but the moving-coil loud-speaker itself is now available as a separate unit for the amateur.



One of the models made by C. Andrews, of Hunton House, Hunton Hill, Erdington, Birmingham. The screw on the left gives very fine adjustment, while the two-pin plug is for the input connection.

Lower Field Currents

Recently developments have been made in the direction of smaller pots containing a field coil that requires only about .5 ampere, or a little less, at six volts. At least two firms supply pots of this type. The only difference between these small pots and the larger models is that the sound output from the former is not so great, but they are quite large enough for use in an ordinary house. The normal size of a moving-coil instrument actually gives far greater volume than is usually required.

The WIRELESS MAGAZINE has consistently recommended that a final output stage consisting of two valves

(*Continued on page 470*)

Further Points About Moving-coil Loud-speakers

(Continued from page 468)

Although it is claimed to be cheaper than any other model on the market, the pot of the Epoch loud-speaker contains 7 lb. of No. 20-gauge enamelled wire and consumes .7 ampere at 6 volts. The makers are the Epoch Electrical Society, Ltd., of 53 Gracechurch Street, E.C.3

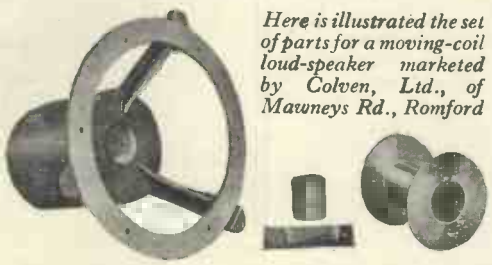
arranged on the push-pull system or in parallel should be used for operating moving-coil loud-speakers, and some readers may wonder how this statement can be reconciled with the opening paragraphs of Capt. Round's special article on page 394, in which he says that in his experience a moving-coil loud-speaker is quite as sensitive as any other cone he has handled and that it does not require a special receiver for its operation.

A Different Proposition

Quite frankly, a three-valve set in Capt. Round's hands is quite a different proposition from a three-valve set operated by the ordinary amateur, and the essential condition is that reproduction must be distortionless. The reason for the WIRELESS MAGAZINE'S recommendation for a special output stage is to ensure absolutely distortionless reproduction, which cannot be obtained from the ordinary three-valve set unless very special precautions are taken in adjusting it.

With the Music Charmer

Quite good results have been obtained when operating a moving-coil loud-speaker from the Music Charmer when care was taken to get the bias on the valves right and the correct valves were used. But distortionless results are much more easily obtained by using a larger output stage such as can be obtained by push-pulling or paralleling two super-power valves, as shown in the Cataract Five described on page 389 and in the Gramo-Radio Amplifier on page 458.



Here is illustrated the set of parts for a moving-coil loud-speaker marketed by Colven, Ltd., of Mawneys Rd., Romford

Completely Assembled Units

At present only three firms market completely assembled moving-coil loud-speakers and two of these are illustrated in these pages. There are more than twenty firms, however, which supply all the necessary parts which can be assembled by the amateur without difficulty.

When choosing a set of parts for a moving-coil loud-speaker the reader should watch for the following points:

1. That the framework of the loud-speaker is rigid so that the magnet pot can be clamped very firmly in position.
2. That the clamp for the cone support (which may be of leather, oiled silk, rubber, or some other similar material) is provided with sufficient bolts or clamps to hold the support tightly all round its periphery.
3. That the air gap in the magnet pot is as small as possible in relation to the size of the moving coil. And,
4. That adequate movement of the magnet pot is possible in all directions so that the moving coil can be accurately centered in the air gap without difficulty.

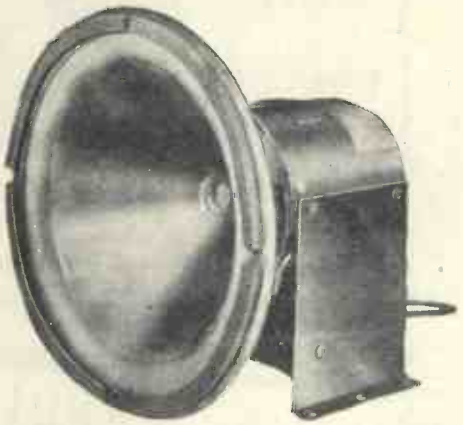
The most difficult part about assembling a moving-coil loud-

