HOW TO USE THE SCREENED-GRID VALVE

Wireless Magazine

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

1/-

VOL 8. No 46. NOV — 1928

The "Touchstone"

A ONE-KNOB FOUR

BY

W. JAMES

OUR RESEARCH CONSULTANT

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Editor:
BERNARD E. JONES

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J. H. REYNER, B.Sc. (Hons.), A.M.I.E.E.

Wireless Magazine

The Best Shillingsworth in Radio

Vol. VIII :: NOVEMBER, 1928 :: No. 46

Research Consultant:
W. JAMES

Assistant Editor:
D. SISSON RELPH

A CRITERION

ON our cover this month is a picture of the Touchstone, a set specially designed for us by Mr. W. James. Old-time craftsmen used the touchstone as a means of determining the purity of precious metals. They took a light rubbing of the gold on a piece of jasper—the "touchstone"—and alongside it made marks from "touch-pencils," each of these being a pencil of a gold of different but known alloy.

Then they streaked aqua fortis *across the lines on the touchstone and, by comparing the change in colour of the test marking with that of the known qualities alongside, determined the "carat" of the specimen.*

In due course, "touchstone" passed into familiar language as meaning a criterion, and in that sense we have given it as the title to the first set designed for us by Mr. William James. His set is a criterion of value—a criterion of quality; designed with the utmost care and thought, it is offered as being the very best of its kind. It does, indeed, give remarkable results.

W. JAMES JOINS US

Mr. James, you will note, is the latest addition to our staff. He has joined us in the capacity of Research Consultant and, in conjunction with our Technical Editor, Mr. J. H. Reyner, will largely determine our constructional policy. We are delighted to welcome him and are sure that readers will congratulate us on this latest addition to our strength.

Since last I had a word to say to the reader I have had an opportunity of seeing Baird's television as transmitted by wire and also by broadcast. In a special article in this present issue the staff does its best to present as honestly as possible its impressions of what it was able to see in a number of special demonstrations. The article, which I hope no reader will miss, will serve its purpose if it leaves the impression that Mr. Baird has done a great deal, a very great deal—more than we thought he had done, but that he has yet to do more.

"STILL" PICTURE BROADCASTS

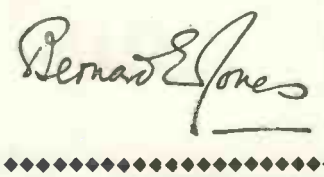
There is the related subject of "still" picture transmission, which has come very largely into the public view during the last few months. An official of the B.B.C. has something to say with regard to the Corporation's policy in this matter.

We have had special facilities for inquiring into the system and apparatus that will be employed, and in due course readers will have the advantage of our information in these respects.

There is no room, I fear, in which to refer to the many features of this issue. Sets there are in variety, apart from the Touchstone already mentioned—a big set by J. H. Reyner (his Eagle Six) and the Key-to-the-ether Two, for example.

I have taken care this month to include an article on each of the most talked about types of valves at the moment, Mr. James telling his secrets of success with the screened-grid valve and Captain H. J. Round contributing further notes on the pentode.

Do Not Overlook the Half-price Blueprint Coupon on page iii of the Cover.



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A NEW NAME FOR BETTER GANG CONTROL CONDENSERS

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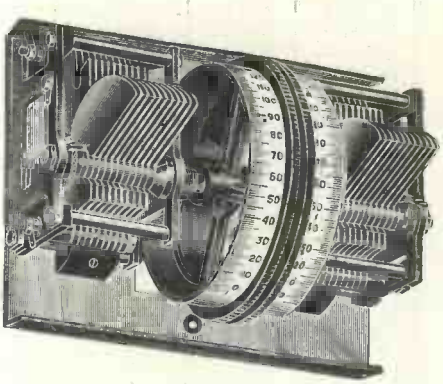

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The "Synchratune" system provides gang control with the added advantage of individual adjustment of the aerial and H.F. stages from the front of the panel. The condensers are mounted on a strong aluminium chassis, which requires two holes only for panel mounting. The bakelite drums protrude through a beautifully finished bakelite escutcheon plate with recessed window, through which is shown scales reading 0 to 180 degrees.

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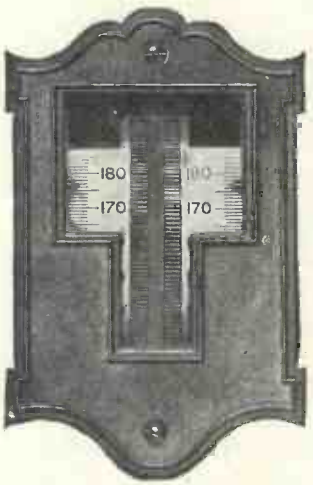
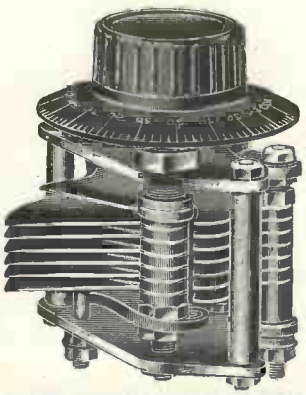
Escutcheon Plate and Drums are of Standard Black Finish, but Walnut, Oak, Mahogany, or Rosewood Finish can be supplied at 5/- extra.



The handsome "Synchratune" Bakelite Escutcheon Plate.



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VALVES TO USE IN THIS MONTH'S SETS

TWO-VOLT VALVES: Three-electrode Types

Make.	Type.	Impedance.	Amp. Factor.	Fil. Volt.	Fil. Cur.
Ediswan	RC2	150,000	30	2	.1
Mazda ...	RC210	86,000	40	2	.1
Mullard...	PM1A	72,000	36	2	.1
Cosmos ...	SP16B	70,000	35	1.8	.09
Six-Sixty	210RC	68,000	35	2	.1
Ediswan	RC210	67,000	40	2	.1
Cossor ...	210RC	60,000	40	2	.1
Marconi...	DEH210	50,000	35	2	.1
Osram ...	DEH210		35	2	.1
Mazda ...	HF210	28,000	20	2	.1
Mullard...	PM1HF		13.5	2	.1
Six-Sixty	210HF	27,000	13	2	.1
Ediswan	HF210	25,000	20	2	.1
Marconi...	HL210	23,000	20	2	.1
Osram ...	HL210		20	2	.1
Cossor ...	210HF	20,000	15	2	.1
Mullard...	PM1LF	18,000	8.9	2	.1
Six-Sixty	210LF		8.5	2	.1
Cosmos ...	SP16G	17,000	16	1.8	.09
Mazda ...	GP210	14,000	13	2	.1
Ediswan	LF210	13,000	13	2	.1
Cossor ...	210LF	12,000	10	2	.1
Marconi...	DEL210		11	2	.1
Osram ...	DEL210		11	2	.1
Mullard...	PM2DX	10,700	13.5	2	.25
Cosmos ..	SP16R	10,000	9	1.8	.09
Six-Sixty	215P	7,300	6.4	2	.15
Mazda ...	LF215	7,000	7	2	.15
Mullard...	PM2		6.2	2	.15
Ediswan	PV215	6,600	8	2	.15
Cossor ...	220P	5,000	5	2	.2
Marconi...	DEP215		7	2	.15
Osram ...	DEP215		7	2	.15
Cosmos ...	SP18RR	4,500	6.5	2	.3
Cossor ...	220P	4,000	8	2	.2
Six-Sixty	230SP		3.9	2	.3
Mullard...	PM252	3,800	3.8	2	.3
Mazda ...	P227	2,900	4	2	.27
Ediswan	PV225	2,700	3	2	.25
Marconi...	DEP240	2,500	4	2	.4
Osram ...	DEP240		4	2	.4
Cossor ...	230XP	2,000	4	2	.3

FOUR-VOLT VALVES: Three-electrode Types

Make.	Type.	Impedance.	Amp. Factor.	Fil. Volt.	Fil. Cur.
Mazda ...	RC407	100,000	40	4	.075
Six-Sixty	4075RC	64,000	34	4	.075
Mullard...	PM3A	63,000	35	4	.075
Ediswan	RC410	61,000	40	4	.1
Cossor ...	410RC	60,000	40	4	.1
Marconi...	DEH410		40	4	.1
Osram ...	DEH410		40	4	.1
Ediswan	HF410	22,000	25	4	.1
Mazda ...	HF407	21,000	18	4	.075
Cossor ...	410HF	20,000	20	4	.1
Six-Sixty	4075HF	16,500	13	4	.075
Mullard...	PM3	16,000	13.5	4	.075
Mazda ...	GP407	14,000	14	4	.075
Ediswan	LF410	10,500	13	4	.1
Mullard...	PM6D	9,000	18	6	.1
Cossor ...	410LF	8,500	15	4	.1
Marconi...	DEL410		15	4	.1
Osram ...	DEL410		15	4	.1
Six-Sixty	410P	8,000	7.3	4	.1

FOUR-VOLT VALVES—*continued*

Make.	Type.	Impedance.	Amp. Factor	Fil. Volt.	Fil. Cur.
Mullard...	PM4DX	7,500	15	4	.1
Mullard...	PM4	7,000	7	4	.1
Mullard...	PM4D	6,000	12.5	4	.1
Mazda ...	LF407	5,700	8	4	.075
Ediswan	PV410	5,500	5.5	4	.1
Marconi...	DEP410	5,000	7.5	4	.1
Osram ...	DEP410		7.5	4	.1
Ediswan	LF410a	4,500	9	4	.1
Cossor ...	410P	4,000	8	4	.1
Six-Sixty	425SP	3,600	3.2	4	.25
Mullard...	PM254	3,500	3.15	4	.25
Mazda ...	P415	2,900	5.5	4	.15
Marconi...	P425	2,250	4.5	4	.25
Osram ...	P425		4.5	4	.25
Cossor ...	415XP	2,000	4	4	1.5
Ediswan	PV425		3	4	.25

SIX-VOLT VALVES: Three-electrode Types

Make.	Type.	Impedance.	Amp. Factor	Fil. Volt.	Fil. Cur.
Mazda ...	RC607	90,000	40	6	.075
Mullard...	PM5B	74,000	37	6	.1
Six-Sixty	6075RC		37	6	.075
Cossor ...	610RC	60,000	50	6	.1
Marconi...	DEH610		40	6	.1
Osram ...	DEH610		40	6	.1
Ediswan	RC610	50,000	40	6	.1
Marconi...	HL610	30,000	30	6	.1
Osram ...	HL610		30	6	.1
Marconi...	LS5B	25,000	20	5.25	.8
Osram ...	LS5B		20	5.25	.8
Ediswan	HF610	21,000	25	6	.1
Mazda ...	HF607	20,000	20	6	.075
Cosmos ...	DE50		9	6	.09
Cossor ...	610HF		20	6	.1
Six-Sixty	6075HF		20	6	.075
Mullard...	PM5X	19,000	17.5	6	.075
Mazda ...	GP607	12,500	14	6	.075
Ediswan	LF610	10,000	15	6	.1
Cossor ...	610LF	7,500	15	6	.1
Marconi...	DEL610		15	6	.1
Osram ...	DEL610		15	6	.1
Marconi...	LS5	6,000	5	5.25	.8
Osram ...	LS5		5	5.25	.8
Six-Sixty	610P		7.2	6	.1
Mullard	PM6	5,700	7.1	6	.1
Mazda ...	LF607	5,300	9	6	.075
Ediswan	PV610	4,200	5	6	.1
Six-Sixty	625SP	3,600	3.2	6	.25
Cossor ...	610P	3,500	8	6	.1
Marconi...	DEP610		8	6	.1
Mullard...	PM256		3.15	6	.25
Osram ...	DEP610		8	6	.1
Ediswan	PV625	3,000	3	6	.25
Marconi...	LS5A	2,750	2.5	5.25	.8
Osram ...	LS5A		2.5	5.25	.8
Mazda ...	P615	2,600	6	6	.15
Marconi...	P625	2,400	6	6	.25
Osram ...	P625		6	6	.25
Cossor ...	610XP	2,000	5	6	.1
Mullard...	DFA9		5	6	.6
Mazda ...	PX650	1,750	3.5	6	.5
Ediswan	PV625A	1,600	4	6	.25
Marconi...	P625A	1,600	3.7	6	.25
Osram ...	P625A		3.7	6	.25

FOUR-ELECTRODE VALVES: Screened-grid

Make.	Type.	Impedance.	Amp. Factor.	Fil. Volt.	Fil. Cur.
Mullard..	PM12	230,000	200	.2	.15
Six-Sixty	215SG	220,000	190	2	.15
Cossor ...	220SG	200,000	200	2	.2
Marconi...	S215		170	2	.15
Osram ...	S215		170	2	.15
Ediswan	SG215	140,000	140	2	.15
Mullard...	PM14	230,000	200	4	.075
Six Sixty	4075SG	220,000	190	4	.075
Cossor ...	410SG	200,000	200	4	.1
Ediswan	SG410	115,000	140	4	.1
Marconi...	S625	175,000	110	6	.25
Osram ...	S625		110	6	.25
Ediswan	SG610	100,000	140	6	.1

FIVE-ELECTRODE VALVES: Pentodes

Make.	Type.	Impedance.	Amp. Factor.	Fil. Volt.	Fil. Cur.
Ediswan	5E225	65,000	80	2	.25
Six-Sixty	230PP	64,000	80	2	.3
Mullard...	PM22	62,500	82	2	.3
Marconi...	PT235	55,000	90	2	.35
Osram ...	PT235		90	2	.35
Cossor ...	23cQT	20,000	40	2	.3
Mullard...	PM24	28,600	62	4	.15
Six-Sixty	415PP	27,000	60	4	.15
Cossor ...	415QT	20,000	40	4	.15

MAINS VALVES: Three- and Four-electrode

Make.	Type.	Impedance.	Amp. Factor.	Fil. Volt.	Fil. Cur.
Marconi...	S Point 8	200,000	160	.8	.8
Osram ...	S Point 8		160	.8	.8
Marconi...	H Point 8	55,000	40	.8	.8
Osram ...	H Point 8		40	.8	.8
Marconi...	HLPoint8	17,000	17	.8	.8
Osram ...	HLPoint8		17	.8	.8
Marconi...	P Point 8	6,000	6	.8	.8
Osram ...	P Point 8		6	.8	.8
Marconi...	KH1	30,000	40	3.5	2.0
Osram ...	KH1		40	3.5	2.0
Marconi...	KL1	3,750	7.5	3.5	2.0
Osram ...	KL1		7.5	3.5	2.0
Cossor ...	MRC	80,000	50	4	1.0
Ediswan	MI41RC	50,000	45	4	1.0
Cossor ...	MHF	20,000	20	4	1.0
Cosmos ...	AC/G	17,500	35	4	1.0
Ediswan	MI41	9,000	16	4	1.0
Cossor ...	MLF	8,000	8	4	1.0
Cossor ...	MP	6,500	5.5	4	1.0
Cosmos ...	AC/R	3,000	10	4	1.0
Cossor ...	MXP		3.5	4	1.0

A glance through the constructional articles in this issue will give the novice some hints regarding the best valves for the various types of circuits

USE YOUR OWN INITIATIVE — GET BETTER RESULTS—and SAVE MONEY

A childlike ease of assembly alone is not sufficient inducement to offer the thinking constructor as a reason for rushing in to blindly build. Constructors to-day are capable of using their own hands and brains, and there are 10,000 Lissen dealers who will help them. When they build they are capable of using their own judgment in selecting the parts which offer them the certainty of better results and best value for the money they are asked to spend.

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20,000 ..	.. 3/6	100,000 ..	.. 4/6
25,000 ..	.. 3/6	150,000 ..	.. 5/6
50,000 ..	.. 3/6	200,000 ..	.. 6/-
	250,000 ohms .. 6/6		

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This new four-valver by the designer of the Everyman Four is a revolution in receiver design. With only one tuning control and without adjustable reaction it will bring in at amazing volume at least thirty stations on the loud-speaker. The valves used are of the standard three-electrode type, and the secret of the set's performance lies in attention to every detail and the use of a special type of tuning coil; moreover the total anode-current consumption of all four valves is only about 12 milliamperes. The actual size and shape of every connecting wire is shown on the blueprint that is available at half-price, and it is not necessary to do any soldering

DESIGNERS of wireless receivers are agreed on one point, the impossibility of producing a set acceptable to everybody. But I believe, as the result of my own experience, that a design may be so well thought out as to offer an irresistible appeal to those who build their own receivers.

A set such as I have in mind will obviously not comprise a haphazard arrangement of parts. Neither will it be based on pure theory. Rather will the set represent a skilful blending of laboratory and everyday experience.

Cheap to Build and Maintain

It will be essentially a practical receiver, easy to handle, cheap to build and maintain, pleasing to the ear, powerful and selective to provide variety, and distinguished in appearance.

Such a receiver cannot hastily be produced. The Touchstone is the result of years of experience. It is really a development of a four-valve receiver that I designed and described during the summer of 1926. This particular set, which is said to have a world-wide reputation (probably 50,000 were made), partly owed its popularity to the effective high-frequency couplings that made possible, with only one high-frequency stage and no reaction, the reception of many European stations. In fact, many users reported the reception of American stations.

The high-frequency couplings were the outcome of an investigation into H.F. amplification and selectivity, and so far no others have been made to rival them. The original receiver is still giving satisfactory service, but the introduction of new components and valves has made possible various improvements as regards amplification, selectivity, quality of reproduction, and ease of handling.

A modern receiver must first of all give good quality and ample volume. Secondly, there must be a volume or strength control. In the third place, the receiver must be selective and powerful in order to receive the foreign stations with ease.

An important point is that the anode current shall be a minimum consistent with good results, and the receiver must, of course, be perfectly stable and easy to tune, regardless of the type of aerial employed.

Selectivity and Power

One high-frequency stage includes two tuned circuits, and if these are made with very low losses, there will be ample selectivity. The amplification to be obtained from this stage will depend upon the design of the couplings and may be so considerable that adjustable reaction is not required. If the high-frequency amplifying valve is of the moderate impedance type, its high-tension current will be small.

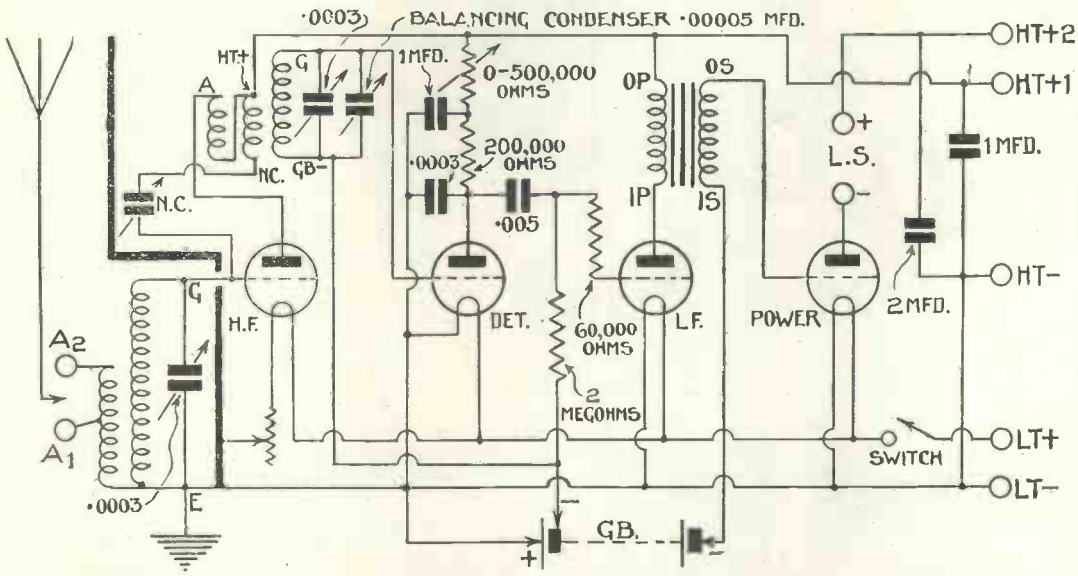
ACTUAL MAGNIFICATION OF SINGLE HIGH-FREQUENCY STAGE IN THE TOUCHSTONE

Wave-length.	*Amplification.*	*Wave-length.*	*Amplification.*	*Wave-length.*	*Amplification.*	*Wave-length.*	*Amplification.*
580	42	450	45	350	48	250	47
500	43	400	47	300	47	200	49

The valve used was a Marconi or Osram HL610, actual impedance 28,000 ohms, having a magnification factor of 28.5. The total H.F. magnification of the signal is of the order of thirty times the above amounts when allowance is made for the aerial-grid coil.

The Touchstone (Continued)

CAREFULLY STUDY THE CIRCUIT OF THE TOUCHSTONE AND NOTE ITS SPECIAL FEATURES!



Here is reproduced the circuit of the Touchstone. It comprises one stage of high-frequency amplification with an ordinary three-electrode valve, a detector, and two stages of low-frequency amplification

For rectification, it is better to employ an anode-bend type in order to maintain the selectivity of the tuned circuits. This stage may be resistance-coupled to the first low-frequency amplifier, which in turn may be transformer-coupled to the power valve.

Low Anode Current

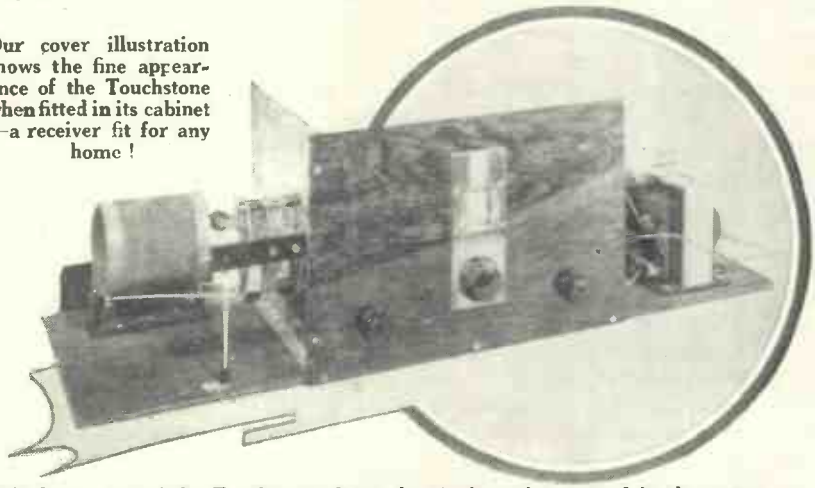
By using valves of moderate impedance in the first three stages the anode current is kept at a reasonably low figure, and a large power valve can, therefore, be used in the output position without straining an ordinary type of dry battery.

The circuit of the Touchstone includes several novel features, which will be apparent from the diagram above. In the first place, an ordinary three-electrode valve is employed for high-frequency amplification, and there is no reaction.

Secondly, a variable resistance is included in series with the anode circuit of the detector in order to prevent motor-boating and to enable the anode voltage of the anode-bend rectifier to be adjusted to a suitable value. It is therefore not necessary to employ a separate high-tension supply for the detector or to fit a potentiometer in the grid circuit. A small by-pass condenser is employed to improve the efficiency of the detector which, with the 60,000-ohm series grid resistance, prevents high-frequency currents entering the low-frequency amplifier circuit.