(Continued on page 472)

A different permanent-magnet type of loud-speaker from that described in detail on page 432. Both models are made by Baker's, of 42 Cherry Orchard Road, East Croydon, and both give excellent reproduction

Further Points About Moving-coil Loud-speakers
(Continued)

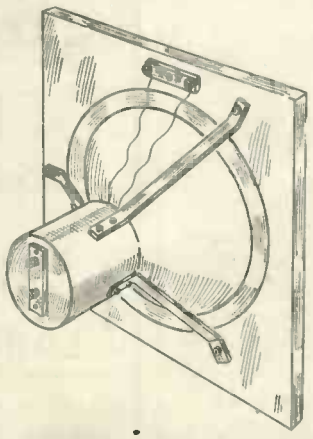
speaker is to centre the moving-coil accurately. It is absolutely essential that the vertical face of the moving-coil should be at right angles to the axis of the centre pole-piece in the magnet pot. For this reason the supporting material should be drawn tightly all round its periphery and firmly clamped in the frame. In this respect five minutes of practical work is better than any amount of explanation that can be given on paper.



Above is shown one of the completely assembled Magnovox moving-coil loud-speakers as supplied to the public. Several models are made and details are available from the Rothermel Radio Corporation, Ltd., of 24–26 Maddox Street, W.1

Easiest with Oiled Silk

Although rubber, oiled silk, and leather can be used for supporting the cone, the WIRELESS MAGAZINE Technical Staff has found oiled silk the easiest material with which to work.



One of the simplest kits of parts for a moving-coil is the Peerless, which makes use of a steel and not a cast-iron pot. The makers are the Bedford Electrical Radio Co., Ltd., of 22 Campbell Road, Bedford

A simple test to find out when the moving coil is exactly centered and the suspension material at the right tautness is to wave a flat piece of card (or even a copy of the WIRELESS MAGAZINE !) in front of the cone diaphragm, so that the face of the card is parallel with that of the frame. A slight movement of the card should cause the diaphragm to move backwards and forwards by quite an appreciable amount.

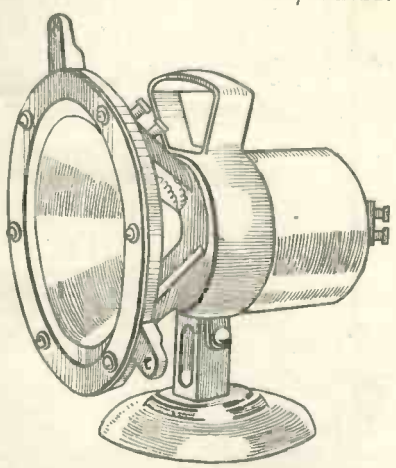
Coil Touching the Pot

If the cone does not move quite freely when this test is made it can be assumed that the moving coil is touching the pot magnet at some point of its travel and until this has been rectified it will be impossible to obtain good results.

Don't Rely on the Eye Alone

It should be pointed out that the moving coil in most cases cannot be centered by eye alone, and the simple test outlined above should always be made before connecting up the loud-speaker to the receiver. If the moving coil does touch the pot magnet the reproduction will be marred by a chattering noise at some points of the frequency scale—a state of affairs that the operator will soon desire to put right!

BM/PRESS.



An interesting feature of this Siren loud-speaker is the carrying handle incorporated in the framework; it should prove a very great convenience. Siren loud-speakers are marketed by H. C. Tofield & Co., of 99 Trafalgar Road, Moseley, Birmingham

The Chummy Four (*Continued from page 406*)

running is possible. Alternatively one battery can be used at a time and the other kept as a stand-by.

Connecting Up the Frame

Before a test can be carried out the frame aerial must be connected to the three flexible leads coming through the front panel. As long as the centre leads from the frame and set are connected together it does not matter which way round the outer leads are connected.

Place the valves in position and apply the recommended voltages. It is easiest to test the set for range if it is placed right at the left-hand edge of a table so that when the lid is open it swings freely, overhanging the floor.

Pull out the knob of the on-off switch and turn the rheostat on the left of the panel full on. See that the centre mark on each vernier dial is opposite the indicating mark on the main dial and rotate the dials by the outside knurled edge.