Probably the most important part of the receiver is the high-frequency amplifier. An ordinary valve is used and readers may wonder why one of the screened-grid type was not preferred. The answer is briefly that far more amplification can be obtained from an ordinary valve than from a screened-grid type. It is also easier to stabilise than the screened-grid type. **These remarks apply only in the case of the special high-frequency couplings used in the Touchstone.**

Our cover illustration shows the fine appearance of the Touchstone when fitted in its cabinet—a receiver fit for any home!



This front view of the Touchstone shows the single tuning control in the centre of the panel, with the volume control on the left and the small balancing condenser on the right

When the Screened-grid is Best

When ordinary coils are to be employed, the screened-grid type of valve offers advantages and it may be considered superior when a two-range set is required, and for manufacturers. But the amateur who is able to employ really effective high-frequency coils can obtain much more amplification with the ordinary type of valve.

Coils with High-frequency Cable

An examination of the illustrations will show that the two coils have a winding of high-frequency cable. As a matter of fact, they both have 68 turns of No. 27/42 silk-covered Litzendraht, which is wound on a tube of paxolin 3 in. in diameter and 3½ in. long. Their inductances are a little below 300 microhenries and, as a result, a tuning range of from 190 to 580 metres is obtained with variable

Overall Magnification More Than 2,000,000!

condensers having a maximum capacity of .0003 microfarad.

Very Definite Advantages

The advantages of a tuning coil of high-frequency cable for the aerial-grid circuit are very definite. A small aerial coil, actually having fourteen turns, with a tap at the eighth, is employed; this gives very good selectivity with considerable magnification of the signal, owing to the low-loss construction and the high step-up ratio.

This coil must not be needlessly damped; a grid leak of 1 megohm, for example, would produce a noticeable reduction in the signal strength. The grid of the high-frequency amplifying valve must, therefore, be given a negative bias in order to stop the flow of grid current. This bias is actually obtained from an adjustable resistance joined in the negative lead to the valve, which is, incidentally, also employed as the volume control.

Most Important Component

The most important part of the receiver is the high-frequency inter-valve transformer. The secondary coil of this transformer has a very low resistance, which enables a small primary winding to be used.

Now, the number of turns in the primary winding, their size and position, greatly affects magnification and selectivity. Tight magnetic coupling is necessary, but it is essential that the capacity of one winding to the other be made as small as possible. A winding of No. 40-gauge silk-covered wire is therefore employed for the primary, and it is wound on thin ebonite spacers over the outside of the earthed end of the secondary. Fourteen turns are employed when the high-frequency amplifying valve has an anode impedance of from 20,000 to 30,000 ohms.

Reduction in Selectivity

If two or three more turns were used, the amplification would be increased by a small percentage, but there would be a much greater proportionate reduction in selectivity.

For a valve of lower anode impedance, fewer primary turns would have to be used. It is, therefore, a matter of great importance that a valve of the correct anode impedance be used in this position as selectivity and magnification are decided by this factor.

Increased Amplification

With the transformer described, the amplification will vary in direct proportion to the amplification factor of the valve. Thus, the stage would give twice as much amplification if a valve having a magnification factor of 20 as compared with 10 was used, both valves having the same anode impedance.

Similarly, a combination of the high-frequency transformer and a valve having a magnification factor of 30 would give 50 per cent.

AN EDITORIAL NOTE

To anyone who has previously relied on reaction in a set to get distant stations, the Touchstone—with its single stage of high-frequency amplification with a three-electrode valve—is almost uncanny in its range and selectivity.

We certainly have never come across any other set of its type that gives comparable results. In producing the Touchstone for "Wireless Magazine" readers, Mr. W. James—he will be remembered as the designer of the Everyman Four—who has now joined our staff as Research Consultant, has certainly produced a winner!

This is a real one-knob set, for it is seldom necessary to use the small balancing condenser. The set makes use of no variable reaction, the enormous amplification of the high-frequency stage bringing in everything that is going, and the selectivity is really remarkable. Even with two-volt valves the overall magnification is at the very least 2,000,000!

Another most important point about the Touchstone is that with six-volt valves the anode-current consumption is only 12 milliamperes—a discharge that modern dry batteries can stand without serious detriment.

With the aid of the full-size blueprint that is available for half-price, nobody will have any difficulty whatever in the construction of this receiver, for all the connecting wires are numbered; and the actual size and shape of each is indicated.

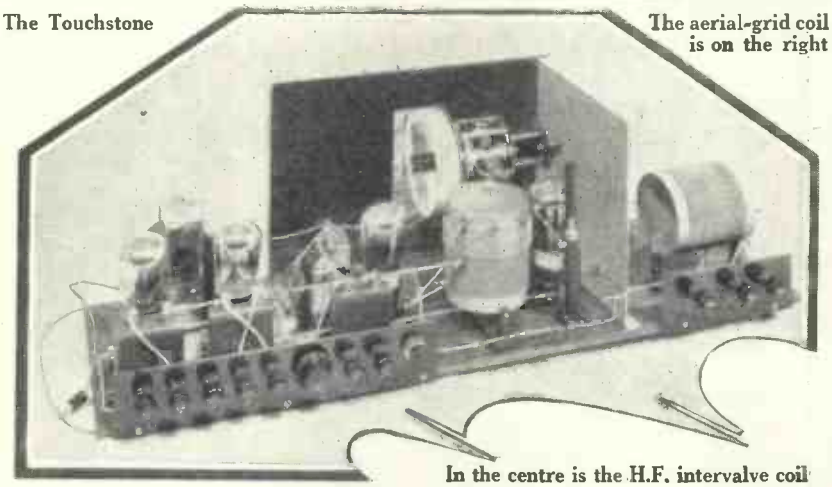
TEST REPORT OF THE TOUCHSTONE

This list of twenty-nine stations is the result of one evening's test carried out about ten miles from London. **Only very loud stations were logged** and any constructor of the set should be able to get as good or better results:

Station	*Wave-length*	*Dial Reading* (Aerial joined to aerial)	*Station*	*Wave-length*	*Dial Reading* (Aerial joined to aerial)
Milan (?)	544	93.5	Hamburg	397	68.5
Munich	537	91.5	Stuttgart	380	65.5
Vienna (?)	517	90.5	Unidentified	374	64.5
Brussels	508	87.5	Leipzig	367	61.5
Daventry 5GB	492	85	London	361	60
Berlin	484	83.5	Bournemouth	326	52
Langenburg	471	82.5	Breslau	322	51
Oslo	461	81.5	Dublin	319	49.5
Paris (?)	460	80.5	Cologne	283	39
Rome	450	79	Barcelona	277	37
Frankfurt	429	75.5	Unidentified	250	30
Unidentified	420	74	Nurmberg (?)	242	23
Glasgow	405	71.5	Unidentified	235	20
Cork (?)	401	70.5	Unidentified	215	12
Madrid (?)	400	70			

The Touchstone (*Continued*)

The Touchstone



The aerial-grid coil is on the right

In the centre is the H.F. intervalve coil

greater amplification than that including a valve with a magnification factor of 20.

In the old four-valve receiver, already referred to, a magnification of about 38 was obtained. This figure has never been challenged and is at least twice as great as that to be obtained from a valve and ordinary high-frequency transformer. But new valves are now available. There are types giving a magnification factor of 30 for an impedance of 30,000 ohms.

H.F. Magnification

With one of these and the transformer a **pure high-frequency amplification of 40 to 50 for the single stage is obtained** with complete stability over the whole range.

This amplification is, of course, greatly increased by the step-up provided by the aerial-grid transformer, and is further multiplied by the slight amount of reaction that may be permanently introduced into the circuit by correctly setting the balancing condenser.

This condenser is connected between the grid of the high-frequency amplifying valve and a third winding on the H.F. intervalve transformer. In order to be thoroughly effective over the whole tuning range, the balancing winding must be carefully proportioned and positioned with respect to the other windings.

In the transformer illustrated, it comprises a winding of No. 40-gauge wire interwoven with the primary in such a manner that the magnetic coupling is extremely tight, whilst the capacity of this winding with the others is relatively small. As a result, it is a very easy matter so to adjust the balancing condenser that complete stability is obtained over the whole tuning range.

Once the balancing condenser is adjusted, which takes only a few moments, it need not be touched again until the high-frequency amplifying valve is changed. This combination of extraordinary magnification and selectivity magnifies weak signals by such an amount that European stations at too great loud-speaker strength can be obtained.

No Reaction Control

There is no adjustable reaction whatsoever in the receiver and it therefore does not howl or squeal.

In order to give the reader some idea of the signal strength, I may mention that without an earth and with the aerial wire not connected in any way to the receiver, but simply held within a few inches of the baseboard, nine or ten stations were received in the course of a few minutes at sufficient strength for ordinary domestic purposes, and the volume control had to be used on some of them.

The measured pure radio-frequency amplification for the single stage is given on page 295. The measurements were made by coupling a shielded oscillator to the grid and filament terminals of the H.F. valve, and measuring the input and output at the various wavelengths.

Accurate Results

This is much more difficult to do than one might think from the description, but the results are reasonably accurate. The magnification, it should be noted, is that provided by a single stage comprising the valve and its transformer. Owing to the efficiency of the aerial-grid coil and the small amount of fixed reaction that is allowable, the

COMPONENTS REQUIRED FOR THE TOUCHSTONE

1—Ebonite panel, 12 in. by 8 in. by $\frac{3}{16}$ in. (Resiston or Becol).
1—Two-gang .0003-microfarad variable condenser (Jackson Bros.)
1—Vernier drum dial for $\frac{3}{16}$ in. panel (Jackson Bros.).
1—Panel rheostat, 15 ohms for 2-volt valves or 30 ohms for 4- or 6-volt valves (Peerless).
1—.00005-microfarad balancing condenser (Bulgin).
1—Pair special Touchstone coils (Wearite or Lewcos).
4—Anti-microphonic valve holders with terminals (W.B., Lotus, or Formo).
1—Neutralising condenser (Gambrell neutrovernia).
1—.0003-microfarad fixed condenser (T.C.C. or Dubilier).
1—.005-microfarad mica fixed condenser (T.C.C. or Dubilier).
2—1-microfarad fixed condensers (T.C.C. or Dubilier).
1—2-microfarad fixed condenser (T.C.C. or Dubilier).
1—60,000-ohm vacuum-type grid leak (Ediswan).
1—2-megohm vacuum-type grid leak (Ediswan).
2—Porcelain grid-leak holders (Bulgin).
1—Low-frequency transformer (Igranic 3.6 to 1, type G, or Ferranti AF3).
1—200,000-ohm wire-wound resistance with holder (R.I. and Varley).
2—Terminal strips, 5½ in. by 2 in. and 10½ in. by 2 in. (Resiston or Becol).
10—Terminals, marked:—Aerial 1, Aerial 2, Earth, L.T.+, L.T.−, H.T.+1, H.T.+2, H.T.−, L.S.+, L.S.− (Belling-Lee).
1—0–500,000-ohm variable resistance (Clarostat, volume-control type).
1—On-off push-pull switch (Bulgin or Lotus).
1—Metal screen (Parex, Raymond, or Ready-Radio).
1—Cabinet with 8 in. baseboard (Peto-Scott).
1—16-volt grid-bias battery (Ever-Ready).
3—Wander plugs, one red and two black (Lectro Linx).
Stiff wire for connecting.
Short length of flex.

Gives A Pure H.F. Amplification of 40--50!

total high-frequency amplification is so great that I cannot measure it with my apparatus.

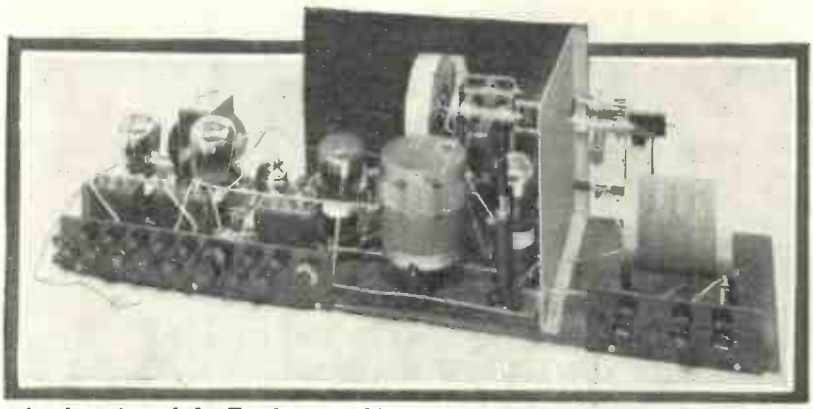
Limit of Selectivity

There are, of course, many factors to be considered in designing high-frequency couplings. These will be gone into at a later date, but at the moment I would emphasise that no greater selectivity can be obtained without impairing the quality as the result of weakening the side-bands.

You will notice that a two-gang condenser is employed for tuning, with a knob-driven drum control which includes a slow-motion device. No attempt need be made to balance the two tuning condensers. The dial is set at zero and both condensers are fastened in their positions of minimum capacity.

Small Balancing Condenser

Now, the aerial-grid coil has the capacity of the aerial on the primary, which tends slightly to increase the capacity across the secondary winding. In addition there are circuit capacities on both transformers. A very small adjustable condenser is, therefore, mounted on the panel and joined across the condenser tuning the intervalve coil. This small condenser is used to balance the circuit, and it need not be touched when once it has been set unless very fine tuning is required.



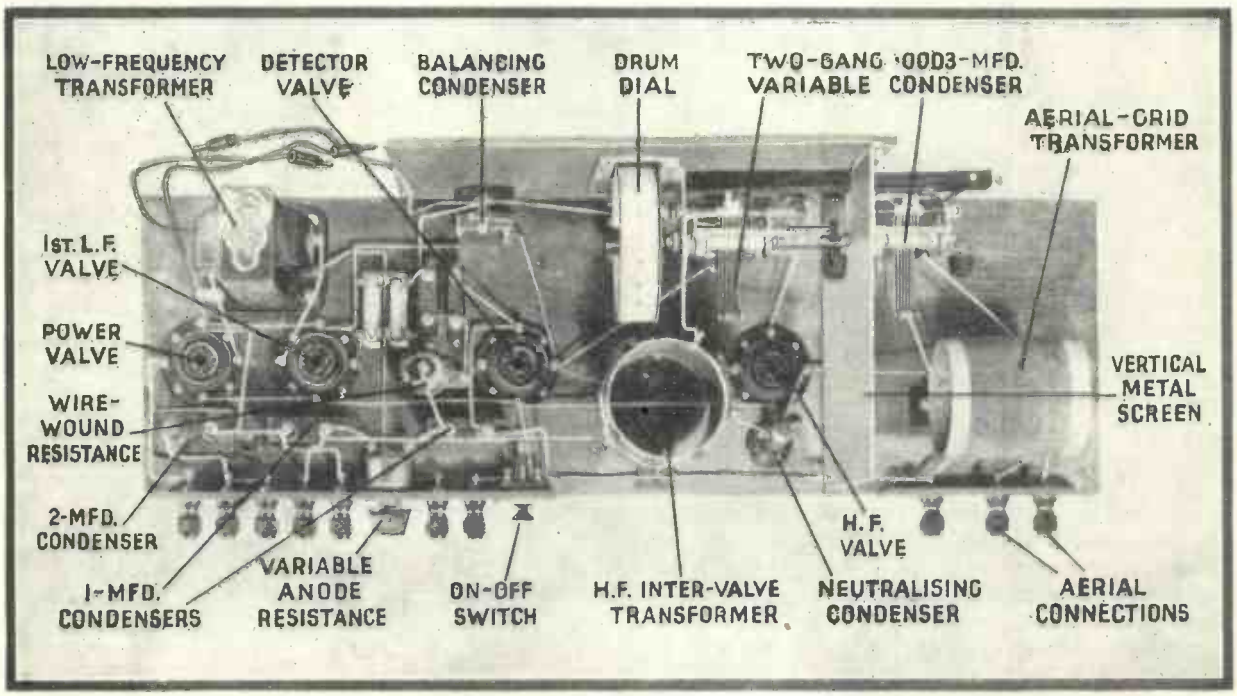
Another view of the Touchstone, which is very simple to build The full-size blueprint available for half-price shows each connection numbered in sequence of wiring

Single-knob control is therefore provided with no complications. The only other knob on the panel is fitted to a filament resistance, joined to the high-frequency amplifying valve. As this resistance is turned so as to reduce the filament current, the negative grid bias of the valve is raised, and so is its anode impedance. The amplification is therefore reduced. By this means a simple and effective control of the volume is obtained.

Very little shielding is necessary. The intervalve transformer is mounted upright in order to avoid direct pick-up and the aerial-grid coil is fitted at right angles to it, so as to minimise magnetic coupling. The aluminium shield, which is earthed, prevents a capacity coupling of the aerial circuit to the high frequency, and therefore promotes stability.

Absolute Stability

The circuit is perfectly stable. It may be balanced, and then the aerial and earth removed, when it will be found to remain balanced. There is



This plan view of the Touchstone clearly shows the simple arrangement of all the parts. No soldering is necessary and every wire is shown full size and shape on the blueprint (No. WM 109) which can be obtained for 9d. post free, up to the end of November

The Touchstone (Continued)

no oscillation of any sort, which constitutes one of the advantages of this receiver.

Bias on the Detector

Passing on now to the detector, you will notice the detector valve is biassed by negative 1.5 volts obtained from the grid battery. Connected in the anode circuit is a fixed resistance of 200,000 ohms, which is joined through a .005-mfd. mica condenser to the grid of the first L.F. amplifying valve. The grid leak has a value of 2 megohms and the high-frequency stopping resistance a value of 60,000 ohms.

The combination is so proportioned that a low-frequency note of 50 cycles is amplified by 90 per cent. as much as a 1,000-cycle note. More bass than this is seldom required.

Improved Rectification

A .0003-microfarad fixed condenser is joined between the anode and filament of the detector valve in order to improve rectification. If a smaller condenser is used here less magnification will be obtained, whilst a larger one will reduce the relative strength of the high notes to the low notes.

The combination of 200,000-ohm anode resistance, a .0003-microfarad condenser, and a valve of moderat impedance for detection, gives very good low-frequency amplification a id quality. A little more amplification will be obtained by using as the detector a valve of the resistance-capacity type, but the extra amplification is not needed.

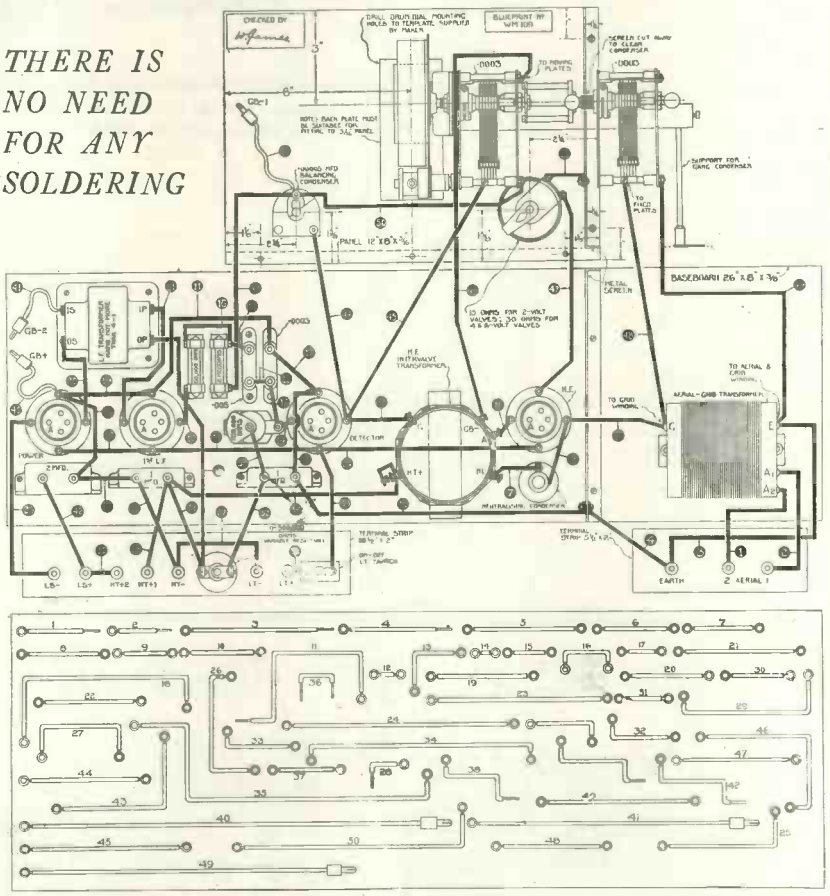
The anode voltage of an anode-bend rectifier has to be adjusted fairly carefully in order to obtain the best working conditions. A variable resistance is therefore included in the circuit. It should be adjusted whilst listening to a signal. The usual 1-microfarad condensers are fitted in order to assist stability.

In the next stage a transformer having a large primary inductance is employed, and the amplifying valve must be of the moderate impedance type, of between 20,000 and 30,000 ohms. With this combination, the higher frequencies are magnified more in proportion to the low. This improves quality, but a .001-microfarad condenser will have to be connected across the primary if a low-impedance valve is used in the third stage of the receiver.

The first three valves are supplied from a common high-tension source, which should have a minimum value of 120 volts and should preferably be of 150 volts. A high-tension supply of the full amount available should be applied to the last stage.

It is most important that the correct valves be used. Low-impedance valves must not be fitted in either of the first three positions, but the largest valve that can be run from the high tension available should be included in the last stage.

THERE IS NO NEED FOR ANY SOLDERING



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 November 30. In wiring up connect leads up to No. 42 in numerical order with panel removed; then mount panel and complete wiring to No. 52. Wires are indicated full size on blueprint. Ask for No. W.M. 109

Choosing Valves

Choose valves having the greatest magnification factors. The particular 6-volt valve recommended for the high-frequency position is the Marconi or Osram HL 610, which has a magnification factor of 30, and an anode impedance of 30,000 ohms. It can be employed with a high tension of 150 volts. In the two-volt series, there is a number of valves having an anode impedance of from 20,000 to 28,000 ohms with a magnification factor of 20 or more (see pages 292—293).

By employing a suitable combination of valves and the parts specified, you will obtain results which for quality and volume combined with selectivity and ease of handling have, I believe, never before been approached.

Making Certain of Success

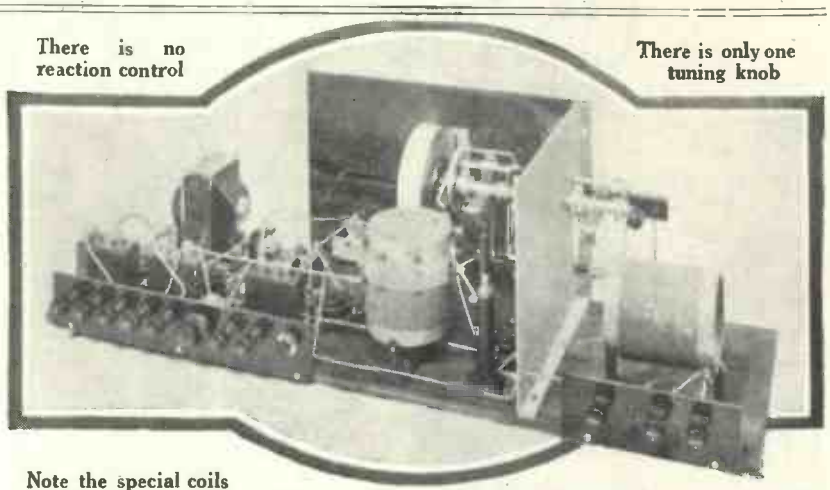
In order to make certain of success with this receiver, readers are recommended to use only those component

No Soldering and Every Wire Shown Full Size and Shape

parts specified in the list on page 298.