Tuning In Signals

First place the frame aerial so that the top edge of the lid is in line with the nearest broadcasting station (as long as it is on the lower broadcasting waveband) and turn both frame-tuning and anode-tuning condensers simultaneously in the same sense until the transmission is picked up. Normally it will not be necessary to use any reaction for the local station.

It will be found that tuning is very critical and at first many stations will be missed. Careful use of the vernier part of the dials and of the reaction condenser will soon enable the operator to receive a number of foreign stations, however.

Noting the Dial Settings

As soon as a station is picked up a note of the dial settings should be made on the card on the front of the panel so that it can be picked up again whenever desired.

There are three golden rules in searching for distant stations and *getting them* : Point the lid approximately in the direction of the station it is desired to pick up; keep the receiver just on the verge of oscillation as far as possible; and turn the tuning knobs slowly.

The direction of the required station can easily be found by reading the small compass which is placed at the top of the cabinet, immediately below the carrying handle. This compass is included with the cabinet supplied by the Ready Radio people, and will prove a great convenience in strange country where the north point may not otherwise be easy to locate.

Some Practical Hints

Further points to note are that results are much better when the set is used as far from the ground as possible. That is, results are usually better at the top of a house than on the lower floors, and better when the set is on a table than on the floor. Out of doors the best results will be obtained on high ground. Even taking the set to the top of a small mound will make quite a difference in the case of really distant stations.

Any reader of the WIRELESS MAGAZINE who has any kind of difficulty whatever with the Chummy Four—we do not expect that anybody will, as a matter of fact—is invited to communicate with the Technical Staff.

We are proud of the Chummy Four and want every reader who builds it to be equally proud. Once again look at that test report on page 402, and let us know if you can beat it !

A Further Test Report

[Since the above article was written, and just as we close for press, the results of an independent test have come to hand. Mr. J. Godchaux Abrahams logged twenty-three stations, but another operator, on the evening of May 5-6, logged thirty-one stations with the Chummy Four !

Unfortunately, he was unable to identify many of the transmissions, so at the moment we are unable to indicate what the extra stations were. This test was carried out at a point six miles south of 2LO.

These results should convince even the most sceptical of the remarkable efficiency of the Chummy Four—it is a really good set. But constructors should take good care to follow the original specification and layout when building it up.—EDITOR.]

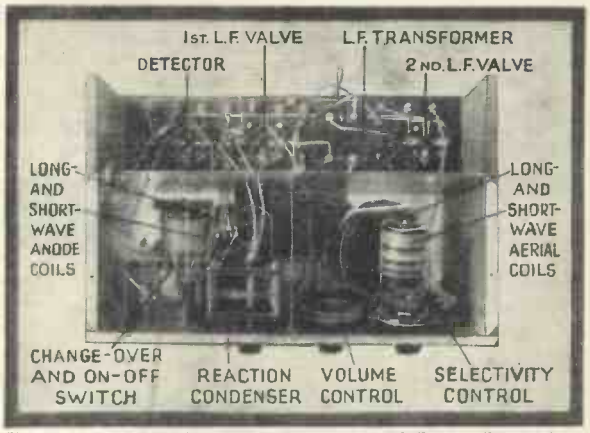
By J. H. Reyner, B.Sc., A.M.I.E.E.

A New Set Tested

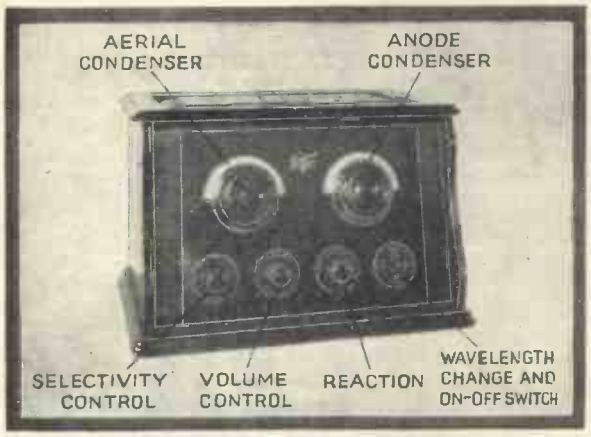
The Burndept Screened Four

SENSITIVITY, selectivity, range, and good quality of reproduction are a few of the outstanding merits of the Burndept Screened Four receiver, which we had the opportunity of testing in our laboratories.