As is the case with every WIRELESS MAGAZINE receiver, a full-size blueprint panel template, layout guide, and wiring diagram is available; this shows all the wires numbered, and also indicates their actual shapes and lengths, full size.

Copies of this blueprint can be obtained for half-price, that is 9d. post free, if the coupon on page iii of the cover is used by November 30. Ask for No. W.M.109 and address your inquiry to Blueprint Dept., WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4.



Note the special coils used in the Touchstone; on the left is the H.F. coil and on the right the aerial-grid coil

An Easy Set to Build

The receiver is an easy one to build. First of all you will notice there is not a single soldered connection, although you may solder them all if you wish. But each terminal point has a nut which will hold the connections, and as the size of each wire is indicated in the blueprint, the wiring can be carried out by anyone.

The baseboard measures 8 in. by 26 in. by 5/16th in. and there are two terminal strips. One of them is for the earth and alternative aerial connections; it is 5½ in. by 2 in. The second strip carries the battery and loud-speaker terminals, the filament switch and the adjustable anode resistance; it is 10½ in. by 2 in.

Mounting the Components

These should be screwed to the back edge of the baseboard. Then the low-frequency and detector circuits should be arranged. Do not fit the Touchstone high-frequency coils until the last moment.

It is recommended that a thick shield be used as this is screwed to the baseboard and the small front panel, and holds them firmly at right angles. If thin metal is used a panel bracket may have to be employed.

Notice that two nuts and bolts are fitted to the shield and there is one hole for a connecting wire to pass through. The screen is also cut away to suit the variable condensers and it must clear them.

On the front panel are mounted the ganged condensers with their drum control, the volume control and the miniature tuning condenser. With the drum dial is provided a template from which the panel may be marked out. Notice in particular that a metal plate has to be fitted on the condenser support at the back of the panel, and be sure so to assemble the unit that it moves freely.

Before wiring is started, remove the panel. Upon referring to the blueprint you will see the various wires are numbered. If you wire in the order given, there will be no difficulties. Handle the Touchstone H.F. coils with care, particularly when wiring them. The bottom contact to the neutralising condenser is made by unscrewing the base, fitting a wire, and then tightening the base.

Rheostat Connection

Before fitting the front panel and its assembly put on the wire from the screen which will be joined to one side of the filament rheostat. If this wire is left about 2 in. long there will be no difficulty in fastening its free end under the terminal of the rheostat when the panel is in position.

As the free movement of the condensers depends to some extent upon their being in line, the baseboard support should be carefully adjusted, and the panel must, of course, be quite rigid.

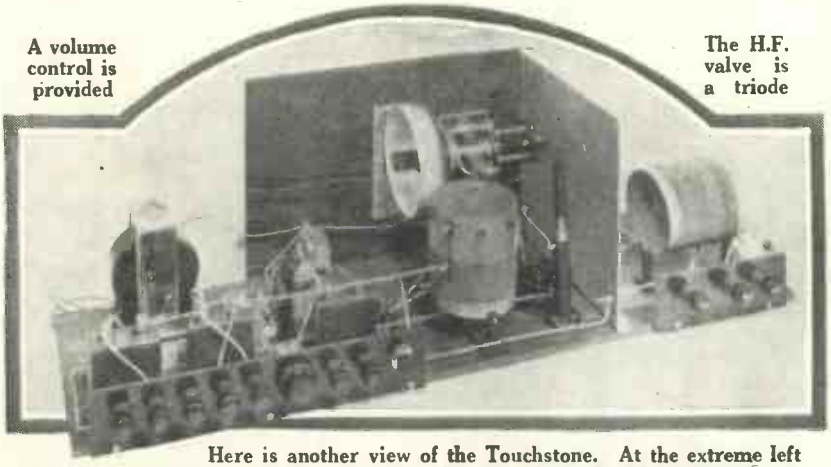
Testing Out the Touchstone

With the wiring completed, insert suitable valves and join up the batteries. Connect the earth and the aerial to the terminal marked Aerial 2. The full primary winding is then included in the aerial circuit.

Turn the knob of the adjustable anode resistance on the terminal strip so that it is about half way in. Now switch on the valves. You will very quickly find the local station and the volume should be reduced by turning the volume control.

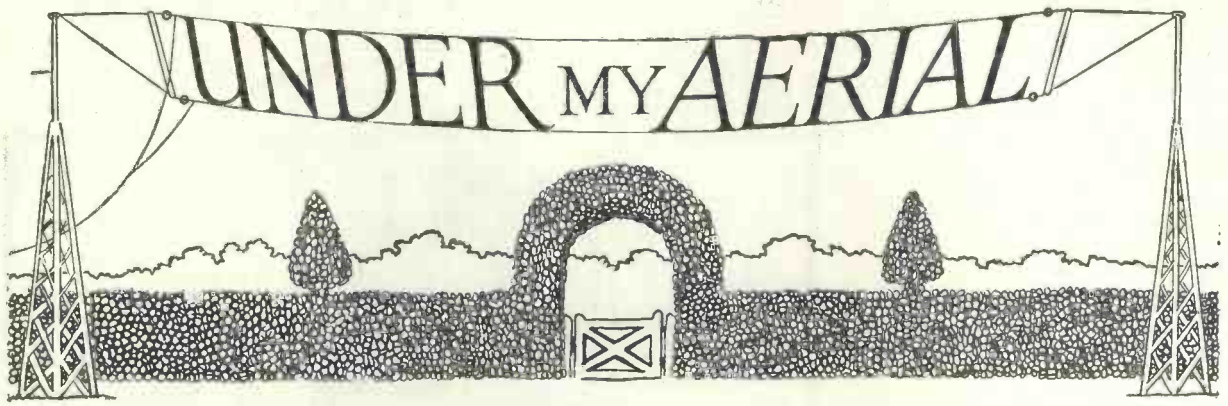
This station will probably be heard

(*Continued on page 396*)



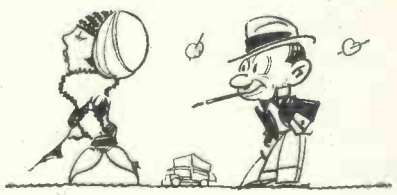
Here is another view of the Touchstone. At the extreme left of the baseboard is the low-frequency transformer, which should have a step-up ratio of not more than 1 to 4. The first stage is resistance-capacity coupled

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



New Valves

HAVE you taken particular notice of the new valves which have been placed on the market this new wireless season? You really ought to find time to make a careful



Particular Notice

study of the specifications of these new valves, you know. Then, when the time comes for you to buy your next new valve, you will know what type of valve will best satisfy your requirements.*

One specially pleasing feature of the new valves is the increased amount of information given about them. Much of this information is conveyed in the type-name of the valve. For example, a valve marked P215 is recognisable at once as a power valve of the two-volt class taking a filament current of .15 ampere.

Some of the new valves have filament voltage and current etched on the glass bulb and, in addition, impedance and amplification factor. All this information may appear to be of little consequence to the non-technical listener, but the fact remains that, the more we understand of this valve information, the better results we shall obtain from our valves.

In the screened-grid valve the chief innovation is the substitution of an upright type with a standard four-pin base and a terminal at the top for the horizontal type with three pins at one end and two at the other.

We expect a certain amount of improvement in valves each season, but the 1928 improvements in existing types of valve, together with the introduction of the pentode, have made me wonder if the present new wireless season will come to be looked upon as a valve season.

◆ ◆ ◆

Regional Names

The suggestion has been made that the new regional stations of the B.B.C. should receive names according to their geographical position. Thus, the new regional station now in course of erection at Potters Bar would be known as the Southern station and Daventry would be known as the Central station. Other

The Suggestion Has Been Made

regional stations, whose sites have still to be determined, would receive the names Northern, Western, and Scottish.

What do you think of this suggestion? Personally, I do not like it in the least. For one thing, it seems a dreadful idea to change the name Daventry, now so well known all over the world, to such an uninspiring name as Central. Southern for London sounds equally tame.

No, the words central, southern, western, and northern are scarcely suitable. They are adjectives, and we must have *names* for the new stations—not adjectives. We don't want to be saying to each other such things as :—

"I picked up the Southern station last night," or

"Southern came in well yesterday."

We want individuality in the new names, and there is no such individuality in the geographical terms mentioned above. Who outside our own country—or in it, for that matter—would associate the word "southern" with any definite part of the country, with anybody or with anything? Let us stick to the name London for the southern regional station. Everybody knows London, and the broadcast talent, technical and artistic, associated with it.

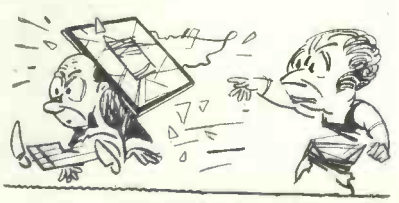
With regard to the other regional stations, I would far rather the authorities adopted the name of the nearest town or village in each case. We should very quickly become familiar with those names, and they would rapidly become as familiar to us as Daventry is at the present time.

George says that the Japanese, in choosing the call sign JOCK for one of their broadcasting stations, have taken one of the possible alternative names for the new Scottish regional station.

◆ ◆ ◆

Picture Transmissions

I wonder if you have done any-



Picture Transmissions

thing yet with regard to the reception of the daily picture transmission from Daventry 5XX. It seems to me that this picture reception is just

*See pages 292 and 293 of this issue—Ed.

the thing for a small wireless club to tackle at the present stage.

The definite inclusion of the transmission of pictures in our broadcast programmes is uncertain and will not be attempted until the B.B.C. authorities have proved to their satisfaction that there is a public demand for the radiation of still pictures by wireless.

Hence my advice that it is better for a wireless club to put together the necessary apparatus for the reception of pictures than for the individual listener to do so.

A special type of three-valve receiver will be necessary for picture reception and, although such a set might be made from an existing three-valve broadcast receiver, it will, no doubt, pay to build a new set solely for the reception of pictures.

What Interests Me More

What interests me more than anything else about the proposed picture transmission is not the apparatus required at the receiving end, but the kind of pictures that will be sent out.

Do we really want pictures by wireless? If so, what pictures do we want? Various suggestions as to broadcast pictures include news photographs, maps, diagrams, dress-making sketches, and picture puzzles. Of these, I must say that the first is the only one to appeal to me. George says we shall get the last on the list all right.

◆ ◆ ◆

The Relay Stations

Before the end of the year, ten of our relay stations will be sending out the same programme on the same wavelength, and I am wondering what the effect will be in areas remote from those stations.

At the present time our relay stations, with the exception of Edinburgh, are working on *international* common wavelengths; that is to say, they are sharing certain wavelengths with other stations in Europe. As you know, Hull, Dundee, Stoke, and Swansea have all been sharing a wavelength used by a Belgian and a Swedish station. Liverpool has been using a wavelength common to stations in Spain and in Sweden. Nottingham has been working on a wavelength also used by stations in Austria, Germany, and Sweden. Bradford has shared its wavelength with German and Swedish stations. Leeds has transmitted on a wavelength com-

Before the End

mon to stations in Spain and Bavaria.

Edinburgh has had one of our national exclusive wavelengths all to itself, but, in the new arrangement, Edinburgh will share this exclusively British wavelength with Bournemouth, Bradford, Dundee, Hull, Liverpool, Plymouth, Sheffield, Stoke, and Swansea. Leeds will continue to use its present international common wavelength.

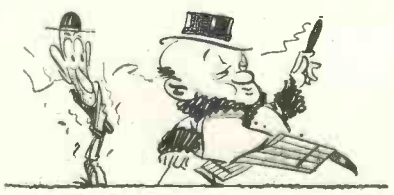
These changes in the wavelengths of our relay stations may be looked upon as a condemnation of the international common wavelength scheme. Interference on wavelengths shared by stations situated in different European countries has been much more serious than was anticipated, and that interference has reduced the service areas of our own relay stations so much that it became questionable whether some of them were worth keeping on the air.

When the ten relay stations are all working on the same wavelength, I wonder what power they will use. If they all have Edinburgh's power (.35 kilowatt), ten times .35 will be 3½ kilowatts—half a kilowatt more than London. Somebody might hear something of the relay stations on the other side of the Atlantic, *without fading*, perhaps.

◆ ◆ ◆

Aberdeen

When Bournemouth begins to transmit on the common wavelength of the ten relay stations, the national exclusive wavelength hitherto used by Bournemouth will be transferred to Aberdeen. This change will make a great deal of difference to the reception of Aberdeen in England and Wales.



A Great Deal of Difference

At present, Aberdeen shares a wavelength with stations in Norway and Sweden. The reception of Aberdeen in the southern parts of our islands, however, has been extremely difficult because of the nearness of Aberdeen's wavelength to that of the much more powerful station Daventry 5GB.

On its new exclusive wavelength Aberdeen should be an easy catch in the south. Those of us who feel sorry to lose Bournemouth—always one of the best of stations—must find compensation in the reception of Aberdeen.

Personally, I shall be delighted to renew my acquaintance with 2BD, our most northern station. I never can dissociate a broadcasting station from those of my friends who happen to live near that broadcasting station. When I am listening to Aberdeen, I always feel as if I am in touch with my old Army friends who live in the Granite City. There were Ged and John G., and, of course, a Jock and a Mac. When those old Army friends of mine listen to London, I wonder if they think of me, as I do of them when I listen to Aberdeen.

◆ ◆ ◆

Exit Nottingham

I am sorry about Nottingham—quite as sorry as any of my friends

I Am Sorry

who live in that Midland city. It so happens that one of my great holiday haunts is in the outer zone of 5NG's service area, and for that reason 5NG has always been my favourite relay station.

My oldest wireless friend in this holiday haunt of mine told me, the last time I was there, that he looked upon the passing of Nottingham as a most serious loss.

"You see, Nottingham is one of my four two-valve receiver loud-speaker stations," he said.

"Which are the other three?" I asked.

Under My Aerial (Continued)

"The two Daventrys and Manchester. My loud-speaker reception of Nottingham on a two-valve set (detector and low-frequency valve) has always seemed to me to be above the ordinary. I don't know why it should be so, but I shall miss Nottingham."

"You might get better results from the ten relay stations all broadcasting the same programme on the same wavelength."

"I doubt it, if the distorted reception of Stoke is anything to judge by."

One of the best things I ever did with a crystal set was to pick up Nottingham at a distance of twenty miles with signal strength sufficient to work two pairs of phones easily.

Well, these changes are all for the best, and we must put up with them cheerfully; but I shall miss Nottingham when I am on holiday.

◆ ◆ ◆

Terminology

"I suppose you have had no difficulty with the new wireless terms which have crept into our wireless periodicals this autumn, George?" I remarked to my technical adviser last night.

"Can't say that I have," replied George, "but I don't call to mind any strikingly new terms."

"There have been several, George. For example, what do you make of 'anti-mobo'?"

"Oh, that's easy. Anti—er—in south English, against; in northern English, feminine of uncle. Mobo—short for motor-boating, I suppose. Anti-mobo—a gadget designed to prevent back coupling in an L.F. amplifier and the consequent effect known as motor-boating or boggling."

I Suppose You Have

"Excellent, George. What do you make of 'flexible aerial unit'?"

"A folding frame aerial, possibly."

"'Scratch filter,' George?"

"Something to do with gramophones, I expect. You remember the old gramophonic proverb, which ran: 'When scratches the needle, with Keatings dust'?"

"'Corrosive cure for accumulator terminals.' Cure for what, George?"

"Acidity, I suppose."

"Now, then, I've got you, George. 'Radiotrician'—what do you make of that?"

"Easy again. Obviously, that is a new American term for a wireless mechanic."

"Quite right, George. You are really excellent on American wireless terms. What about this one—'Doo-hickey'?"

"Terrible, terrible. American slang term for the English slang term, 'gadget.' Pass the tobacco jar."

◆ ◆ ◆

Your Loud-speaker

Are you going to be content with your old loud-speaker this winter, or are you going to set yourself up with one of the vastly improved loud-speakers of the present season?

It is a pity that one cannot dispose

Are You Going?

of an old loud-speaker in the way that one can dispose of an old motor-car, an old piano, or an old typewriter—sell the old thing or exchange it in part payment for a new one. If either or both of these things could be done, I daresay most of us would soon be proud possessors of up-to-date loud-speakers.

Still, there is a chance that some of us will be able to find the means wherewith to purchase a new loud-speaker. Should that be so in your case, which of the new loud-speakers would you go in for?

A difficult question, isn't it? There are moving-coil loud-speakers, cone loud-speakers of new design, and exponential horn loud-speakers. My suggestion is that your new loud-speaker should be purchased entirely on the faithful quality of its reproduction, no matter of what type.

Of course, if you decide to make your own new loud-speaker, the matter of choice is a simple one; the new linen-diaphragm loud-speaker described in the September number of the WIRELESS MAGAZINE, every time. What about it?

◆ ◆ ◆

Mainly So

We had been discussing the latest developments in wireless, and our

We Had Been Discussing

conversation had turned from valves to loud-speakers, from loud-speakers to transformers, and from transformers to mains units. After a long pause George suddenly said to me:

"Wireless is not one of your mains successes, is it?"

"How can it be when the house is not supplied with electric light?" I asked in reply.

"That is a difficulty, certainly," said George as he pushed a piece of my No. 18 d.c.c. wire down his pipe.

"I have electricity in my laboratory, though, you know, George."

"Um—yes. Laboratory, accent on the first syllable if the announcer speaks from London, on the second if he speaks from Manchester. All you do with the electricity supply in your so-called lab*or*atory, Manchester calling, is to charge accumulators, isn't it?"

"Not in the least, George. I have done many other things with electricity there."

"You ought to make a mains unit and work a set from it in your lab."

"Perhaps I might do so this winter, George."

"Do you know, a little time ago I had a great idea for a mains set?"

"What was the great idea, George?"

"Connect up the studio microphone to the electric-power station and send out programmes by wired wireless along the supply lines."

"But——"

"All you would have to do would be to plug in your loud-speaker to a wall plug, switch on, and there you are."

HALYARD.

Our Impressions of Television

TELEVISION, or the transmission of *moving* pictures by wireless, has excited the curiosity of the public everywhere, and many strange stories of its possibilities have been rife.

On the other hand, a number of attacks have been made on J.L. Baird, the British inventor, because he has hitherto refrained from demonstrating his achievements to that section of the Press most competent to judge of their value.

Latest Developments

WIRELESS MAGAZINE readers can now learn the truth about the latest television developments, for the Editor and several members of the staff have lately been afforded special facilities by the Baird Television Development Co., Ltd., for a series of private demonstrations of television both by wire and by wireless.

At once we can say that the new art has advanced so far that it has definite commercial possibilities. Mr. J. L. Baird has demonstrated to us conclusively the practicability of sending by wireless an image of a person's head and shoulders which can be recognised.

Many strange rumours are current regarding the immediate possibilities of television, but this article, which is based on the results of special demonstrations given to the Editor and staff of the "Wireless Magazine," by Mr. J. L. Baird, disposes of most of them. Here at last is the truth about television!

J. L. Baird, the British television inventor

The reproduction at the receiving end is subject to flickering. The whole picture tends to swing up and down; but sometimes its position remains fairly constant for a minute or so.

It is not fair to assume that the reproduction is as good as a cinematograph show, for cinematography has forty years of development behind it, while Mr. Baird has been engaged in television research only five years or so. No useful purpose would be served by leading our readers to suppose that television has reached perfection, and Mr. Baird will, we are certain, agree with us on this point. He is always trying to improve his results.

Before making any further comments on the quality and scope of the transmissions that can be made at present let us describe Mr. Baird's demonstrations.

In the first place we were shown a transmission by wire of a head and shoulders in three colours, but as colour television is still in the early stages of experiment we shall say no more about it at present.

Readers who are interested, however, are referred to the article "Colour Television Experiments," by R. F. Tiltman, which appeared on page 266 of the October WIRELESS MAGAZINE.

General arrangement of Baird television receiver

Monochrome Television

Secondly, we were given a demonstration of television by wire in monochrome. What we saw was the reproduction of a man's head and shoulders, accompanied by a running commentary from the person being "televised," which was reproduced from a loud-speaker.

Lastly, we were given a special opportunity of seeing an actual television transmission (that is, by wireless) between Long Acre and Leicester Square, a distance of half a mile or less.

Television by Wireless

Again, we saw the head and shoulders of a man and it was apparent that this wireless transmission, in spite of the fact that it was carried out with apparatus of an experimental nature that had been rebuilt a number of times, was practically as

Our Impressions of Television (Continued)

good as that made by wire—a fact that is of real importance.

The television transmission was made on a wavelength of 200 metres from a 500-watt transmitter at Long Acre energising a closed circuit.

Receiving Apparatus

This was picked up at the Engineer's Club, Leicester Square, on an indoor aerial arranged round three sides of a room and amplified by a three-stage resistance-coupled amplifier with a small transmitter-type valve in the last stage, this requiring an anode potential of between 400 and 600 volts.

We were unable to test for ourselves the broadness of the tuning for the television receiver was "fixed tuned" for 200 metres. We were told, however, that the transmission occupies a frequency band of between 10,000 and 20,000 cycles.

Separate "Sound" Wavelength

The speech and other sounds accompanying the movements of the person being "televised" were sent out on a wavelength of 250 metres with a small 10-watt transmitter, and picked up on a five-valve radio receiver in the ordinary way. The loud-speaker employed was of the moving-coil type.

In order to make the television image appear a reasonable size, a system of two magnifying lenses is used, but in the televisor demonstrated to us one of these had been removed and so the reproduced image we viewed was smaller than will be the case with the instruments offered for sale to the public, when it will measure about 4 inches wide by 5 inches deep.

A Streaky Effect

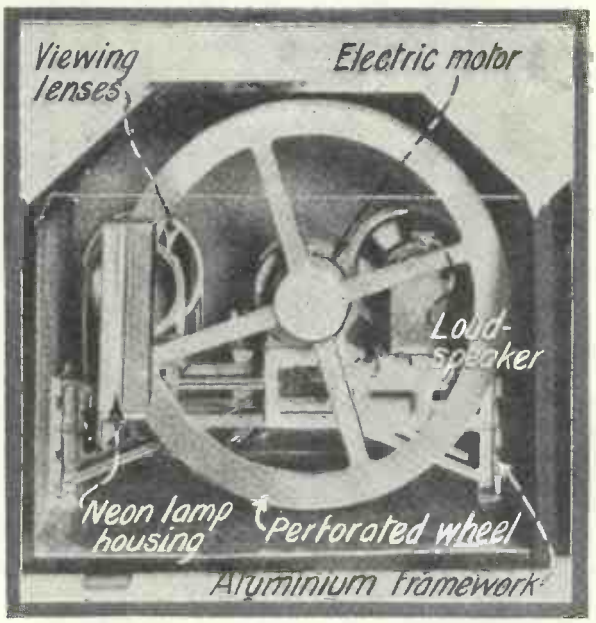
The movement of the disc with a spiral of holes, in conjunction with a neon lamp, forms the image, produces a streaky effect almost vertically down the picture.

It is possible to distinguish the whites of the eyes when the latter are rolled and the glistening of the teeth when the mouth is opened. Such movements as the opening and shutting of the eyes and mouth were quite distinct.

We were most interested in trying for ourselves the effect of altering the two controls on the televisor, which, by the way, is quite simple to operate. One control varies the speed of the perforated disc and so "tunes in" the image.