To some people the screened-grid valve is symbolical of complexity, and in consequence they hesitate before obtaining a receiver incorporating one of these valves. Should they operate one of these Screened Four receivers, however, we feel confident that they will change their views.



Underneath view of the Durndept Screened Four. The high-frequency valve is inserted from the top of the cabinet



Front view of the Burndept Screened Four, showing arrangement of controls

In spite of the good selectivity obtainable, we found that the process of tuning in a distant station required little skill, owing to the stability of the receiver and the smoothness of the slow-motion dials, whilst owing to the provision of a calibrated chart on the high-frequency tuning condenser, it was merely necessary to set this to the required wavelength and adjust the aerial-tuning condenser until maximum strength was obtained.

The reaction control was perfectly smooth throughout the entire range of wavelengths covered, whilst an effective volume control is also incorporated, this being a rheostat in the circuit of the H.F. valve filament.

Two Tuning Ranges

There are actually two tuning ranges, from 220 to 560 metres and from 750 to 2,000 metres. A change over from one wavelength to another is accomplished by operating two switches. The first is of the lever pattern, and also serves to switch the set on or off. The second is a selector switch, which gives three degrees of selectivity on each range.

The Burndept Screened Four gave excellent quality, provided that the maker's instructions with regard to valves and battery potentials were followed.

(Owing to pressure on our space, we are obliged to hold over other test reports until next month).

Catalogues and Pamphlets

Readers who desire to obtain copies of the publications referred to below can do so free of charge by mentioning the "Wireless Magazine."

WE have received from R.I. and Varley, Ltd., of Kingsway House, 103 Kingsway, W.C.2, a very interesting folder which deals with all the components manufactured by the firm, and also gives circuits in which they can be used.

The Celestion Radio Co., is issuing, for the use of traders, a well-printed folder dealing with their loud-speakers.

Leaflet No. 83 issued by Philips Lamps, Ltd., of Philips House, 145 Charing Cross Road, W.C.2, describes the range of battery chargers and eliminators made by the firm.

A selection of leaflets from the Fuller Accumulator Co. (1926) Ltd., of Woodlands Works, Chadwell Heath, Essex, deals with the various types of accumulators produced by the firm. Details of accumulators for house, train and automobile light and for wireless receivers are given.

A catalogue of which every radio "fan" should possess a copy is that issued by the Grafton Electric Co., of 54 Grafton Street, Tottenham Court Road, W.1.

Orphean loud-speakers are described in a folder from the London Radio Manufacturing Co. Ltd., of Station Road, Merton Abbey, S.W.19.

A. W. Griffin and Co., of Redditch, have sent us a number of leaflets describing their rheostats, switches, coil-formers, transformers and permanent crystals.

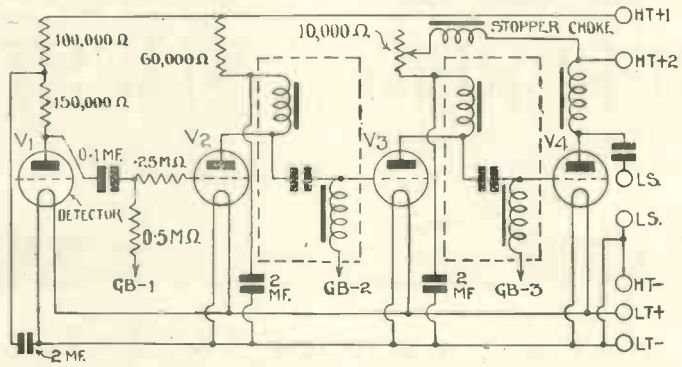
"How to build your own high-tension eliminator for A.C. or D.C." is the title of an interesting little booklet which the Telegraph Condenser Co., Ltd., of Wales Farm Road, North Acton, W.3, are issuing at 3d. a copy.

The City and General Radio Co. have recently taken new and enlarged premises at 46 Watling Street, E.C.

We are asked by the London Electric Wire Co. and Smiths, Ltd., to draw attention to an error that occurred in their advertisement on page 371 of the previous issue of WIRELESS MAGAZINE. Q aerial coils and high-frequency transformers were priced at 15s. each. Actually the price of the Q high-frequency transformer is 21s., although the Q aerial coil is only 15s. The firm wish to apologise for any inconvenience that may thus have been caused to readers.

WIRELESS MAGAZINE Reference Sheet — *No. 62*

Three-stage Power Amplifier (*Continued*)



The design of this amplifier has been discussed on Sheet No. 61. The following Cossor and Marconi valves are suitable:—V1, 610 H.F; V2, 610 L.F.; V3, 610 P; V4, L.S. 5A. Valves of other makes having similar characteristics may, of course, be substituted

This sheet was first published last month, but owing to an error that then occurred in the circuit, the diagram is now reprinted in its correct form

Choosing the Right Accumulator for the Job

IN the old days of heavy-consumption bright-emitters a deal more thought was given to choosing "the right battery for the job" than is now usual.

"Safe" Discharge Rate

The fact that the "point-ones," and valves with even greater filament current economy, are in general use may account for this. But it is still rather important to know just what is the maximum *safe* discharge rate of a given battery.

No formula or rule can be quite accurate, for although most modern batteries are lead-plate type, their construction and plate composition differ widely.

A safe rule-of-thumb, however, is that *a battery should not be discharged at a rate which, if continued, would exhaust it (after being fully charged) in less than ten hours.* For example, a 60 *actual* a.h. battery should not be discharged at a rate exceeding 6 amperes.

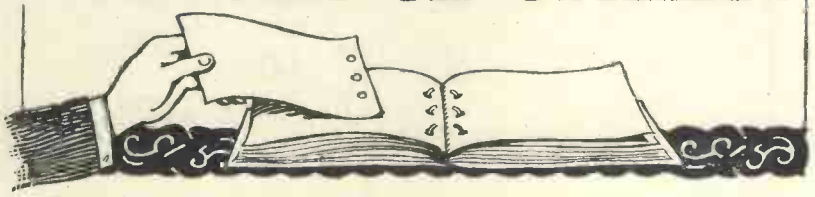
There is nothing to be gained by taking too heavy a current from an accumulator, because, in the example quoted, a discharge of 8 amps. could probably only be maintained for about 6½ hours, although in theory the time limit should be 7½ hours.

Full Capacity Not Obtained

If a battery is subject to a heavy discharge rate, its theoretical capacity is not realised. A small discharge current may, in effect, give a "capacity" even greater than the rated maximum.

JUICE-BOX.

"Wireless Magazine" REFERENCE SHEETS



Compiled by J. H. REYNER, B.Sc., A.M.I.E.E.

Month by month these sheets can be cut out and filed—either in a loose-leaf folder or on cards—for reference. The sequence of filing is a matter for personal choice. In a short time the amateur will be able to compile for himself a valuable reference book

WIRELESS MAGAZINE Reference Sheet *No. 66*

Loud-speaker Efficiency

THE efficiency of any piece of apparatus is the energy output expressed as a percentage of the energy input. If the instrument was perfectly efficient the efficiency figure would be 100 per cent. Electrical apparatus generally varies in efficiency from 50 per cent. to 90 per cent., and in many cases a greater efficiency than this is obtained, as, for example, in the case of a large power transformer, where an efficiency of 99 per cent. is practicable.

Much of the apparatus used in wireless practice, however, is not by any means as efficient as this. The loud-speaker has an efficiency in the neighbourhood of 1 per cent. only for a horn type of loud-speaker, while for a hornless type, the efficiency is even below this. This means that the actual energy output in the form of sound is less than one-hundredth of the electrical energy originally supplied to the loud-speaker.

Modern design tends in some instances to increase the efficiency. For example, the use of very long horns of exponential type results in a more effective radiation of sound and the efficiency may rise slightly. On the other hand, the use of the cone type of loud-speaker, particularly of the free-edged coil-drive type now so popular, tends to a much reduced efficiency, the overall sensitivity of the instrument being sacrificed in order to obtain a greater uniformity of response.

As an instance of the general order of efficiencies some figures given by Balbi may be quoted. The losses divide themselves into acoustic loss in the base and the horn, mechanical loss in the diaphragm and resistance, hysteresis and eddy currents losses in the electrical portion of the mechanism.