This is not enough, however, for the top of the picture may drop to the middle of the viewing aperture and another "bottom" appear above it, as sometimes happens with an ordinary cinema projector.

For this reason a "phasing" control is provided and a movement of this alters the position of the image up or down so that it can be brought into the best position.



Internal arrangement of Baird Televisor

We would particularly emphasise the fact that no synchronising wave of any kind is transmitted. Mr. Baird claims to have overcome the need for this by an automatic device which keeps the motor that drives the perforated disc running at exactly the right speed once it has been adjusted by means of the control provided.

This, in our opinion, is the most important of Mr. Baird's achievements at the receiving end, and one that puts him in advance of most of his competitors in this new field of scientific endeavour.

The photographs reproduced in these pages show the general appearance of the televisors that will be offered for sale as soon as a service can be started. It has been mentioned that a high anode voltage is required for the last valve of the television amplifier. This is obtained from an M.L. converter unit built into the set and run from a 12-volt starter battery. The current for all the valves is obtained in this way, no other battery being employed.

Limited Appeal

In view of the high original and running costs of a television set we believe that the appeal of the proposed service will be unavoidably limited at first.

We should be sorry for readers of the WIRELESS MAGAZINE to jump immediately to the conclusion that because of the advances that have been made during the past few months a televisor will be found in every home in six months' time.

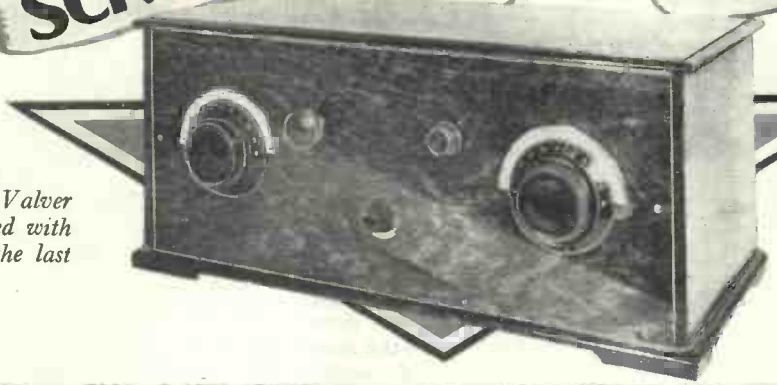
B.B.C.'s Experiments

At the time of going to press, however, we learn that there is some possibility of the B.B.C. undertaking experimental television transmissions outside ordinary programme hours.

We have followed Mr. Baird's developments closely for the past few years and can testify to the really remarkable strides that he has made with his system. Ignoring all criticism, whether informed or otherwise, he has steadily evolved a system which has, as we have already explained, distinct possibilities for future development and everybody will wish him success in his work—but television will be undeservedly crippled if it is forced to leap before it can crawl.

According to Thomas F. Logan, noted American advertising authority, radio sets in that country are used an average of 850 hours during the year, more than two-thirds of the radio sets are in use from two to six hours a day, and the listening peak is reached at the end of the week.

THE ALL-WAVE SCREENED-GRID THREE



A Fine Three-Valver that can be used with a Pentode in the last stage

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

Uses Transformer Coupling for the Screened-grid Valve

THE phenomenal success of the Inceptor 3 at the Radio Exhibition has proved beyond doubt that readers of the WIRELESS MAGAZINE —and others who are not yet readers —do want simple yet good sets employing screened-grid valves.

It is no exaggeration to say that the screened-grid valve sets published in these pages so far have been both more numerous and more popular than any such sets described in other radio journals.

This new set is a development of the Inceptor 3 type of circuit in that it employs a screened-grid high-frequency amplifier and a pentode or three-electrode power valve. Plug-in coils were used in the Inceptor 3, but this receiver employs a new dual-range tuner specially developed for screened-grid valves.

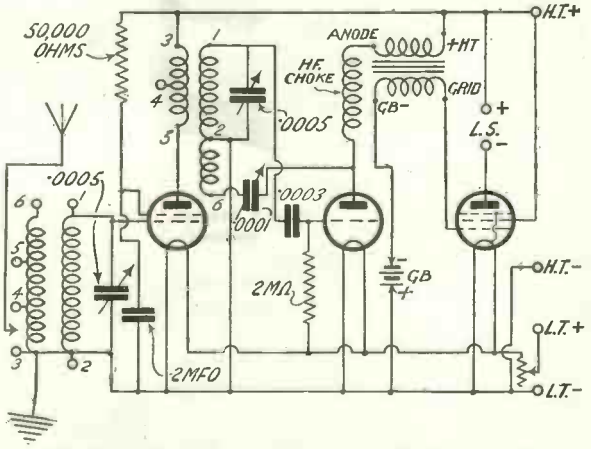
Covers Both Wavebands

It is, of course, more expensive to build than the other set, but has the advantage that both wavebands are covered without the need for changing coils.

There has been some controversy regarding the best coupling to use with screened-grid valves; usually a form of tuned-anode coupling has been used as no ordinary high-frequency transformer has a primary with sufficient impedance to match the valve and so get anything like the best possible results from the combination.

However, one firm well-known in the coil world has developed a special type of transformer for use with screened-grid valves, and it is this that is incorporated in the All-wave Screened-grid Three.

These coils have only just appeared on the English market, but many thousands of them have been used successfully in Holland with a famous Dutch make of screened-grid valve. There is every reason to believe that they will be equally successful here.



Circuit of the All-wave Screened-grid Three. By using a special dual-range tuner it covers both wavelength bands

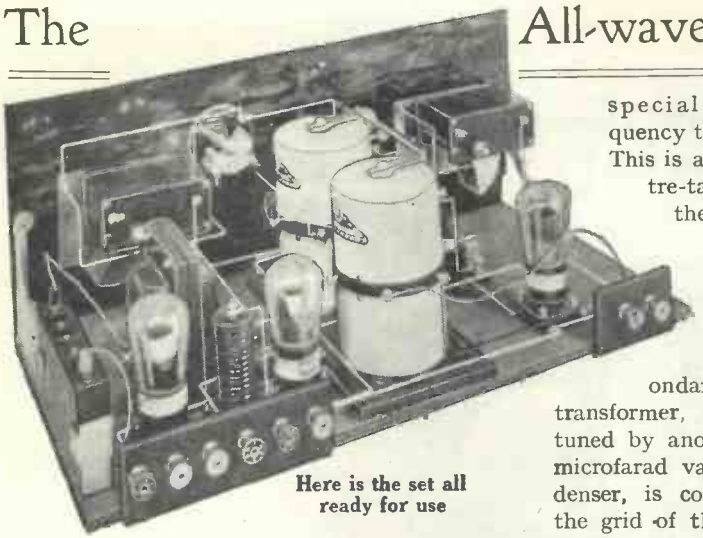
Five-Valve Results

For the benefit of those who have not read about the Inceptor 3, which was fully described in the previous issue of WIRELESS MAGAZINE, it may be repeated here that, if a pentode be used in the set, it will give approximately five-valve results.

The All-wave Screened-grid Three employs a similar circuit and it also is practically as good as an ordinary five-valver. It has the advantage, also, of having only two tuning controls and of covering the two broadcast wavebands (that is

Covers Both Wavelength Bands by Means of Single Switch

The All-wave Screened-grid Three (Contd.)



Here is the set all ready for use

from 250 to 550 metres and from 1,000 to 2,000 metres) by means of one simple switch. The only other controls are a master rheostat used as an on-off switch and a reaction condenser.

For Family Use

It will thus be appreciated that the set is extremely simple to operate once the minor adjustments have been made and it is particularly suited to the needs of the average family, for when the British programmes are found too dull, there will always be a number of foreign transmissions from which to choose.

A glance at the circuit diagram will show that the aerial tuner consists of two windings, which are auto-coupled. The primary, which is aperiodic, is provided with three tappings by means of which the degree of selectivity with any particular aerial can be varied.

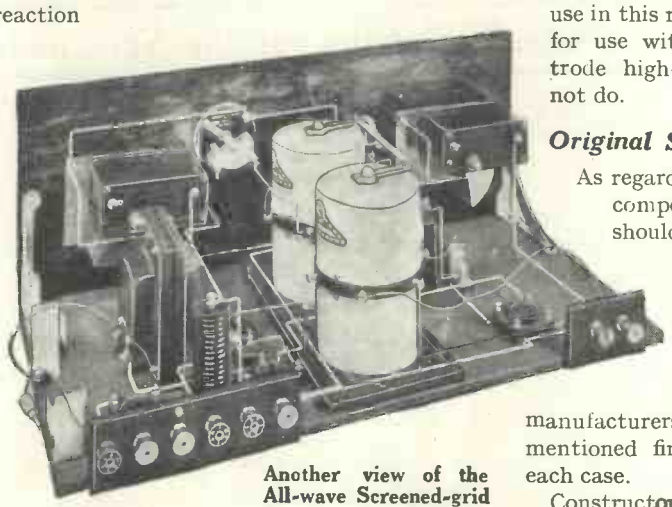
The secondary of the tuner, which is tuned by a .0005-microfarad variable condenser, is connected to the operating grid of the high-frequency valve.

Screening-grid Voltage

It will be observed that in series with the lead to the actual screening grid is a 50,000-ohm resistance. This is inserted to cut down the voltage applied to this electrode to the right value when 120 volts are fed to the receiver.

In the anode circuit of the screened-grid valve is the primary of the special high-frequency transformer. This is actually centre-tapped, but the tap is not needed in this particular circuit.

The secondary of the transformer, which is tuned by another .0005-microfarad variable condenser, is connected to the grid of the detector valve and has coupled to it a reaction winding, the degree of oscillation being controlled by a .0001-microfarad variable condenser.



Another view of the All-wave Screened-grid Three without Valves

As reaction is incorporated, leaky-grid rectification is employed, because it is more sensitive than the anode-bend method. The leak, of course, introduces damping across the coil, but its bad effects are more than compensated for by the reaction arrangement.

As would be expected, the detector is coupled to the last valve, which may be either a pentode or an ordinary super-power valve, by means of a transformer, a high-frequency choke being placed in series with the primary in the usual way.

Valves Not Actually Screened

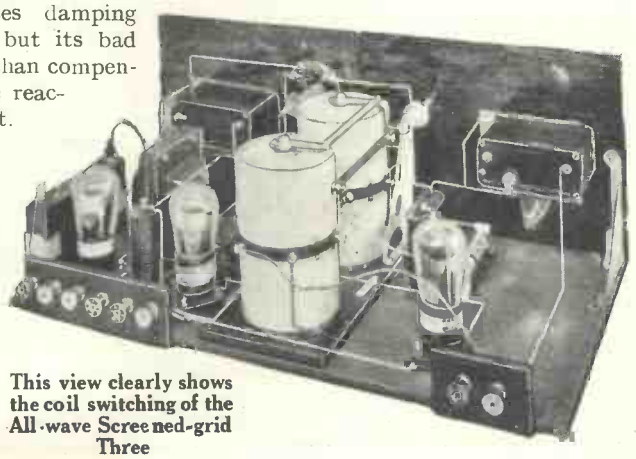
A glance at the photographs will show how the arrangement works out in practice. It will be noticed, for instance, that it is not necessary actually to screen the high-frequency valve as the aerial coil and transformer are themselves protected in this way. All of the switch-gear for changing the wavelength range is also enclosed, the controls being taken through a system of coupled levers to a knob on the front of the panel.

We wish particularly to point out that only the type of dual-range coil actually specified by type letters in the list of components is suitable for use in this receiver. Coils intended for use with ordinary three-electrode high-frequency valves will not do.

Original Specification

As regards the remainder of the components, constructors should keep as possible to the original specification, as only by so doing can they expect to duplicate the results obtained with the original set. The manufacturers of those parts are mentioned first in the brackets in each case.

Constructors should note that all the necessary constructional details are given in these pages, but those who desire to work from a full-size blueprint can obtain one for half-price, that is 6d., post free, if they



This view clearly shows the coil switching of the All-wave Screened-grid Three

Very Simple to Build

use the coupon on page iii of the cover by November 30. Ask for No. W.M.110; and address your inquiry to Blueprint Dept., WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4.

The first part of the construction to be undertaken is, of course, the drilling of the panel. This will present no difficulty as the makers of the .0005-microfarad variable condensers supply a template in each carton.

Mounting the Panel Components

When the panel has been drilled, mount thereon the two .0005-microfarad variable condensers, the .0001-microfarad reaction condenser, and the filament rheostat.

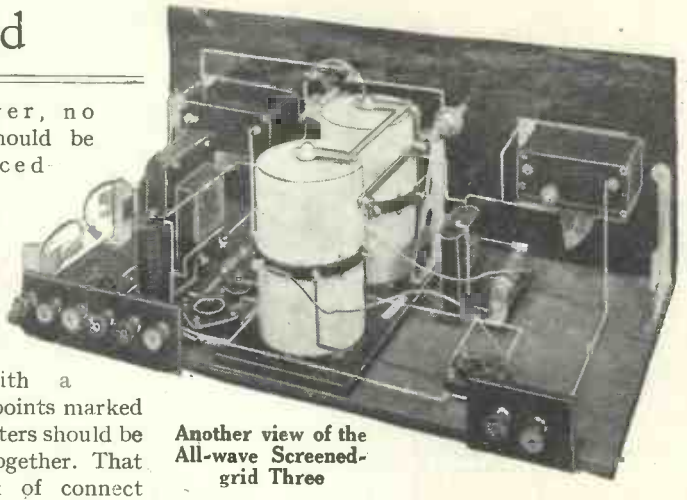
Next, place the dual-range tuner unit in position on the baseboard and pass the switch spindle through to the front of the panel. Note that in order to get it on the baseboard, the panel bush supplied is not used, the spindle being taken straight through the panel.

By the way, although an ebonite panel was used in the original receiver, there is no objection whatever to using a wooden panel if desired; the results will not be affected in any way whatever, as the frame of each condenser and the spindle of the coil switch are all earthed. By using a wooden panel the constructor can save several shillings in the cost.

Study the Photographs

When the tuner has been fixed down, the rest of the components can be laid out. There is no need to go into detail, for the arrangement must be clear, even to the novice, after looking at the photographs and blueprint (or the reduced reproduction of the latter to be found on page 310).

Moreover, no difficulty should be experienced with the wiring, for it will be noticed that each terminal point is marked with a letter. All points marked with like letters should be connected together. That is, first all of connect those points marked *a*; then the points marked *b*; and so on.

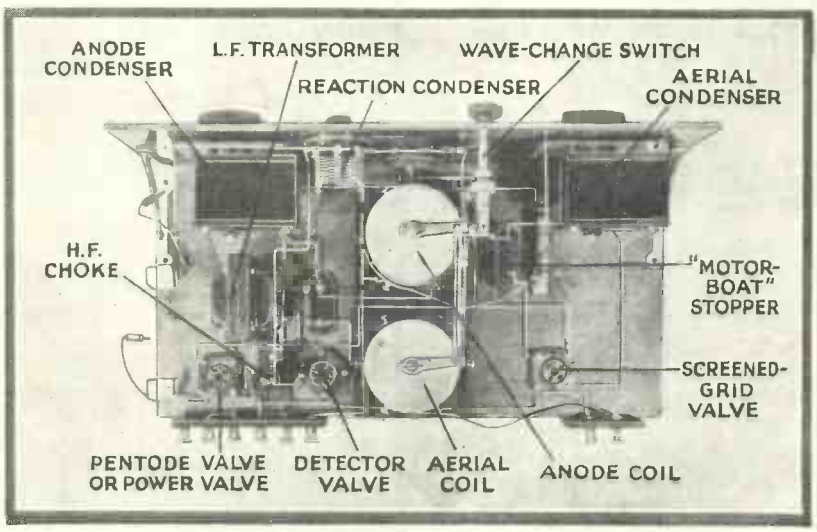


Another view of the All-wave Screened-grid Three

In wiring up the grid leak and condenser (*a*, *g*, and *m*) note that between the points *a* and *m* there is an insulating clip and no electrical connection. If a connection is made between these points the low-tension battery will be short-circuited through the secondary of the high-frequency transformer, so beware!

There are five flexible connections, which are not lettered. One is from the aerial terminal and is tapped on to No. 4, 5, or 6 terminal of the aerial coil according to the degree of selectivity required. The second is from terminal No. 5 on the high-frequency transformer to the anode terminal on the top of the screened-grid valve. The third and fourth are from the nine-volt grid-bias battery on the baseboard to the G.B.— terminal of the low-frequency transformer and L.T.— terminal of the last valve holder respectively.

The last flexible lead is from H.T.+, and is connected to the auxiliary grid terminal on the base of the pentode power valve if one of these is used. If a pentode cannot be obtained, an ordinary three-electrode valve can be used, although the volume will not then be so great, of course.



This plan view of the All-wave Screened-grid Three clearly shows the arrangement of the components

Flex Lead

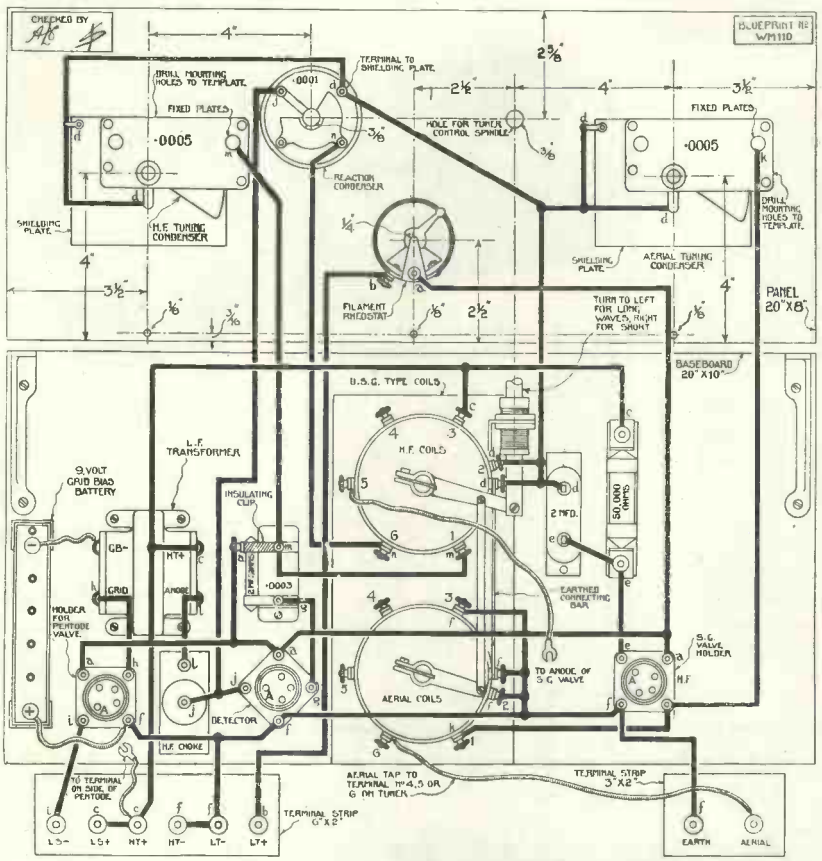
In this case the last flexible lead can be omitted, for if left lying free, the high-tension supply may be accidently short-circuited.

Before the set can be used, suitable valves must be chosen. This is not a difficult matter, if the list on pages 292–293 is consulted. The choice of filament voltage, if not depending on the accumulator to hand, must be governed by the pentode.

Two- or Four-volt Valves

There is no six-volt pentode, and the four-volters are better than the two-volters. It will be seen that there is a choice of three of these. The detector valve should have an impedance of between 15,000 and 25,000 ohms for use with the

The All-wave Screened-grid Three (*Continued*)



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 November 30. Ask for No. W.M.110

particular transformer used in the original receiver.

The cost of the valves is 22s. 6d. each for the screened-grid valve and pentode, while the detector is 10s. 6d. If a pentode is unobtainable for some time, and an ordinary three-electrode power valve with an impedance in the neighbourhood of 3,500 ohms is used, the price will be 15s.

Grid-bias Battery

If a three-electrode power valve is used in the last stage, it will be desirable to use a higher-voltage grid-bias battery, in order to conserve the high-tension supply.

To use the All-wave Screened-grid Three, insert valves in the holders, and connect up the batteries, etc. If any other voltage than 120 is applied to H.T.+ a different value of resistance will have to be inserted in the lead to the screening grid of the high-frequency valve.

When all the external connections have been made, turn to the front panel and adjust the wave-change knob to the lower wave lengths, that is, screw it as far as possible to the right.

Now turn on the rheostat fully and see that the reaction condenser is set at zero. With both hands turn the knobs of the .0005-microfarad variable condensers until the local station is picked up; the dial readings will be approximately the same over the entire scale.

Increasing Selectivity

Before trying to get other stations, re-adjust the grid bias for the best quality of reproduction, and try varying the aerial tap until the local station can be cut out with as small a movement as possible of the tuning condensers.

When searching for really distant stations adjust the reaction condenser until a slight rustling or hissing sound is heard from the loud-speaker; this indicates that the set is on the verge of oscillation and in its most sensitive condition for receiving.

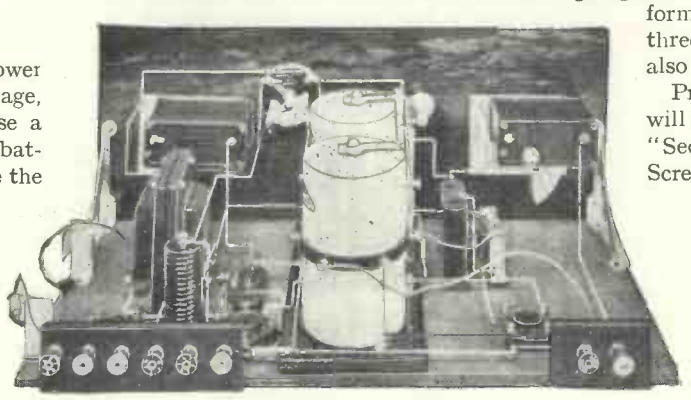
Screened-grid valves give such great magnification that sets employing them sometimes seem to have very flat tuning. The remedy for this state of affairs, if it is experienced in the All-wave Screened-grid Three, is to shorten the aerial.

Long Aerial Not Needed

Indeed, a long aerial is not needed with a screened-grid valve set; a length of ten to twenty feet will be found ample—and the number of stations received will astonish you if you have not previously used a screened-grid valve!

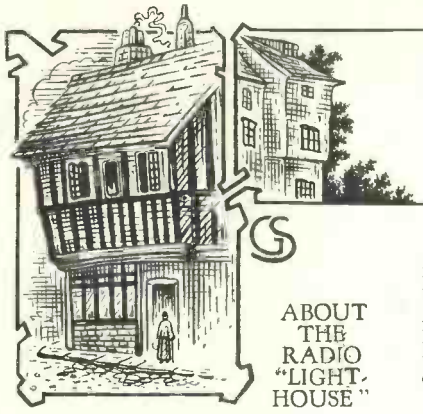
Once again we would point out that the ordinary Lewcos dual-range screened tuner will not be suitable for use in the All-wave Screened-grid Three. The high-frequency transformer must be of the special type designed for use with screened-grid valves. In the same way, an ordinary split-primary high-frequency transformer intended for use with three-electrode valves will also be unsuitable.

Prospective constructors will be interested in the article "Secrets of Success with Screened-grid Valves," by W. James, our Research Consultant, on pages 350 and 351 of this issue.



Rear view of the All-wave Screened-grid Three

FOR LIST OF COMPONENTS REQUIRED SEE OPPOSITE PAGE



ABOUT THE RADIO "LIGHT-HOUSE"

STEERING SHIPS BY RADIO

PERHAPS the most interesting side line in modern wireless development is the so-called direction finder, or wireless compass, as used for determining the bearings or location of an aeroplane or ship relatively to a given transmitting station.

Directional Aerial Properties

Direction finding is generally carried out by utilising the directional property of a frame aerial at the receiving end. When the strength of the incoming signal rises to a maximum, the observer knows that the plane of the frame aerial is pointing directly towards the transmitter. Alternatively, at the point of zero or minimum pick-up, the plane of the receiving aerial is perpendicular to that line.

In either case the navigator knows his bearings on one particular transmitter, and by taking a similar cross-bearing on a second known transmitting station, he is able to calculate his exact position in space either at sea or in the air.

The Department of Scientific Research has recently published an Official Report (H.M. Stationery Office, price 2s. 3d.), on the performance of a different type of direction-finder, which has been specially designed to assist navigators in foggy weather and is known as the rotating beacon or wireless "lighthouse."

In this case the directional properties of the wireless signal are imparted at the transmitting end, and reception takes place on an ordinary open aerial. The signal energy is, in fact, concentrated into a rotating beam, which sweeps around the horizon in the same way as the rays of light from a lighthouse.

The official tests by the Radio Board were carried out on a rotating beacon installed at Fort Monckton near Gosport. The loop aerial used for transmitting consists of six turns of wire five feet square, the system being energised with a high-frequency current of forty amperes. The aerial is pivotally mounted and is driven by specially synchronised gearing, so as to rotate at a speed of exactly one revolution per minute.

Signal Superposed on Carrier

At the precise instant when the concentrated beam from the transmitting aerial points north, a characteristic signal is superposed on the radiated carrier wave, this signal being repeated each time the rotating frame passes the same point.

In order to discover his bearings relatively to the wireless beacon, it is only necessary for an observer at sea to record the time interval between two occurrences. First he must note the exact time of receipt of the N signal.

Rise and Fall in Signal Strength

Then he must listen in his headphones to the rise and fall in signal strength of the continual heterodyne note representing the "sweep" of the wireless beam across the ship. When this note sinks to minimum strength, he knows that the plane of the transmitting aerial is exactly perpendicular to the imaginary line connecting the ship to the beacon station.

He now knows the direction of two lines in space. First a line pointing northwards, secondly a line joining his ship to the transmitting beacon. Finally, the time interval between these two lines, as recorded on a chronometer, measures the actual angle between them, because, as previously explained, the beam sweeps out a complete circle once in every sixty seconds.

Working Range of Fifty Miles

As the result of an extended series of observations taken in this manner, the Research Committee report that the Fort Monckton radio "lighthouse" has a reliable working range of over fifty miles by day and night, at which distance the majority of the recorded bearings were found to be correct to within a marginal error of only two degrees. M. A. L.

The All-wave Screened-grid Three

(Continued from preceding page)

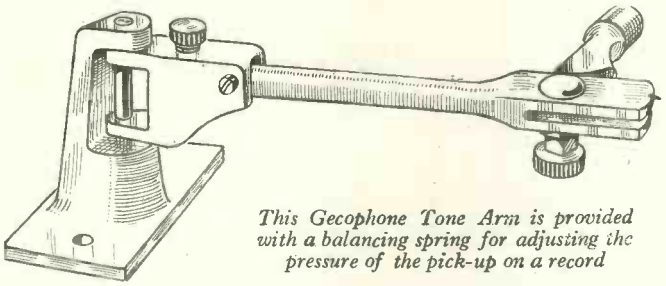
COMPONENTS REQUIRED FOR THE ALL-WAVE SCREENED-GRID THREE

1—Ebonite panel, 16 in. by 8 in. (Red Triangle, Becol, or Parfait).
2—.0005-microfarad variable condensers (Burndept, Cyldon, or Peto-Scott).
1—.0001-microfarad reaction condenser (Peto-Scott Midget, Cyldon Bébé, or Dubilier).
1—15-ohm panel rheostat (Lissen, Igranic, or Peerless).
1—Dual-range tuner with H.F. transformer for screened-grid valves (Lewcos).
3—Anti-microphonic valve holders (Formo, Lotus, or W.B.).
1—50,000-ohm wire-wound resistance (Dubilier, Ferranti, or R.I. and Varley).
1—2-microfarad fixed condenser (Ferranti, T.C.C., or Dubilier).
1—.0003-microfarad fixed condenser with series insulated clip (Dubilier, T.C.C., or Lissen).
1—2-megohm grid leak (Dubilier, Graham-Farish, or Lissen).
1—Low-frequency transformer (R.I. and Varley, Ferranti, or Lissen).
1—High-frequency choke (Lewcos, Wearite, or Peto-Scott).
1—Pair battery clips (Bulgin).
1—Pair panel brackets (Peto-Scott).
2—Terminal strips, 7 in. by 2 in. and 3 in. by 2 in. (Red Triangle, Becol or Parfait).
8—Terminals, marked: Aerial, Earth, L.S.+, L.S.—, H.T.+, H.T.—, L.T.+, L.T.— (Eelex).
2—Wander plugs (Lectro-Linx).
Short length of flex.
Stiff wire for connecting (Glazite).
1—Cabinet and baseboard, 9 in. deep (Pickett Bros.).

NEW STANDARDS in APPARATUS

SET AT THE RADIO EXHIBITION

BY comparison with previous exhibitions some of the prices ruling in Olympia last month were a revelation in what the British manufacturer can do when put to the test. In the following article I am going to review what I consider to be the most outstanding features of this autumn's developments, for the benefit of WIRELESS MAGAZINE readers.

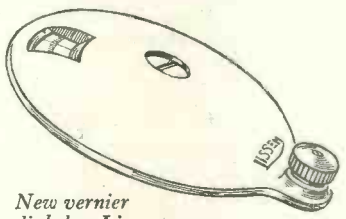


This Gecophone Tone Arm is provided with a balancing spring for adjusting the pressure of the pick-up on a record

Whether the "cuts" are due to the reduction in patent royalties, or to improved methods of mass production, or to other natural causes, the marketing of a three-valve receiver at under £7, including valves and royalties, certainly marks a new era in the cost of loud-speaker reproduction.

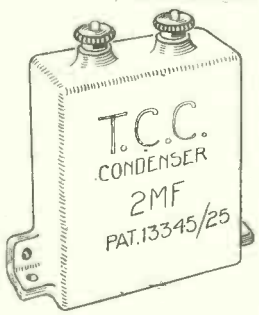
For £7

Nor is this an isolated example. For instance, for five guineas one can purchase a three-valve receiver including a detector and two transformer-coupled amplifiers mounted in a handsome cabinet. When the valves are added the overall cost is still below £7, a figure which will compare favourably with anything to be expected from abroad should the British market in receivers be thrown open to outside competition.



New vernier dial by Lissen. It has a ratio of 8 to 1

At this price one cannot reasonably expect ultra-selectivity, not yet to run a moving-coil loud-speaker, but the makers guarantee good quality loud-speaker reproduction and at least one alternative programme, wherever the listener may be situated. In some localities a choice of several stations is available.



Moulded case of new T.C.C. fixed condensers

Increased Popularity

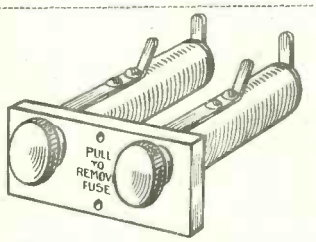
One undoubted result of the new scale of prices will be the installation of loud-speaker sets in thousands of homes where up to the present the cost of the necessary outfit has proved too much for the person of only moderate means.

The use of screened-grid H.F. amplification and the introduction of the new pentode power amplifier on the low-frequency side have, between them, set another new standard of values.

Screened-grid Detector and Pentode

A three-valve set comprising a screened-grid tube, a detector, and a pentode amplifier will give practically the same performance in range and volume as a five-valve set built according to last year's specification.

There are now two types of screened-grid valve generally available, one, the original model, mounted horizontally and requiring a special adapter, and a later model designed to fit into the standard four-pin holder, the additional screen electrode being brought out to a terminal at the top of the bulb.



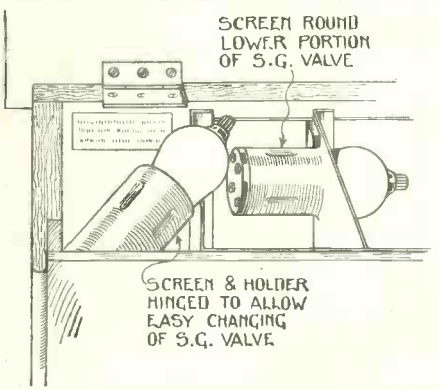
Gambrell twin-fuse unit for mains receivers and battery eliminators

The pentode, of course, is a five-electrode valve, containing three grids, the first being the input or control grid, the second a screening-grid carrying the same voltage as the plate, and the third an earthed grid located between the plate and the screening grid to prevent a reversal or diminution of the plate current due to secondary emission.

High Magnification and Mutual Conductance

The outstanding merit of the pentode is a high magnification factor and a distinctly favourable coefficient of mutual conductance, so that it gives a large power-output such as is required for loud-speaker work.

In fact, a single pentode will give practically the same output as two ordinary power amplifiers. On the high-frequency side a screened-grid amplifier, owing to its greater stability, functions with an efficiency equal to two

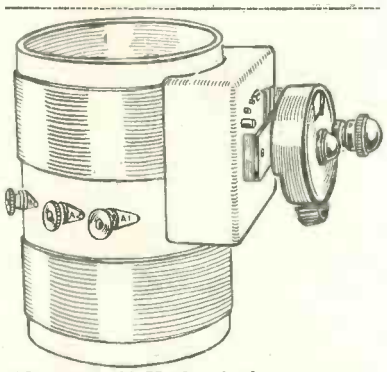


Ingenious swinging holder for screened-grid valve in Marconiphone 44 receiver. This set comprises two screened-grid high-frequency amplifiers, a detector and a power valve

ordinary stages of radio-frequency amplification.

Consequently, as previously stated, a three-valve receiver fitted with these new tubes can be counted as the equivalent of the former five-valver, a set which combines long-distance reach with ample loud-speaker volume.

It must, of course, be remembered that the pentode is a heavy consumer of high-tension current, and is best used in combination with either a mains supply unit or a wet-cell H.T. battery.

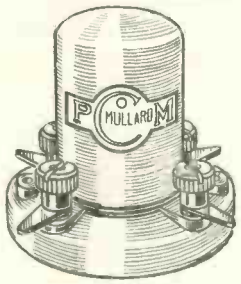


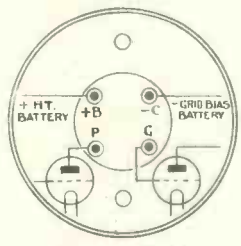
New R. I. & Varley dual-range tuner. This has an aperiodic aerial coil and is one-hole fixed

Speaking of H.T. supply, Olympia excelled itself this year in the number and variety of units designed to supply both plate and filament current from the electric lighting mains. If one can take these outward signs as a portent, the dry-cell type of H.T. battery will soon become obsolete.

High Initial Cost of Mains Supply Units

Unfortunately the cost of mains supply units still remains at such a level that the listener of moderate means must perforce content himself with a less expensive alternative. Actually, in the long run, he would save money by changing over from dry cell to eliminator, but the initial cost too often forbids the experiment.





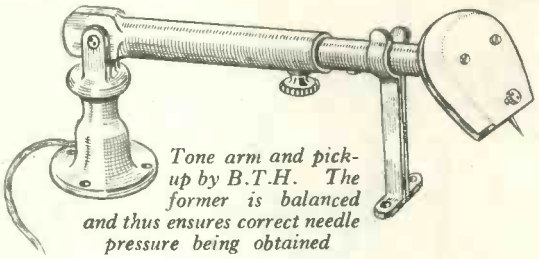
Mullard resistance-coupling unit

It is interesting to notice that the new dry-contact type of rectifier seems to be ousting the thermionic valve as used in eliminators designed for A.C. mains. Dry-contact units are now available which will deliver a rectified current of as much as one ampere, or sufficient to feed the filaments of an eight-valve set from the mains; whilst for the high-tension supply 100 milliamperes at 200 volts is the standard specification. This combination frees the listener absolutely from any battery troubles.

Alternatively a low-priced trickle-charger can be used to keep the accumulator always "at the ready" in the home, and so cut out the inconvenience of making periodical visits to the local garage.

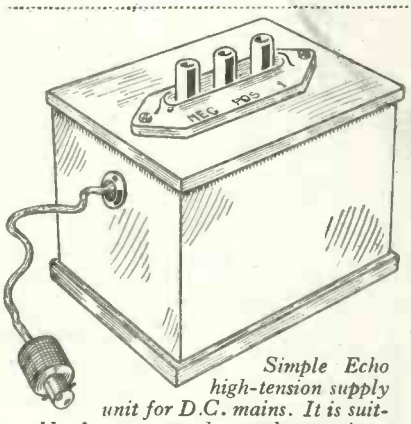
Another Outstanding Development

Apart from the particular valves already referred to, another valve development of more than usual interest must be referred to. The first is the new Point 8 or "Raw A.C." valve designed to be fed with current directly from the lighting mains.



Tone arm and pick-up by B.T.H. The former is balanced and thus ensures correct needle pressure being obtained

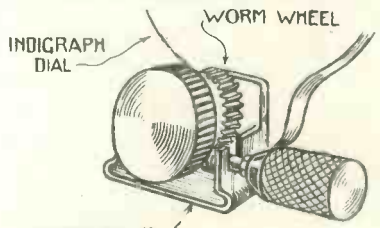
In one sense the Point 8 may be regarded as a development of the so-called "indirectly heated valve" which made its first appearance at last year's show. This, it will be remembered, was also fed directly from the mains, but there were two filaments. One filament carried the heavy current, and so served to heat by radiation a second filament, which was the actual source of the electron stream passing through the valve.



Simple Echo high-tension supply unit for D.C. mains. It is suitable for one- to three-valve receivers taking not more than 10 milliamperes

Grid Tap

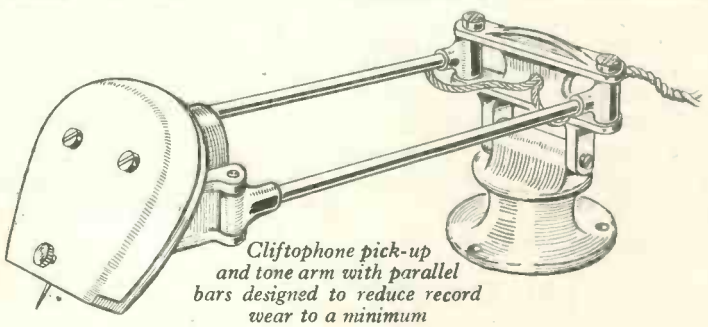
In the new A.C. valve there is only one filament, not two. In order, however, to cut out any hum due to the fluctuating character of the A.C. supply, it is necessary to insert a potentiometer across the secondary of the input transformer and to connect the grid of the valve to an intermediate tapping on the potentiometer.



Micrometer adjustment device for use with Igranic Indigraph dials

The necessary re-wiring is, however, simple and inexpensive, particularly when combined with an H.T. eliminator, whilst the economy in current consumption is considerable.

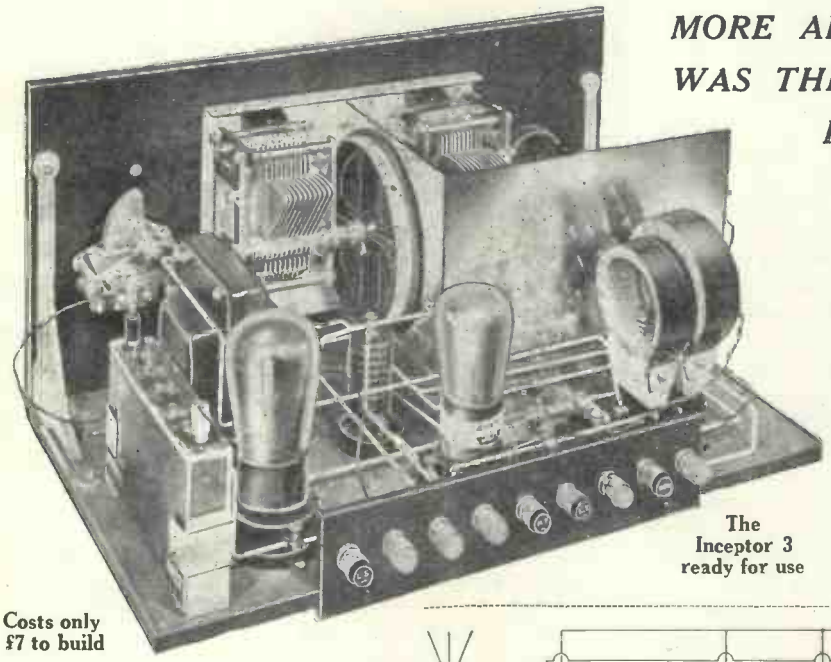
MORTON BARR.



Cliftophone pick-up and tone arm with parallel bars designed to reduce record wear to a minimum

The Inceptor 3 Revolutionises Home-construction

MORE ABOUT THE SET THAT WAS THE SENSATION OF THE RADIO EXHIBITION



The Inceptor 3 ready for use

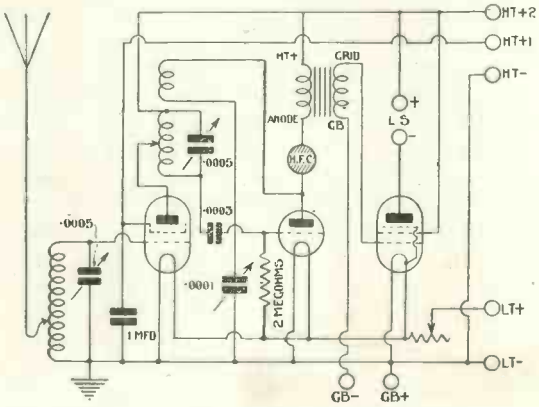
Costs only £7 to build

WE knew, of course, that the Inceptor 3 would be a popular receiver when we decided to give a free full-size blueprint of it away with the previous issue of the WIRELESS MAGAZINE. But optimistic though we were, we had never hoped that it would be quite so successful in its appeal as it undoubtedly has been.

"Three As Good As A Five"

Throughout the time that the Radio Exhibition at Olympia was open our stand was beseiged by enthusiasts eager to see the "three as good as a five"—and we were glad to show them.

The same story could be told of two other models of the Inceptor 3—made up and exhibited without our knowledge—on the stands of two manufacturers who both believe great things of it, namely, Sydney S. Bird & Sons, and Rooke Bros.



Modified Circuit of the Inceptor 3

Mr. Bird, of Sydney S. Bird and Sons, is especially pleased with the Inceptor 3 and his version of it, built up on a glass panel and enclosed in a glass case, is shown on another page of this issue.

Those who did not get a copy of the October WIRELESS MAGAZINE and who now want one are, we fear, doomed to disappointment, unless they can borrow a copy from a friend. In spite of the fact that we printed a large extra supply the magazine was almost sold out all over the country and now there are very few copies available.

Limited Number of Copies

We can, however, supply a limited number of copies containing all the constructional details and a full-size blueprint for 1s. 3d., post free. Early application is necessary, and inquiries should be addressed to the Publisher, WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4.

It is too early yet (that is at the time of going to press early in October with these pages) for us to have received reports on the Inceptor 3 from readers, but we publish here the results of an independent test carried out by J. Godchaux Abrahams, the well-known broadcasting authority.

Unfortunately, Mr. Abrahams was unable to undertake a test in time for publication in the previous issue as he was in Germany for some weeks studying broadcasting conditions there.

Time for Short Test Only

Even now that the Radio Exhibition is over there are only a few days

The Inceptor 3 Is The World's Most Up-to-date Set

for Mr. Abrahams to make his test and it is necessarily a brief one. We can promise readers the results of a prolonged and independent test in these pages next month, however.

In the meantime readers have our assurance that the Inceptor 3 is really worth building, and that it will do all that we have claimed for it.

Pentode Difficulties

Some difficulty has arisen over the fact that pentode power valves are scarce, but that is a state of affairs for which we cannot hold ourselves responsible.

The valves are complicated to make and up to the present manufacturers have been able to turn out only comparatively small quantities; we understand, however, that more and more plant is being "earmarked" for pentodes, and the temporary shortage should soon be relieved.

Those who are unable to get pentodes, however, should not let that fact stop them from building the Inceptor 3—it will give excellent service if an ordinary three-electrode power valve is used in the last stage.

Using An Ordinary Power Valve

The volume will not be as great, of course, as it is if a pentode is used, but the set will still be remarkably good and quite powerful enough for most purposes. If a three-electrode power valve is used choose one with an impedance of about 3,500 ohms. A complete list of valves will be found on pages 292 and 293.

TEST REPORT ON THE INCEPTOR 3

THE Radio Exhibition at Olympia was the cause of my receiving the Inceptor 3 but one day before going to press; although I had clamoured for a three-day test, the receiver could not be withdrawn from the WIRELESS MAGAZINE *stand; it was one of the centres of attraction.*

And it fully deserved it. I rushed it home to my wireless den, and within an hour or so put it through its paces. In every way, it behaved as a five-valver should, and I was greatly pleased with the results obtained.

Mark you, for my test on the middle broadcasting band I possessed only No. 60 tapped coils, and this somewhat restricted the test, for with lower coils I have no doubt I could have worked down successfully to 200 metres or so.

Tuning was exceedingly sharp and I experienced no difficulty in receiving the stations detailed in the log herewith direct on the loud-speaker.

With more time at my disposal I believe I could have ganged the condensers to work perfectly together; as it was the difference between the two readings was not a great one.

For my test, I went all out for foreign stations which are not so frequently received, and pulled in with great ease Milan, Munich, Buda-Pest, Gothenberg, and Kattowitz; on the long waveband, Warsaw, Lahti, Motala, and Scheveningen-Haven came in at much greater strength than I usually get them on a seven-valve super-het.

The Inceptor 3 is an excellent proposition; it gives selectivity and full volume.

In its simple form, the Inceptor 3 represents long-distance reception within the reach of all.

J. GODCHAUX ABRAHAMS.

LOWER WAVEBAND
Coils used as specified.

Wavelength.	*Station.*	*Aerial.*	*Anode.*
416	Gothenberg	106	108
422.5	Kattowitz	110	112
428	Frankfurt	112	114
444.1	Brunn	116	120
449	Rome	118	122
470	Langenberg	124	126
491.8	Daventry (5GB)	132	136
508	Brussels	136	140
517	Vienna	140	145
535	Munich	148	152
544	Milan	150	153
555.5	Buda-Pest	155	154

UPPER WAVEBAND
Coils used: No. 200 for aerial and No. 200 for anode (both centre tapped). Reaction, No. 60.

Wavelength.	*Station.*	*Aerial.*	*Anode.*
1,070	Hilversum	60	65
1,111.1	Warsaw	62	73
1,153.8	Kalundborg	65	76
1,250	Berlin (Königswusterhausen)	86	88
1,363	Motala	94	98
1,522	Lahti (Finland)	104	110
1,604	Daventry (5XX)	115	120
1,765	Radio Paris	122	128
1,950	Scheveningen-Haven	160	155

Tested on October 1, 1928, for a period of three hours only.