The following table gives the approximate values of these losses as a percentage determined on a representative type of horn loud-speaker:—

	Per cent.
Electrical Losses	
Resistance	36
Hysteresis	20
Eddy Current	8
Mechanical Losses	12
Acoustic Losses	
In base	14
In horn	9
Total loss	99
Useful work	1
	100

WIRELESS MAGAZINE Reference Sheet *No. 67*

Loud-speakers, Diaphragm (Displacement of)

SOUND is reproduced in a loud-speaker by causing a diaphragm to vibrate backwards and forwards. This causes compression and expansion of the air in the vicinity, in consequence of which sound waves are set up. These are radiated outwards to space in a more or less efficient manner, depending upon the actual form of radiator adopted.

In order to obtain uniform sound radiation at all frequencies it is necessary for the diaphragm to move an increasing distance as the frequency is reduced. In order to produce equal intensity of sound it is necessary to do the same amount of work.

This may be achieved by moving the diaphragm a short distance rapidly or by moving it a much greater distance more slowly. Hence, at the very low frequencies, where the diaphragm is moving very slowly indeed relative to the vibration rate at the upper end of the audible scale, it is necessary for the diaphragm to move through an appreciably greater distance.

The relative motion at low and high frequencies depends upon the type of diaphragm. With a plane diaphragm which is large in comparison with the longest wavelength radiated the displacement of the diaphragm is inversely proportional to the frequency. Thus if the frequency is reduced ten times the diaphragm must move ten times as much.

This is not a practical case, however, for the wavelength of a sound vibration at a frequency of 100 cycles per second is 11 feet, and the diaphragms normally in use are much smaller than this.

A practical form of loud-speaker therefore approximates to a point source. The ideal point source is one in which the diameter of the diaphragm is small in comparison with the shortest wavelength radiated. This is not quite true with the average loud-speaker on the upper frequencies, but in the middle and low registers it is.

The law here is that the amplitude of the diaphragm must vary inversely as the square of the frequency. Thus if the frequency is reduced ten times the diaphragm must move through a distance 100 times as great.

The ordinary diaphragm of a loud-speaker unit as applied to horn and cone loud-speakers is physically incapable of vibrating to the required extent, and consequently, the free-edged coil-drive cone is adopted in order to reproduce the low-frequencies satisfactorily.

A partial remedy is the use of a large diameter cone for a diaphragm.

WIRELESS MAGAZINE Reference Sheet — *No. 68*

Loud-speakers (Effect of Baffle)

ONE of the fundamental factors in the satisfactory construction of a moving-coil type of loud-speaker is the inclusion of a baffle. It is commonly thought that such a baffle is peculiar to this form of speaker, but actually it applies to any form of hornless loud-speaker. The action of the horn type of instrument is quite different and does not enter into the present consideration.

The vibrating diaphragm causes air vibrations on both sides of the diaphragm. Before any sound energy can be produced, however, the air must be definitely compressed and expanded a certain number of times per second, the actual number of compressions determining the pitch or note of the sound.

If the diaphragm is left free without any baffle or boxing, the air vibrations on the front and the back of the diaphragm tend to interfere with each other, and the diaphragm is thus short-circuited. A compression on the front of the diaphragm is accompanied by an expansion of the air at the back, and if there is a short-circuit path round the edge of the diaphragm it is clear that the air can simply flow from front to back of the diaphragm without doing any appreciable work.

In order to overcome this effect, it is necessary to surround the diaphragm with a large board or baffle, so that this short-circuit path is obviated as illustrated in the diagram. The sound waves must then be radiated from the front and back of the diaphragm independently.

The ratio of the sound radiated with and without a baffle of this nature is inversely proportional to the square of the frequency. Thus, if the frequency is reduced by ten, the relative sound radiated with and without the baffle is increased a hundredfold. Hence, the effect of the baffle becomes increasingly evident towards the low frequencies, and it is for this reason that the baffle is used to bring out the low tones.

If instead of placing a large board round the diaphragm, we inclose the whole loud-speaker in a box, this serves the same effect, provided adequate precautions are taken to avoid resonance of the air inside the box. This may be done by leaving the back of the box open, or by padding the box with cotton-wool or other sound-proof mediums or by both.

Diagram showing effect of baffle

This enables the complete instrument to be reduced to a reasonable size.

WIRELESS MAGAZINE Reference Sheet — *No. 69*

Frame-aerial Efficiency

THE voltage induced in a frame aerial is considerably below that obtained even with quite a small indoor aerial. The action of a frame aerial was explained in Sheet No. 5, the voltage in the frame being the difference between the voltages set up in the two vertical sides.