Those who have already built the Inceptor 3 will be interested in trying a slight modification which only means changing two flexible leads. The alteration is to the anode-coil connections and is as follows:

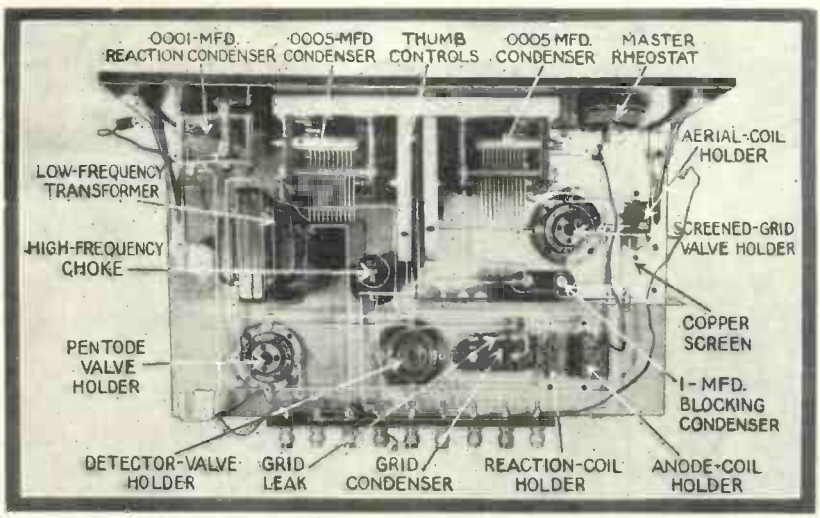
Instead of connecting the lead from H.T.+2 to the centre-tap on the anode coil it is connected to the end of the coil remote from the anode, while the anode of the valve is connected to the centre-tap on the coil instead of to the end. The circuit diagram reproduced in these pages shows this alteration, which in many cases gives improved results.

In the actual set the alteration is made as follows (consult the blueprint for numbers):

Connect the flexible lead (No. 26) from the anode of the screened-grid valve to the centre-tap of the anode coil, *instead* of to the coil holder. Connect the flexible lead (No. 33) from H.T.+2 to the "socket" terminal (not the "plug" terminal) of the anode-coil holder, *instead* of to the centre-tap of the anode coil.

Experience seems to show that the characteristics of screened-grid valves are at present liable to variation and in cases where self-oscillation is experienced constructors should apply the remedy (suggested last month) of taking the aerial tap straight to the tap on the aerial coil through the side of the cabinet and removing the flexible lead attached to the aerial terminal on the strip at the back of the set.

Where the listener is so close to a local station that the Inceptor 3 seems unselective because of its great power even on a short indoor aerial, try using a double-tapped coil in the aerial circuit, instead of only a centre-tapped coil. The degree of selectivity will thus be increased slightly.



This plan view clearly shows the arrangement of all the parts in the Inceptor 3

It Comprises Screened-grid H.F. Valve, Detector and Pentode

Wireless Magazine, November 1928

Savoy Hill Officials Explain for "Wireless Magazine" Readers

The New Telephoty Transmissions

All About the B.B.C.'s Experimental Picture Broadcasting Service

IN case listeners who have been on tiptoes with anxiety or expectation over the question of picture reception by wireless should think that this latest development is being held up by the broadcasting authorities, let it be clearly understood that no one is watching events more closely than the B.B.C. itself and that any invention which is of proved value and for which a sufficient demand exists in connection with the broadcasting service will always receive full consideration at Savoy Hill.

Marvel of Science

Wireless, the marvel of science, is still so much in its infancy that it were foolish to imagine that, having reached the present stage of efficiency, no further territory remains to be explored.

The speech and music which are being received in millions of homes tonight are merely symbolic and transitory. Even when the mystifying capabilities of the ether are brought still further under control and the efforts of great brains materialise into the inclusion of pictorial representations flashed through space to the listener's fireside, we shall still be wandering within the realm of the symbolic and transitory.

Still More Wonderful

Something still more wonderful may be found outside that realm. As one of the great thinkers of our time has put it, a means may be discovered to ally thought with ether direct and to broadcast and communicate thought without the intervention of the senses or any mechanical device in the same manner as a receiving set is to-day tuned to the wavelength of a transmitter so that there may be a free passage between them.

Having this possibility in mind, the B.B.C. regards picture transmission as nothing more than yet another transition stage along the pathway of advancement. But when will that transition stage definitely be reached? Is it to be taken that the tests which have been made by the B.B.C. engineers in connection with "still" pictures mark its advent? Again, what are these tests?

They have generally been regarded as telephotographic tests; but the meaning of telephotography is now accepted, mainly, as photography with a camera fitted with a long-distance lens, like a telescope, to provide a close-up view of a scene which for some reason or other the photographer cannot approach closely.

Telephoty—What it Means

Phototelegraphy, on the other hand, is interpreted as meaning the transmission of photographs by means of telegraph lines. It is, perhaps more correct to describe the picture broadcasting tests as telephoty (compare telephony), meaning the transmission of pictures by electric current.

Having arrived at a definition of what the tests were concerned with, let us study the attitude of those responsible for their performance. As in the case of the exhaustive experiments with contrasted programmes from the Daventry experimental station, which have been going on for fifteen months past and are even yet uncompleted, the B.B.C. has adopted the policy of *festina lente*, preferring to await actualities rather than to indulge in promises that have their roots in over-zealousness.

When any change or innovation is contemplated, it is always necessary to experiment widely both from the engineering and the programme points of view to ensure that the decisions as regards service are taken with full knowledge of the problems involved.

Hence, it was that on the conclusion of a certain amount of preliminary technical experiment carried out in the first place between the B.B.C. research station at Clapham and the Oxford Street transmitter during the early summer, the Corporation decided after several months to widen the scope of the experiment by arranging for a very short picture transmission daily from Daventry (5XX) outside regular programme hours.

Regular Programmes

If, and when it is discovered that there is a sufficient public demand for "still" pictures radiated in this way, similar transmissions may be included in regular programme hours; but it will be in the light of the interest shown by listeners themselves that any development of this nature will be considered.

Various systems of picture broadcasting have received consideration during the past two years, one which was regarded as holding out a certain promise being a transmission which took the form of a ray of light scanning a photograph rolled round a drum, the varying electric current being received by a stylus passing over a roll of sensitised paper.

Picture Immediately Visible

In this case, on completion of the reception, the paper had to be detached from its cylinder and developed and fixed after the manner of an ordinary photograph. This system resembled most nearly that which the B.B.C. finally decided to adopt for its experiment, but the accepted system has the advantage that the picture as received is immediately visible to the eye, although it is little more permanent

than a photographic proof, which dissolves on exposure to light.

Storing in a Dark Place

It is necessary, therefore, that recipients who wish to retain any illustrations should store them in a dark place. The pictures produced on the receiving machine measure 5 in. by 4 in. and are transmitted in three minutes. The receiver has the appearance of a small dictaphone or phonograph, except that the cylinder round which the sensitised paper is wrapped is of brass.

As the cylinder revolves, a platinum needle travels over the paper, making a brown dot whenever electric current is flowing and making no mark at all when the current is broken. Like broadcast listening, however, successful reception is likely to be marred by atmospherics at times.

If sufficiently powerful apparatus is used, it should be possible for owners of the apparatus to tune-in to Vienna and other Continental stations which are using or are about to use a similar device to that with which the B.B.C. is experimenting. Distances of upwards of 850 miles have already been covered, one of the earliest long-distance transmissions being a photograph of the Prince of Wales, which was sent out from Vienna and received in London.

In what way can picture transmission of this character be of value to the broadcasting service? It must be remembered that telephoty can take place both by day and by night. This permits the broadcasting of weather charts, or photographs of missing persons for whom S O S messages are broadcast at any time of the day during transmission hours. Photographs of artists and speakers can also be given prior to their broadcasts, as well as illustrations of scenes from radio plays which listeners are to hear.

Of greater utility, perhaps, are pictures and diagrams to illustrate broadcast talks on fashions, while children's stories could also be elaborated pictorially. Photographs of topical events, such as the opening by the King of some great national museum, or scenes from the Derby, could also be transmitted. These ideas will all be considered as the necessity arises.

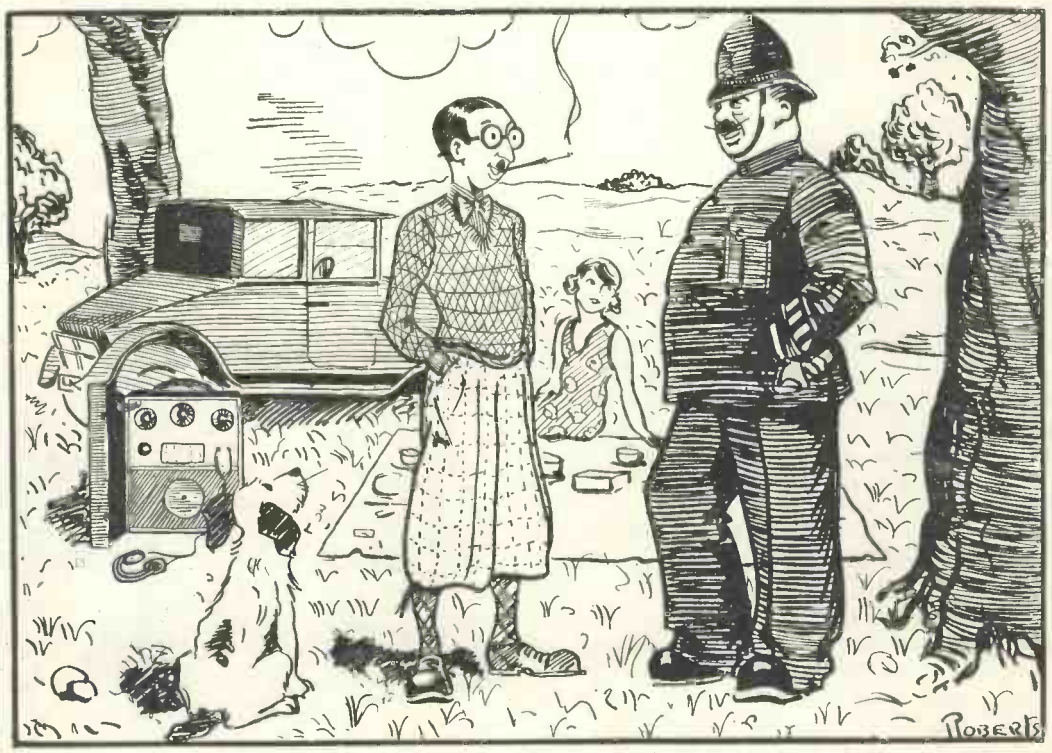
The system used for the present experiments is in the nature of telephoty, that is, the broadcasting of photographs, drawings, or diagrams, in contradistinction to television, or instantaneous motion pictures.

Possible Television Developments

As regards the latter, in which rumour has stated that the B.B.C. is on the eve of playing an important part, at the time of writing no apparatus had been placed before the Corporation of so practical a nature as to make a service possible to the listener.

But here again, the B.B.C. is watching developments closely; and when the inventive genius of some master-mind has produced results which will guarantee a service that will benefit listeners, the officials at Savoy Hill are prepared, subject to the approval of the Postmaster-General, to lend their co-operation.

In This Age of Red Tape!



Policeman: "Now then, I want to see your licence!"
Picnicker: "Certainly! Gun, car, marriage or wireless?"

Gang Control in the Symphonic Four

By J. H. REYNER, B.Sc., A.M.I.E.E.

GANG-CONTROL methods have suffered a temporary eclipse in recent times, although the reason for this is somewhat obscure. Probably the introduction of new types of circuit, particularly those associated with the screened-grid valve, have been occupying the attention of designers to the exclusion of the development of the ultimate simplicity obtainable by single-control tuning.

FIGURES FOR TEST ON GANGING

TABLE I

Dials set at 100°. Balancing condenser adjusted to tune correctly.

Wave-length.	*Condenser No. 1.*	*Condenser No. 2.*
279	0	1
285	20	20.5
300	40	40
320	60	59.5
350	80	80
380	100	100
420	120	120.5
470	140	139.5
522	160	159.5
575	180	179.5

It is a fact, however, that gang-control circuits with only one stage of high-frequency amplification have not been successful in the past. Where two stages of H.F. are available there is a sufficient reserve of amplification to overcome the gradual falling out of step of the tuning condensers at the ends of the scale.

Falling off in Efficiency

Even so, under some conditions the mistuning at the ends of the scale is so marked that the receiver falls off in efficiency.

Clearly, therefore, where a smaller number of tuned circuits is employed, a more efficient system of ganging must be adopted, and an investigation of the matter showed that the old system of adjusting each condenser independently and the locking the various spindles to a common operating mechanism is, at the best, a compromise and cannot be scientifically accurate.

Consider the circuit shown in skeleton form in Fig. 1. Here we have an arrangement showing two high-frequency stages and a detector. This arrangement would be followed by any suitable low-frequency amplification desired.

Each tuned circuit consists of an inductance, a tuning condenser, and an associated fixed capacity due to external sources. This is where the difficulty comes in, for the stray capacities are different in the three circuits and the discrepancies are, in many cases, quite marked.

Consider the Aerial Circuit

Let us consider the aerial circuit first of all. It is necessary to couple the aerial to the first tuned circuit in some manner. Usually this is accomplished by employing a separate aerial coil more or less tightly coupled to the secondary, or by tapping the aerial circuit across a small portion of the secondary coil. The second method is practically equivalent to the first, although not exactly so owing to capacity coupling between the primary and secondary windings, where a separately coupled aerial coil is employed.

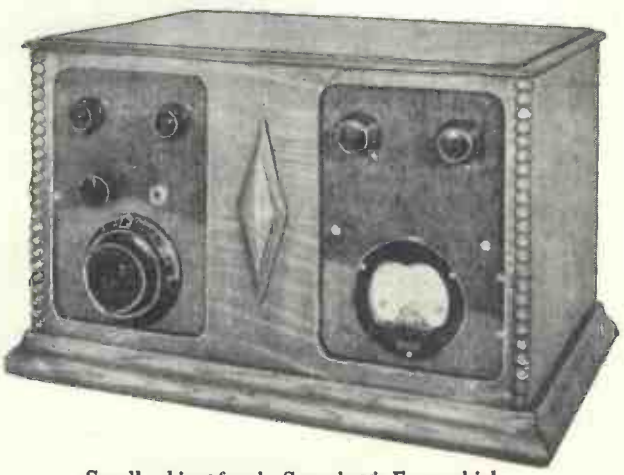
The net effect upon the circuit of connecting the aerial in this manner is somewhat complex because the aerial is a system embodying both inductance and capacity and the tuning of the secondary circuit actually tunes the aerial circuit as well.

Provided the aerial is being operated at a wavelength well above its natural wavelength, however, we can consider, for simplicity, that the aerial acts as an equivalent capacity tapped across part of the circuit.

Equivalent Capacity

The equivalent capacity across the whole circuit is $1/t2$ times the actual effective aerial capacity where t is the step-up ratio of the aerial transformer or in other words, the ratio of the number of turns on the full coil to the number of turns on the tapped portion.

Now let us suppose that the inductances in the various circuits are all equal. In order to tune them to a given wavelength we shall require a given value of capacity in each case; if there were no stray capacities in the circuit, and if we had three identical condensers and varied them together the circuits would remain tuned to identical wavelengths throughout the whole



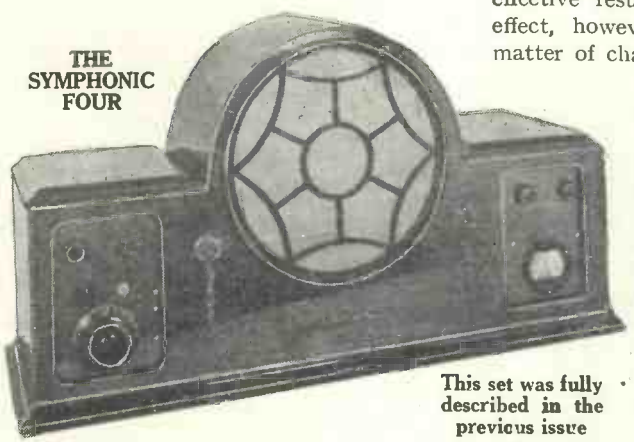
Small cabinet for the Symphonic Four, which was fully described in the previous issue

of the scales of the condensers.

The presence of the aerial capacity across the first circuit, however, throws this balance out, for the effective tuning capacity in the first circuit is now that of the tuning condenser plus the equivalent capacity introduced by the aerial. Thus in order to tune the first circuit, we must reduce the capacity of the variable condenser until the total capacity is equal to the capacity of the other two condensers.

Not A Feasible Solution

This arrangement is satisfactory for one wavelength, but clearly cannot be correct for other wavelengths unless we are using a circular-plate type of condenser which follows a straight-line capacity law. Then if we have to rotate the first condenser 5 degrees in order to decrease the capacity by the required amount, the capacity at every other part of the scale will be less than the other two condensers by exactly the same capacity, which is what is required. For other reasons we do not use circular plate condensers to-day, so that this method is not a feasible solution.



THE SYMPHONIC FOUR

This set was fully described in the previous issue

Stray Capacities

Not only have we this capacity effect across the aerial circuit, however, but we have also stray capacities across the other circuits. The self-capacity between the primary and secondary windings of the transformers can be represented as an equivalent capacity across the secondary circuit.

There is in addition the effective grid to filament capacity.

This depends not only upon the geometric capacity of the valve but also upon the actual amplification of the valve under its working conditions.*

The input capacities of the two H.F. valves are probably of the same order, but in the case of the detector valve the value is usually different, resulting in further discrepancies in the tuning characteristics.

In some cases, the various capacities in the circuit are of such an order that they, more or less, balance each other out and the tuning condensers may be linked up together with effective results. Any such effect, however, is rather a matter of chance, and deviations from the layout suggested or alterations in the components used will have a serious effect on the results and may make all the difference between good and bad reception.

The most satisfactory and scientific solution of the difficulty is to match the capacities in the circuit by external means and this is the principle adopted in the matched-reactance system employed in the Symphonic Four. The skeleton circuit of the arrangement is shown in Fig. 2 and will be seen to be simple in character.

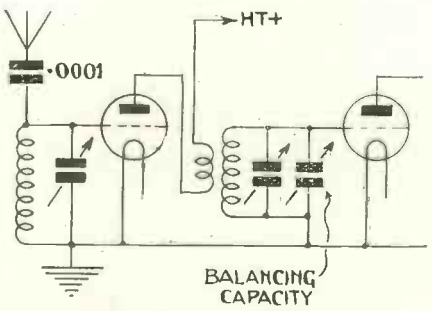


Fig. 2.—Matched-reactance ganging used in the Symphonic Four

The aerial is not coupled in the usual manner but is connected straight to the grid of the first circuit through a .0001-microfarad fixed condenser. This is a method which has been found very successful when used with Q coils and it has several advantages over the more usual methods.

Double-hump Effect Obviated

The principal advantage is that the double-hump effect obtained with the tapped or coupled aerial system is obviated and the tuning characteristic of the circuit is much more uniform over the wavelength scale. There are no flat spots such as are often experienced with the more usual methods.

The effect of coupling the aerial in this manner is to add a definite parallel capacity across the tuned circuit of the order of 70 or 80 micro-microfarads. Across the secondary of the H.F. transformer we have the effective valve capacity, which is slightly greater than that across the first valve, and we have the capacity introduced by the primary winding, the magnitude of which varies with different types of transformer.

Extra Capacity Needed

In general the effective extra detector capacity is probably of the order of 30 or 40 micro-microfarads, necessitating an additional capacity of 40 to 50 micro-microfarads in order to make the circuit similar to the aerial circuit.

If this capacity is added, therefore, the two arrangements are identical and provided that the coils have the same inductances, the setting of the tuning condensers will remain identical over the full scale.

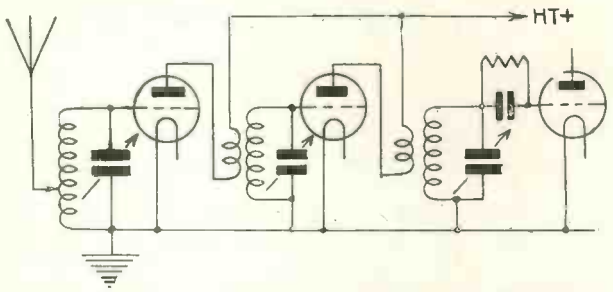


Fig. 1.—Skeleton circuit with two stages of high-frequency amplification and a detector, which can be followed by any low-frequency combination desired

*Actually $C_{ff} = C_{gf} + (\mu+1)\,C_{ga}$
where C_{gf} = capacity between grid and filament.
C_{ga} = capacity between grid and anode.
μ = *actual* amplification factor of valve under particular conditions.

Gang Control in the Symphonic Four *(Continued)*

Practical tests indicate that this is actually the case and that if the two condensers are set to read the same at one point of the scale and the detector circuit is then tuned with the balancing capacity provided, so that the reactances of the circuits are made identical, then the two dials will rotate step by step over the whole scale, the readings being identical.

Results of A Test

The table which is given on page 318 shows the results of a test made with two similar condensers which had been used to tune circuits which had been matched in this manner. It will be seen that the dial readings are absolutely identical, indicating that the ganging is of the highest possible order.

So accurate, indeed, is the ganging that it is possible to employ a dual condenser instead of the usual two-gang condenser. This means a saving both in space and price; the efficiency of the arrangement is proved by the test report of the Symphonic Four, which surprised me at the time when it was taken.

I have no doubt that readers who build the receiver will be able to obtain an even better performance than that given.

I feel that the method will revive interest in gang-controlled circuits, for it can be applied to any number of stages with the same accuracy so that it is not necessary to lose any efficiency whatever in obtaining the simplicity of the single control.

Regarding the actual receiver, complete operating instructions were given in last month's issue, and the simplicity of operation is such that there is no need to add to this portion of the description. Some comments on the accessories, however, may be made.

Choosing A Loud-speaker

The particular type of horn loud-speaker may be replaced, if desired, by any other good type of loud-speaker, although this should be of such a character as to reproduce the high and low notes in a satisfactory degree as otherwise the good qualities of the amplifier will be lost.

The Celestion loud-speaker is a favourite with many readers and we have been able to make arrangements for these loud-speakers to be available in a skeleton form for this receiver. The model employed is the standard C12 type which is provided mounted on a thin board of ply-wood.

The whole of the mechanism is mounted on this board, but in order to protect the diaphragm, the apparatus is boxed in at the back. As this is square in shape, it will be necessary to make slight modifications in using it in the Symphonic Four. For this purpose, the plywood front should be unscrewed from the protecting case and the wood very carefully trimmed to be circular in shape. Great care must be taken in this operation not to damage the diaphragm.

The loud-speaker can then be mounted behind the grille in the domed portion of the cabinet when it will be found to give excellent results. Although the area at the back of the diaphragm inside the cabinet is large, there is a slight danger of box resonance and it may be found desirable to drill some large diameter holes in the back of the cabinet immediately behind the loud-speaker. These holes should be at least 2 in. in diameter and should be four to eight in number, allowing ample exit for the air.

At Radio Berne

The two lady announcers at the well-known Swiss broadcasting station

Another Loud-speaker

Another loud-speaker which will be of interest is the new Amplion Lion. This is a cone loud-speaker having a particular form of reed motion with which an even pull is obtained on all strengths of signal. This not only gives better reproduction, imparting more brilliance to the music, but it also assists in obtaining a better response to transient noises so that greater "attack" is obtained, more nearly in conformity with the original production.

I have not yet had an opportunity of testing one of these loud-speakers myself, but from a demonstration given by the Amplion Company, the instrument appears to have possibilities. It is understood that they market a type specially designed for incorporating in receivers. This has a 14 in. diaphragm. It would appear admirably suited to the present set, which will make the most of its good properties.

Make Enquiries

There is some doubt as to whether the movement can be housed satisfactorily inside the domed portion of the cabinet, which is 14 in. in diameter. At the time of going to press, I have not been able to obtain a skeleton model in order to satisfy myself on this point, but if any reader wishes to use this type of loud-speaker he can make enquiries for himself.

It is quite a simple matter to increase the size of the dome portion slightly in order to allow for the 14 in. cone should this be found necessary.

New Headquarters for the B.B.C.

So involved have the activities of the B.B.C. become during recent months, that the Corporation has outgrown its present headquarters at Savoy Hill. At present the authorities are on the look-out for a site suitable for the erection of a new building. It is understood that arrangements are going through for a site in Langham Place, at the top of Regent Street.

The Chummy Four!

This receiver was fully described in the June issue of the WIRELESS MAGAZINE.

View of the station and laboratories where the transmitter ANE is housed, at Bandung, Java (Dutch East Indies)

GREAT RELAY SUCCESSES

Prof. G. Baumgartner, of the University of Munich, who succeeded in successfully relaying the station Bandung, ANE

MUNICH RELAYS BANDUNG (JAVA) AND MELBOURNE (AUSTRALIA)

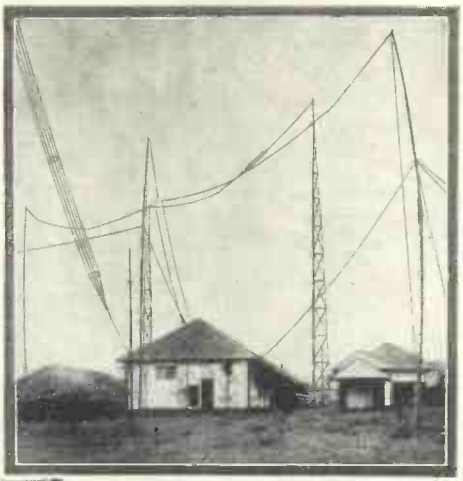
An Interview with Prof. Baumgartner, Chief of the Technical Department of the German Reichstelegraph and Scientific Manager of the Bavarian Broadcasting Stations

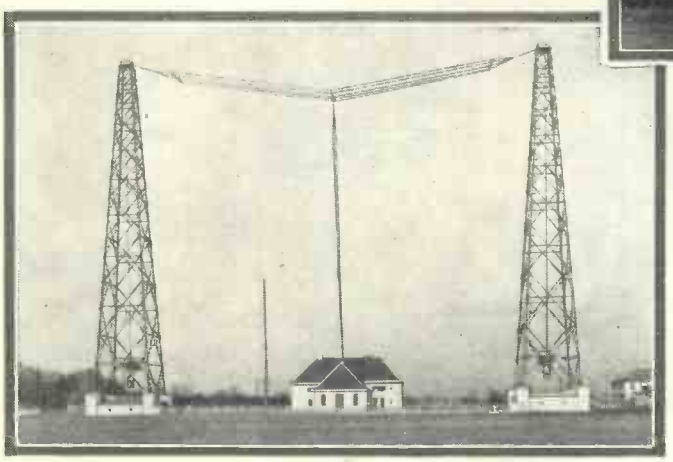
FOR some time already—as our readers may know—the well-known Professor G. Baumgartner, Chief of the Technical Department of the German Reichstelegraph and Scientific Manager of the Bavarian Broadcasting Stations, has been experimenting in relaying broadcast stations situated a great distance from Munich.

Great Relay from Munich

Early in the year Prof. Baumgartner succeeded in successfully relaying the station Bandung ANE (Java) on the Munich transmitter. The distance Bandung-Munich amounts to 7,500 miles—and the relay was a complete success!

Many Dutch people with relations in their colonies were that night wondering at the familiar sound of their own language transmitted by a foreign station but soon the mystery was solved when the German speaker announced: "Achtung! Hier Müchen! We are relaying the Java station Bandung ANE; distance: 7,500 miles—Achtung!"





Two views of the aerial masts and station ANE buildings at Bandung

Another Great Relay

A little later, Prof. Baumgartner succeeded in relaying the station Melbourne—still farther away, as the distance between Melbourne and Munich amounts to 11,125 miles. This is nearly the greatest distance over which a station can be relayed as it is about the distance separating us from our antipodes. The clearness of these relays was simply wonderful.

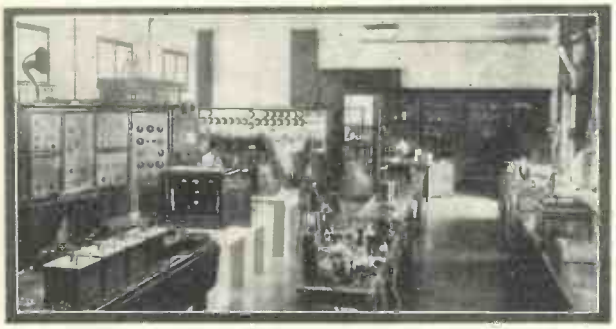
Very small indeed were the "aids and appliances" by means of which Prof. Baumgartner succeeded in receiving the Javanese and Australian stations. The receiver consisted of a simple apparatus with a detector and one stage of L.F. amplification. The following interesting details can be given about the circuit used by the Professor.

Receiving Apparatus

The receiver is an audion apparatus aperiodically coupled with the aerial with one single L.F. amplifying stage. The apparatus was built in the

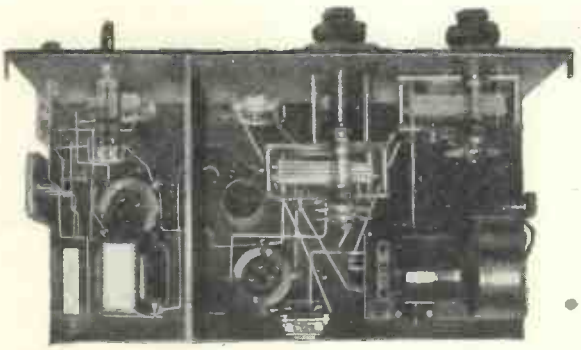
experimental department of the Telegraphentechnisches Reichsamt at Munich. The whole of the parts of the receiving set are built in a case (see photograph) that is lined with strips of tinfoil a small distance apart, to shield it.

According to Prof. Baumgartner this purpose was gained completely. The intervening space shown on the photograph is used to make possible a coupling between the wavemeter and the tuning coils.



Transmitting room and laboratory of station ANE at Bandung

The aerial used by Prof. Baumgartner consisted of one wire some 100 ft. long stretched high above a street. After a series of tests, however, it appeared that a simple aerial suspended in a room sufficed in securing him a fairly good reception.



Plan view of the receiver used by Prof. Baumgartner for relaying the Melbourne short-wave station

The music produced by the short-wave receiver was led from the reception room to a couple of ante-amplifiers by means of a special cable, and here music and speech from Bandung and Melbourne were worked up to a sufficient energy to have them led to the transmitters at Munich, Nürnberg, and Augsburg by special cables.

Keeping Listeners on the Track

So as to avoid the listeners getting off the track, Prof. Baumgartner had announced at regular intervals that Munich was relaying Bandung and Melbourne respectively. In order to enable him to do so a Reisz microphone was switched on to the lead going to the ante-amplifiers. The quality of the music relayed was controlled by comparing it with the music from the short-wave receiver.

Prof. Baumgartner informs us that he is going to continue conducting experiments and we are convinced that many a time to come we shall be able to enjoy good music from far away stations relayed by Munich.

Timing Cars with Selenium

YET another use has been found for the light-sensitive metal selenium. At the famous Arpajon motor speed trials held in France recently, a most accurate means of timing the cars, in which the selenium cell was used, was tried for the first time, and worked most successfully.

The timing apparatus itself was arranged at the winning post, where a spot-light at one side of the course was directed on a small selenium cell at the other side. Each car automatically set "the works" in operation by breaking a thread stretched across the road near the post. This closed contacts which switched on the spot light and allowed a small current to flow through the cell.

As the car crossed the line the spot-light beam was interrupted for a fraction of a second, causing a variation in the current passing through the selenium. This variation actuated sensitive relays, and finally the output was applied to an inker, which printed on a strip of paper a stroke indicating the time of the winning car.

A. FRERE.

GENERAL CALL-SIGNS

MOST listeners who can "read" morse are familiar with the general call to all stations, consisting of the letters CQ, which is used in wireless telegraphy when sending messages or inquiries intended for general reception.

Apart from this, however, there are other general call-signals which are more limited in their application, being used in the case of messages concerning all stations of a particular class. For instance, there is BXA, the general call-signal denoting any British Naval coast station, and BXZ, which applies to British warships. GEZ is used as a general call to any British Royal Air Force ground station or civil aviation aerodrome transmitter, and GEZAA to any aircraft belonging to the R.A.F.

The general call-signal used to summon any or all of the French aerodrome stations keeping watch on the 900-metre or 1,400-metre wavelength is FNZ, while FOZ denotes les aeronefs francais, *and is used as a general call to the French commercial aircraft working on 900 metres. FXA, the general call for* aeronefs de la Marine de Guerre, *applies to any of the French Naval aircraft, and FBMC to ships of the French Navy.*

The letters DEUT (presumably suggested by the beginning of the word "Deutschland") are used as a general call to German ship stations, and KCQD for Latvian ships.

The general call applying to aircraft of the Dutch Royal Navy is PBP, and this is followed when necessary by the letter and number of any individual machine. PCF applies to any, or all, of the Dutch Naval aerodromes, and may be followed by a name or number indicating any particular aerodrome. PBQ denotes Dutch auxiliary ships, PAX Naval mine-sweepers, PBK and PBO denote Onderzeebooten (*"under-sea boats" or submarines*), *and PAG and PBA the Dutch torpedo-boats.*

A number of general call-signals are in use in the U.S.A., among them NQO, denoting Naval coast stations, NOB, United States warships, WTM, commercial stations, WKW, merchant vessels, and WWLH, any station under the Bureau of Lighthouses.

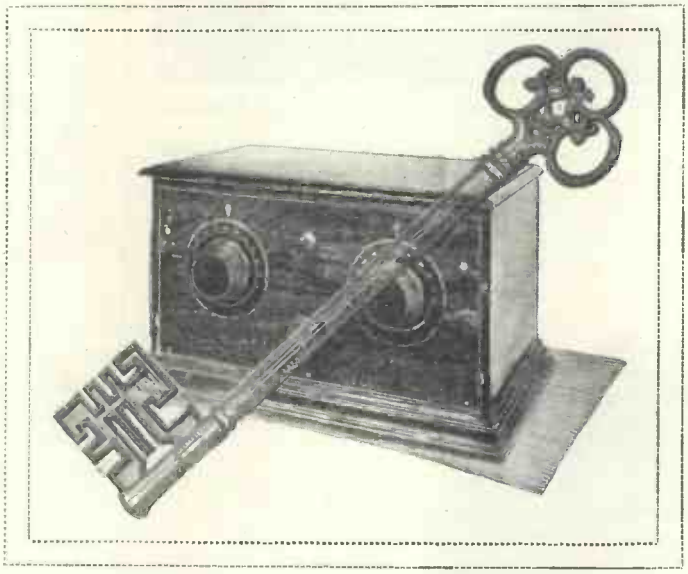
W. O.

Not only is this receiver simple to assemble, but it is the most powerful two-valver it is possible to build and will receive on either the ultra-short or broadcast wavelengths. Anybody can assemble it completely in an hour or two and the cost is very reasonable. It is a two-valver that will receive on practically any wavelength with three-valve results

The Key-to-the-Ether Two

COMPRISES DETECTOR TRANSFORMER-COUPLED TO PENTODE OR THREE-ELECTRODE POWER VALVE

SPECIALLY DESIGNED, BUILT AND TESTED BY THE "WIRELESS MAGAZINE" TECHNICAL STAFF

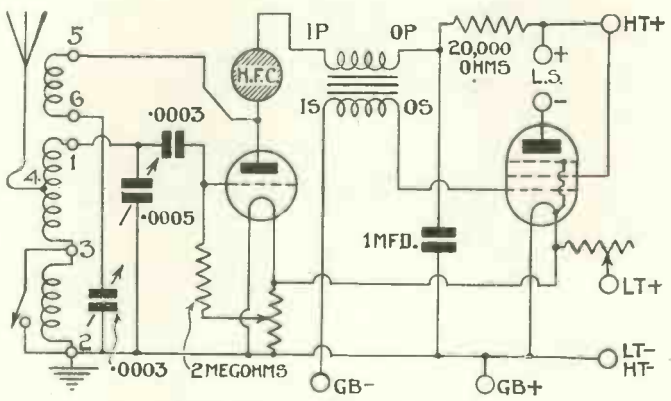


ANY receiver that is called a "key to the ether" ought obviously to be something special, and readers will be quite right in concluding that the two-valver to be described in these pages is above the average. In fact, it will be no exaggeration to say that it is the best and most useful design that can be obtained with modern apparatus utilising two valves.

How the Set Gives Three-valve Results

The combination used is a grid-leak detector transformer coupled to a low-frequency amplifier. Now the latter can be one of the new pentode power valves or an ordinary three-electrode valve. The former costs 22s. 6d., as against 15s., but on the other hand the pentode will give practically three-valve results. Every constructor is recommended to use a pentode in this set, for by so doing he is obtaining what is practically a three-valver at an extra cost of only 7s. 6d. Moreover, this set is easier to build.

We believe, however, that the demand for pentodes will be so great that readers may experience difficulty in obtaining them at short notice, and where delay occurs we recommend that the set should be used with an ordinary three-electrode valve.



Circuit of the Key-to-the-ether Two

So much for brief considerations of range and volume. Let us now consider another important point about the Key-to-the-ether Two—the feature that really justifies its name. By means of an ingenious combination of two tuners it is possible to cover practically every wavelength, from the shortest to the longest broadcast wave.

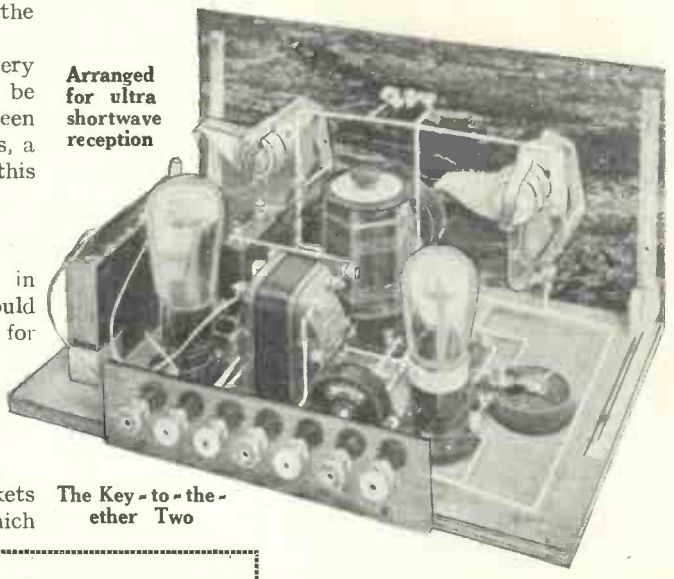
For covering the lower and upper broadcast wavelengths, that is from approximately 250 to 550 and 1,000 to 2,000 metres, use has been made of a new double-range tuner controlled by a single push-pull switch. The tuner is mounted in a standard six-pin base and is removed when it is desired to receive on the ultra-short waves. For reception on this band, one of two six-pin short-wave coils is used; these are particularly efficient, because they are wound with copper strip instead of ordinary wire.

America!

It will thus be realised that the Key-to-the-ether Two is, when used with a pentode, as powerful a set as it is possible to obtain with the number of valves (it has the range and volume of an average three-valver) and will receive a very large number of stations by virtue of its unlimited wavelength band. With this set it should be possible any night to receive two or three American

short-wave transmissions; for further information see the test report reproduced on this page.

Not only is this set of great utility, but it is really very simple to construct, and the whole assembly can be completed in an hour or two once all the parts have been obtained. As with all WIRELESS MAGAZINE receivers, a full-size blueprint is available; further details of this will be given later in the article.



Arranged for ultra shortwave reception

The Key-to-the-ether Two

Following-out the Actual Circuit

Technically minded readers will be interested in following out the circuit in detail and for this they should refer to page 324. As shown here, the tuner is that for reception on the broadcast waves, that is above 200 metres. The numbers refer, of course, to the contacts on the six-pin base.

The tuner arrangement is as follows: The low-wave coil is connected between sockets Nos. 1 and 3, and the aerial is tapped on to No. 4. Between sockets Nos. 2 and 3 is connected the long-wave winding, which is short-circuited for reception on the lower range by means of an ordinary push-pull switch mounted on the panel.

The same reaction winding is used for both wavelength bands and this is connected between sockets Nos. 5 and 6. The degree of feed-back or oscillation is controlled by a .0003-microfarad condenser connected between socket No. 6 and earth. The aerial coil itself is tuned by a .0005-microfarad variable condenser.

Most Sensitive Method

Leaky-grid rectification is employed as this is the most sensitive method for a circuit of this type. The grid condenser is .0003 microfarad, and the leak 2 megohms. An interesting point is that one end of the grid leak is taken to the slider of a potentiometer connected across the low-tension supply. This enables the bias on the grid of the detector to be controlled within fine limits, and is of particular value when receiving on the ultra-short waves, as the reaction can be arranged without any trace of "plopping" or overlap.

TEST REPORT OF THE KEY-TO-THE-ETHER TWO

LONG-WAVE STATIONS

Station.	*Wavelength.*	*Aerial Condenser.*
Croydon	900	22°
Hilversum	1,069	33°
Kalundborg	1,153	38°
Lahti	1,525	66°
5XX	1,604	70°
Kharkov	1,700	75°
Radio Paris	1,750	80°
Schevenigen	1,950	93°

SHORT-WAVE STATIONS

Breslau	322.6	64°
Gleiwitz	329	66°
London	361.4	70°
Stuttgart	379.7	73°
Hamburg	394.7	76°
Langenberg	470	89°
Berlin	484.6	92°
5GB	491.8	94°
Brussels	508.5	96°

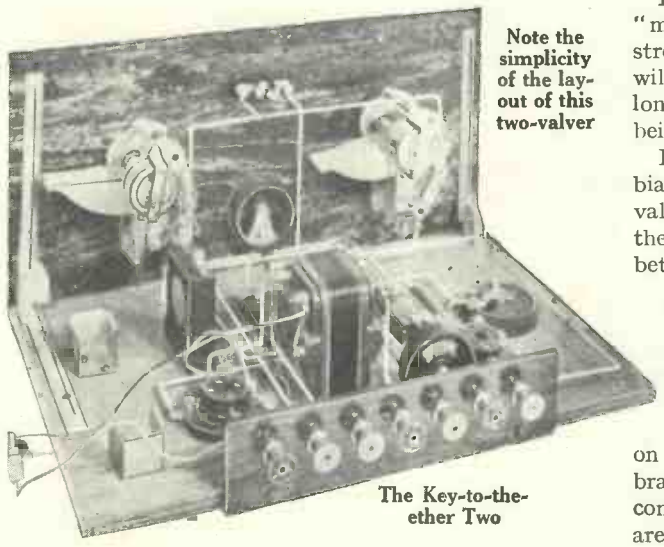
As is essential in all circuits with capacity-controlled reaction a high-frequency choke is included in the anode circuit of the detector, in series with the primary of the low-frequency transformer. This choke must be suitable for all wavelengths from 20 to 2,000 metres.

"Motor-boat" Stopper

Because so many amateurs now use mains supply units for their high tension and "motor-boating" is likely to occur in some cases, we have incorporated a simple stopper in the set; this takes the form of a 20,000-ohm resistance in series with the anode feed for the detector valve and a 1-microfarad condenser which acts as a by-pass to earth for any unwanted low-frequency oscillations that may be set up.

If the question of expense is of very great moment, this "motor-boat" stopper can be omitted. Readers are strongly recommended to retain it, however, because it will enable high-tension batteries to be kept in use much longer than they otherwise could be without nasty noises being heard.

Provision is, of course, made for applying negative bias to the grid of the pentode or three-electrode power valve. The use of appropriate grid bias greatly prolongs the life of a high-tension battery and results in far better quality of reproduction.



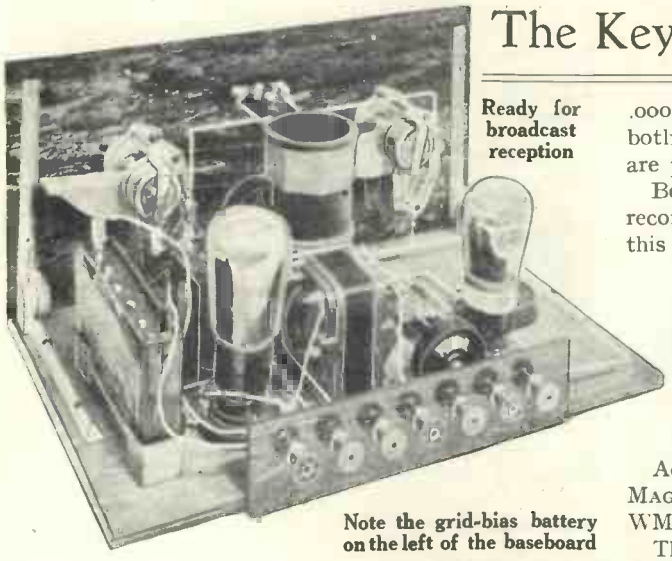
Note the simplicity of the lay-out of this two-valver

The Key-to-the-ether Two

Keep to the Recommended Components

As regards the components actually used, constructors are recommended to utilise as far as possible the same parts as were utilised in the original WIRELESS MAGAZINE receiver. A list of these parts appears on page 327 and the name that appears first in the brackets in each case is that of the manufacturer whose component was used in the original set. Alternatives are mentioned for the benefit of those who have

The Key-to-the-ether Two (Continued)



Ready for broadcast reception

Note the grid-bias battery on the left of the baseboard

difficulty in obtaining the original components.

It will be noticed that the tuner used for the broadcast range is the new Formo dual-range unit; this we have found quite satisfactory. Readers who build the set will notice the manufacturers recommend a reaction condenser of .0005-microfarad, but after prolonged tests we found a .0003-microfarad condenser large enough to give reaction over the entire wavelength range.

On the Short Waves

For reception on the ultra-short waveband, use is made of a six-pin short-wave coil, which is plugged into the base instead of the dual-range tuner. As has already been mentioned, these short-wave coils are wound with copper strip and are, therefore, exceptionally efficient.

As the Key-to-the-ether Two is intended for use with a pentode power valve, and these require less grid-bias than a super-power valve of the normal three-electrode type, a 9-volt grid-bias battery has been mounted on the baseboard of the receiver. Once the bias is correctly set it can be left for very long periods without any readjustment.