Clearly, therefore, a single-turn loop is only equivalent to a few feet of vertical aerial; thus it is customary to use a number of turns on the frame so that the equivalent vertical aerial is in the neighbourhood of 3 feet or 4 feet.

As a matter of interest, tests were carried out at the WIRELESS MAGAZINE Laboratories to determine the relative efficiency of a frame aerial and a vertical wire. Two frame aerials were first tested, one having a 2 ft. side with a total area of 4 square feet, and having eleven turns. This gave a rectified current on 2LO of 0.4 microamperes. A second frame consisted of fourteen turns on a framework 2 ft. long and 1 ft. high, this having an area of one-half that of the previous frame. This gave a rectified current of 0.1 microamperes. The second frame is a more general size, the first frame being rather larger than is practicable for the majority of cases.

A comparison was then made with a simple vertical aerial with a small tuning coil in position, and it was found that a current of 0.1 microamperes was obtained with 6 ft. of vertical wire, the bottom end being connected to a coil of wire lying on the floor, this forming a rather inefficient capacity earth. A length of 12 ft. of wire flung across the room, at an average height of 4 ft. 6 in. only, gave 0.3 microamperes, while if the average height at which the wire was slung was increased, the rectified current increased rapidly.

The results show, therefore, that a 6-ft. vertical aerial is equivalent to the average frame as used in a portable receiver, but that if a large frame can be used, then the results become equivalent to a good indoor aerial.

The advantage of the frame lies in the fact that the high-frequency resistance is considerably less than that of the ordinary tuning coil. If it were not for this fact, the discrepancy between the frame and aerial systems would be very much more marked. The theoretical figures for the equivalent vertical aerial are exceedingly small if one assumes equal high-frequency resistances, and it is only the fact that a frame is a much more efficient tuning system than an ordinary tuning coil that renders it at all a practicable proposition.

It should be remembered that these results apply to broadcast wavelengths.

WIRELESS MAGAZINE Reference Sheet — *No. 70*

Short Waves (Range of)

SHORT waves are transmitted mainly by reflection from the electrified upper atmosphere. There is a ground wave, but this is rapidly damped out, after which there is a blank area in which no reception is obtained. This continues until the first reflection is obtained, the intervening space being known as a "skip distance." Good reception then continues until the reflections become tangential to the earth, when a further blank area commences.

The process then begins again, there being successive reflections and blank areas. The table herewith gives approximate theoretical distances from the transmitter at which short-wave signals may be expected, taken from an article in "QST," July, 1927.

There are certain discrepancies between the values given and actual observed facts.

Wavelength (metres)	Maximum range of ground wave (miles)	Range of good daytime reception (miles)	Range of good night-time reception (miles)	
			Summer	Winter
100	110	up to 300	up to 3,000	up to 10,000
50	90	up to 4,000	up to 7,500	1,000–12,000
30	70	400–5,000	2,000–7,500	3,500–12,000
20	55	1,000–4,000	4,000–6,000	None

Music Charmer

THIS cheap three-valver—it can be built for £3 10s. 0d.—made an immediate appeal to hundreds of listeners (WIRELESS MAGAZINE, *March*, 1928). *The following enthusiastic letter from a Liverpool reader is typical of many that have come to hand.*

Congratulations ! Heaps of them, on the Music Charmer. I feel I must write to you regarding this set.

I have been an amateur for the past ten years, so I think I know a little of construction of sets. This set, I may say, I have built for my brother-in-law, and I might say that I don't feel like parting with it.

While writing this I am listening to the Kettner Five and my wife has just remarked: "You had better build one like that for ourselves."

For simplicity, quality, and reception, it has, in my opinion, no equal. One item I may tell you it is that I have used all Lissen parts, with the exception of the variable condensers, one of which is Ormond and Peto-Scott reaction.

I may say that using a No. 60 coil the reception that I get on the lead from my earthing switch, which is 20 feet long, is simply wonderful: Liverpool (local), Manchester at full volume and 5GB on half volume.

I wish again to tend you my heartiest congratulations and success to the WIRELESS MAGAZINE.

Index to Advertisers

Mullard

THE · MASTER · VALVE

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