Tuning Condensers

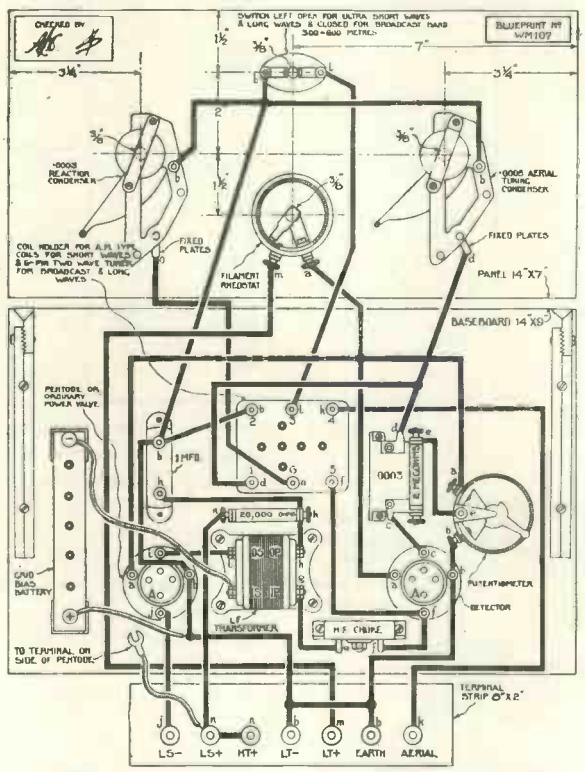
It should be noted that although the two variable tuning condensers, one for aerial tuning and the other for reaction control, look alike in the photographs, the former is .0005-microfarad, while the latter is only .0003-microfarad: the same size framework is used for both, but there are fewer plates in the latter and they are placed farther apart.

Before beginning the actual construction, readers are recommended to obtain a full-size blueprint. Although this is not absolutely essential (all the details are reproduced on a reduced scale in these pages) it does save a great deal of time and trouble. Copies of the blueprint can be obtained for half-price, that is 6d., post free, if application is made (accompanied by the coupon on page iii of the cover) by November 30.

Where to Send Your Application

Address your inquiry to Blueprint Dept., WIRELESS MAGAZINE, 58-61 Fetter Lane, E.C.4, and ask for No. WM107; your copy will be sent by return of post.

The first part of the construction is the drilling of the panel and the mounting of the necessary components thereon. These are few in number—in fact, there are only four: the two variable condensers, push-pull change-over switch, and filament rheostat.



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 November 30. Ask for No. WM107

As soon as these components have been fixed in position, join the panel to the baseboard by means of the brackets and lay out the rest of the components. No difficulty will be experienced if use is made of the photographs and blueprint or the reduced reproduction of the latter on this page. When everything has been fixed in position, wiring up can be started straight away, and here the blueprint will be found of especial value.

Lettered Points

It will be observed that each terminal point is marked with a small letter; these letters indicate which points should be connected together and in what order. For instance, all points marked with like letters are connected together with one wire or as few wires as possible. First connect all those points marked *a*; then all the points marked *b*; and so on, until the wiring is completed.

Before the set can be used, however, suitable valves must be obtained. For the detector, a valve with an impedance of 12,000 to 25,000 ohms will be suitable, with the particular transformer used in the original receiver. A complete list of valves appears on pages 292-293 of this issue and

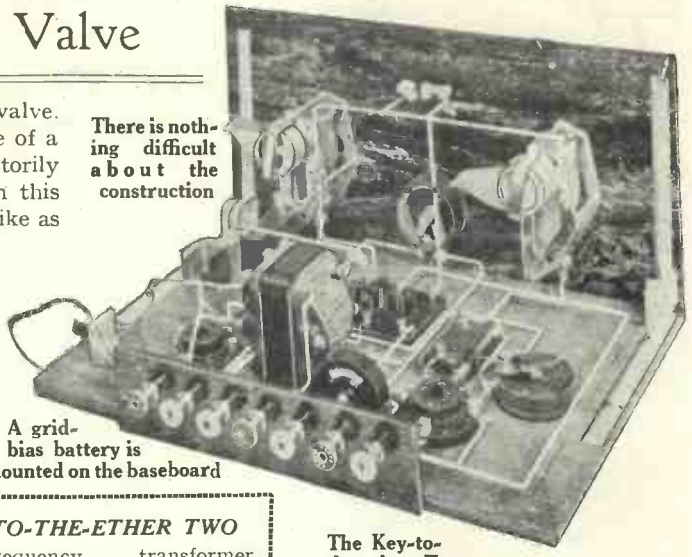
Uses a Pentode Power Valve

readers should refer to that for the choice of special valve.

Although the set has been designed for the use of a pentode in the last stage, it will work quite satisfactorily with an ordinary three-electrode power valve; in this case, of course, the volume will not be anything like as great.

Only Two-four-volters Available

Only two- and four-volt pentodes are available, and for details of these the reader is referred to the list of valves already mentioned. If an ordinary super-power valve is used it should have an impedance in the neighbourhood of 3,000 to 5,000 ohms.



There is nothing difficult about the construction

A grid-bias battery is mounted on the baseboard

The Key-to-the-ether Two

COMPONENTS REQUIRED FOR THE KEY-TO-THE-ETHER TWO

1—Ebonite panel, 14 in. by 7 in. (Becol, Parfait, or Trolite).
1—.0005-microfarad variable condenser with vernier control (Dubilier K.C., Jackson, or Gecophone).
1—.0003-microfarad variable condenser with vernier control (Dubilier K.C., Jackson, or Gecophone).
1—7-ohm panel rheostat (Gecophone, Lissen, or Igranic).
1—On-off switch (Lotus, Lissen, or Bulgin).
2—Dial indicators (Bulgin).
1—Six-pin coil base (Cason, Formo, or Lewcos).
1—.0003-microfarad fixed condenser (Graham-Farish, Lissen, or Dubilier).
1—2-megohm grid leak (Graham-Farish, Lissen, or Dubilier).
1—Baseboard potentiometer (Lissen or Igranic).
2—Anti-microphonic valve holders (Trix, Lotus, or W.B.).
1—High-frequency choke (Burndept, Lewcos, or Igranic).
1—Low-frequency transformer (B.T.H. 4 to 1; Lissen, or Igranic).
1—20,000-ohm resistance (Graham-Farish, Ediswan, or Loewe).
1—1-microfarad fixed condenser (Lissen, T.C.C., or Hydra).
1—Pair grid-bias battery clips (Bulgin).
1—Terminal strip, 8 in. by 2 in. (Becol, Parfait, or Trolite).
7—Terminals, marked: Aerial, Earth, L.T.+, L.T.—, H.T.+, L.S.+, L.S.— (Eastick).
1—Cabinet, with 9 in. baseboard (Caxton).
1—Pair panel brackets (Bulgin).
1—Dual-range tuner (Formo).
2—Short-wave coils (Lewcos AMS4, and AMS9).
4—2 ft. lengths wire (Glazite).
2 ft. Flex.
1—Spade tag.
2—Wander plugs, one red and one black, for grid bias (Lectro Linx).

To use the receiver on the broadcast bands, plug in the dual-range tuner and insert the valves in their respective holders, not forgetting to connect the flexible lead from L.S.+ to the extra terminal on the pentode if one of these valves is used.

Battery Connections

Connect up aerial, earth, and loud-speaker. Across the low-tension terminals apply an accumulator of the same voltage as the valves to be used, while to H.T.+ connect a battery of 120 volts. It will be noticed that no H.T.— terminal is provided, this connection being made to L.T.—.

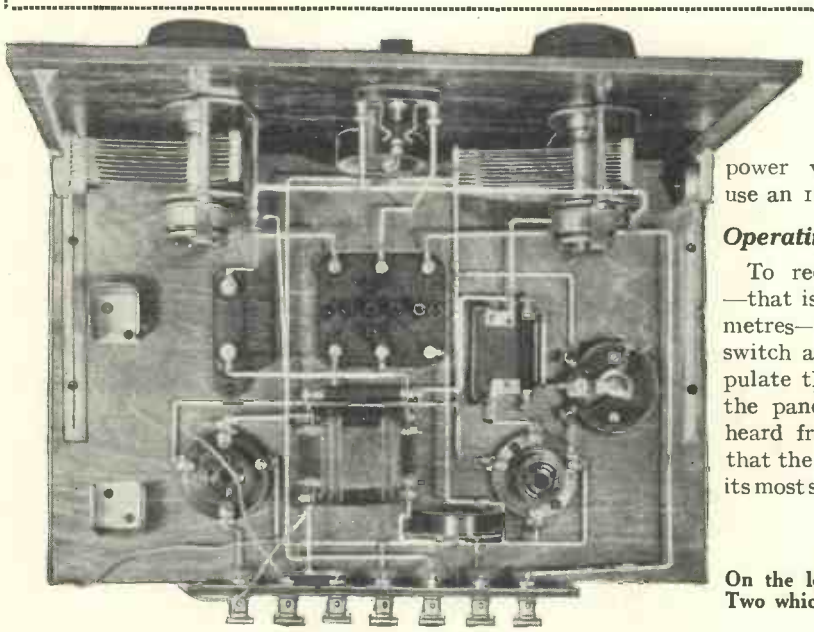
Adjust the tappings to the 9-volt grid-bias battery on the baseboard so that the lead from the secondary of the transformer is at the negative end, while the lead from the valve holder is at the positive end. In this way 9 volts negative bias is applied to the grid of the pentode.

If an ordinary three-electrode power valve is used it will be necessary to use an 18-volt bias battery.

Operating the Key-to-the-ether Two

To receive on the lower broadcast band—that is, between approximately 250 and 500 metres—pull out the knob of the change-over switch and turn on the rheostat. Now manipulate the reaction condenser (on the right of the panel) until the slight rustling sound is heard from the loud-speaker, which indicates that the set is on the verge of oscillation and in its most sensitive condition for picking up signals.

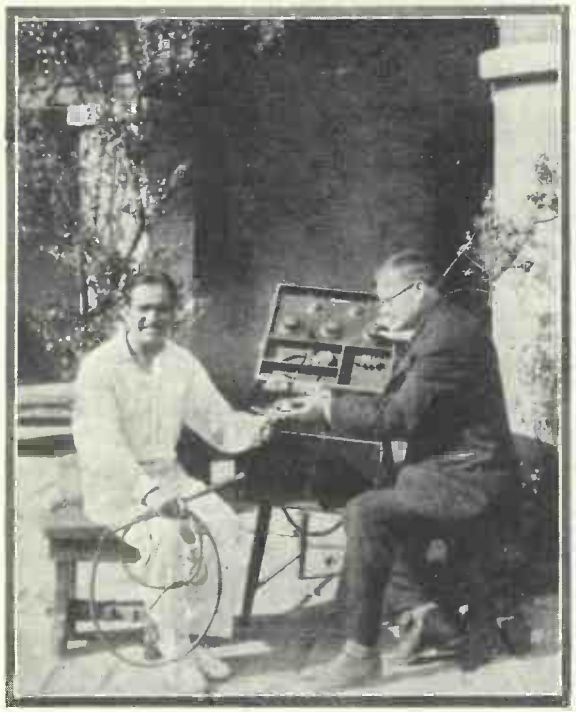
(*Continued on page 370*)



On the left is a plan view of the Key-to-the-ether Two which clearly shows the arrangement of all the parts

Those Foreign Languages!

By HUGH R. SEELEY



On the left is Douglas Fairbanks, the famous film star

WHEN I told Ann—but, of course, I forgot, you do not know Ann; she is, as even her most intimate friends acknowledge, a very pretty niece of mine, by marriage. In the case of attractive girls I always think that any relationship, however remote, should be taken into consideration.

Talking for Hours

Very well, then. When I told Ann that some business papers of mine were being brought across the Herring Pond by a man from Chicago, who, because he was a radio fiend or fan, was given a letter of introduction to me by a friend at New York, she clapped her hands and cried: "How awfully jolly for you. You're such a dab at wireless that I suppose you'll talk to him about your sets for hours on end."

I admitted that I had some general knowledge of radio and that I looked forward to exchanging ideas with an American amateur on a subject of mutual interest! My wife on hearing the news took a more matter of fact view of the proposed visit. "As he's coming from the United States," she said, "I think you had better replenish the Tantalus and, perhaps, an additional bottle or so might add to his happiness in England." I made a note of this suggestion; she is so practical, level-headed and far-seeing.

I cannot say that I was agreeably impressed by the demeanour of Hiram L. Strood when he presented himself on the following day. Words, apparently, to him, were assessed at a high value and his curt "Sure" when I introduced him to my family savoured of boredom although I am convinced that his greeting, in his opinion, was an affable one.

"Meet Mrs. Seeley," were the words I had used, for I judged that such an American expression would set him at his ease. In appearance he was akin to the hundred and one other horn-rimmed specimens of New World manhood I had seen rubbernecking around Nelson's Column; a trifle more dishevelled perhaps, but no doubt this was due to the fact that "he travelled light" and carried, as he said, "his one and only grip with him on his trip through Yurrup."

Barely were the preliminaries over when mellowed by the refreshment—no, they were plural—offered to him he burst out with: "Say, where's the radio? Frank (our mutual friend) tells me that you're a great guy on this side and have got us poor boobs beat to a frazzle."

My Justified Pride

His language was strange to me—to us all, in fact, as we only speak English—but I gathered that he was referring to my wireless installation, one in which I took a certain amount of justified pride. With Ann, I conducted him to the small room reserved for my experiments.

He beamed, positively beamed, took off his horn-rimmed spectacles, wiped them carefully, readjusted them on his nose and without a by-your-leave but with a mere, "I reckon that's a swell hook-up," reached out for a screw-driver and, within a few seconds, before I could stop him, had taken the lid off the case in which my receiver was housed.

Remonstrance

"I beg your pardon," I ventured politely, but firmly, I hope. "I——." He turned to Ann. "Interested in radio?" he asked.

"Rather," she replied, "it's topping," but he barely noticed her answer; his hands slid over the dials, the terminals—binding-posts he called them—then along the wires as if trying to decipher the circuit.

"Antenna?" he queried. "No," I answered, "she has a delightful soprano voice, but I cannot see what——" He interrupted me very rudely.

"Tickler?" I gasped. From the corner of my eyes I caught a glimpse of Ann's face; her cheeks were crimson.

"How dare you!" I retorted. "I should not permit myself such a liberty." The insolence of these foreigners. As he turned to look at us both a puzzled expression swept his face. "Why this hot air? Surely the matter's of interest. Howdyer booster?" Now that is exactly as it sounded.

Our Innate Modesty

"Booster? Boost her?" I repeated dully. "Please understand that our English girls require no advertisement. Their innate modesty——" But he was not listening; again his thoughts, eyes and hands had drifted to the receiver.

He looked out of the window. "Ground?"

"About one acre." I volunteered the information readily as the garden is a good one; what that had to do with wireless I could not fathom. For a few seconds there was silence; he was still puzzling out things on his own.

"Suffer from bloopers?" was the

next question. I frowned. Although his language was foreign to me I felt that we were on safe ground so long as he confined his remarks to radio; a description of any minor ailments he or any members of his family may have had could not interest us deeply. But it was not to be; Ann, involuntarily perhaps, had repeated the word in an inquiring tone. "Bloopers?" she said.

"Yes, aren't you a D.X. bug; don't the distance itch ever get you! Why, in God's own country, if I reach out on some nights I can strike a reg'lar squealfest." I glanced at Ann and was on the point of telling her to rejoin her aunt in the drawing-room when Hiram L. Stood (of Chicago) pointing to a corner of the desk inquired: "A battery?" I followed his finger; there could be no mistaking the accumulator.

An Escaped Lunatic?

The man must be a lunatic; what did he think it was? Perhaps, after all he was not the expected visitor, but some stranger who——. The thought was a disturbing one and I backed a few steps with the intention of protecting my niece should he develop suddenly more violent symptoms.

And then the blow fell, without warning. "Say," he cried, as his hand following one of the leads reached the H.T. eliminator, "is that the B battery?"

Ann fled in confusion. Muttering some excuse, I hustled him out of the room and house and apologised to both my wife and niece for this unfortunate occurrence. I have since written a very sharp letter to my friend at New York. B battery indeed! And in the presence of a lady, too! Does the study of radio deteriorate our manners?

* * *

P.S.—A colleague to whom I related the incident informs me that I misunderstood Hiram L. Strood and that the expressions he used were accepted—and were even considered polite—in the American world of radio fans. Still, I think I should have been warned. Although we have learnt much Americanese from visits paid to cinema displays, for the benefit of the uninitiated I append the translation of a few words in common use on the other side:

What the Terms Mean

Antenna (aerial); ground (earth); tickler (reaction); bloopers (oscillators); D.X. itch (that distance feeling); D.X. bug (one who reaches out); A battery (L.T. accumulator); B battery (H.T. battery); squealfest (an oscillator's festival), and so on.

Racing by Radio!

A SHORT time ago the daily Press was enthusiastic about a new rocket car, the invention of engineers of the Opel Automobile Co., for which a speed of 400 m.p.h. was claimed. The car was a more or less standard Opel, except for the fact that a dozen giant rockets were mounted on a bracket at the rear. The rockets were fired in batches, electrically, and the rebound resulted in (or was supposed to result in) a speed of 400 m.p.h.!

It was generally accepted that the rocket car was in the nature of a Press "stunt," and it would appear to have died a natural death.

Now, however, the Opel Co. have turned to radio control, in order again to attract the public eye. A radio-operated racing car has been constructed, with typical Teutonic thoroughness, and to give the Opel Co. justice, the results obtained with the car outclass many other attempts at radio control.

The car is a standard two-seater Opel, but when it made its first appearance as a "radio-car" on a German race track it was stripped to "sports" specification. The radio control apparatus is contained in three huge cabinets mounted in the dickey-seat compartment, and a frame aerial surmounts the whole apparatus.

Apart from two outsize volt and ammeters, three valves and a number of tuning controls on a metal panel, there is nothing to indicate that the apparatus in the dickey compartment is a wireless set. Moreover, there is nothing to indicate how the receiver works.

When the radio car formed one of the events in the programme of the afore-mentioned race meeting, it was shrouded in mystery. Even the Press was not allowed the usual facilities to examine the apparatus.

Quaint Translation

A rather quaint translation of the description, issued in connection with photographs of the car, reads: "Two wires go from the *antinnæ* (sic!) to the steering gear. From the outside the volt and ampere meters can be seen with the indicators. The current is self-acting and the car can also be sent on the reverse as well as the forward direction."

It is understood, though, that the operation of the car was carried out in the conventional manner. The output of a three-valver (which it is believed was *not* operating from the frame aerial, but from part of the car chassis acting as a counterpoise) was applied to a series of delicate relays. These in turn operated relays heavy enough to take the current needed to operate the steering gear, clutch, and so forth.

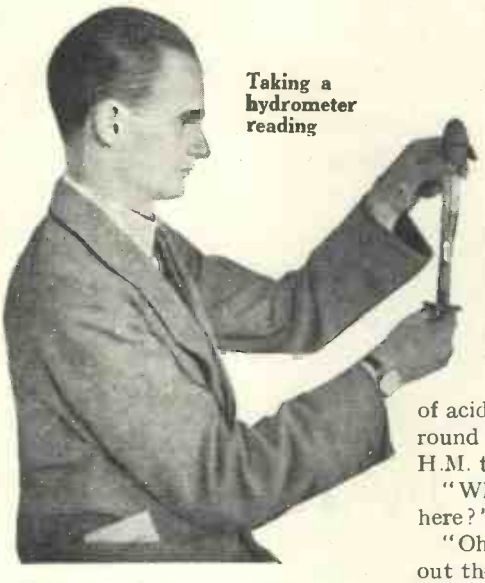
At High Speeds

Quite what would have happened had the radio part of the car ceased to operate one hesitates to think, for in the demonstration run the car was made to drive round the track at high speeds. A single-strip steel spring buffer surrounded the whole of the car, however, so presumably the engineers had attempted to foresee any difficulties.

This is not, of course, the first radio-controlled car that has been produced.

QUEUE.

An example of American art in receiver designer



Taking a hydrometer reading

You Will Only Get the Best Out of Radio by

Taking Care of Your Low-tension Battery

IF the only attention you give to your L.T. battery is to take it at more or less the proper intervals to the charging station, then you are wasting much of its life.

Apt to Suffer!

Accumulators are rather apt to suffer because—with the better makes, at least—they are too reliable! What I mean is that no matter how badly handled or overworked is a modern accumulator, it will still go on delivering its quota of "juice" until the plates disintegrate or the electrolyte dries up!

So long as a battery continues to work a set at normal volume (even if the rheostats have to be turned full on), and does not need charging too frequently, many people are content to remain ignorant of the existence of an L.T. supply. Which is a foolish policy, because sooner or later the inevitable happens.

The man at the charging station is finally consulted, after the advice of expert friends (*sic!*) has proved of no avail.

"Won't Stay Charged"

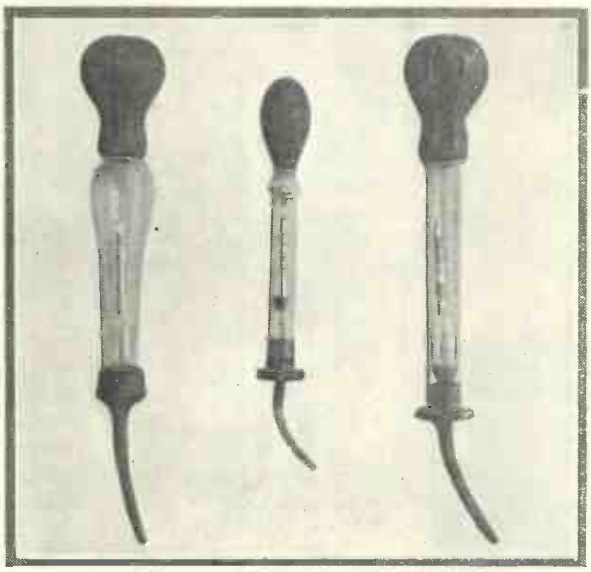
"Can you do anything with my accumulator, please? It won't stay charged. . . . Went out all of a sudden a couple of nights ago. Does it want any water in it?"

"Yes, it could do with some juice," says the honest man. Strictly *entre nous*, there's about two teaspoonfuls of acid and a lot of sediment floating round the bottoms of the plates! The H.M. tests this suspicious liquid.

"What the —— have you put in here?"

"Oh, why . . . when it konked out they said that a little salt would buck it up for the rest of the evening. But it didn't, you know. Don't you think the plates are bent a bit? I thought perhaps if you put those straight, and put some water in the thing——"

"I think you'd better have a new battery," says the very honest man—which is the best piece of advice that could be given.



A group of representative hydrometers. They are not very expensive

But to return to your case, which I hope is not like the foregoing. A good battery costs as much as the best components in a set: the best of batteries need periodical attention, and it is bad to let the charging-station staff be the sole arbiters of its fate. It is advisable, too, to have an independent check on the way the battery is charged; if you know how to test an accumulator, you can make this check yourself.

Here are the chief points to note. Some of them I have enlarged upon, so that, in the words of Gilbert (of Sullivan fame), there may be no "possible doubt whatevah!"

Firstly, a check should be taken of the size of the battery at present being used, and you should make sure that it isn't being overworked.

When to Test

Secondly, you should test the accumulator at the charging station immediately it is brought home and put into use, at least twice during its period of usage, and within a few moments of its being disconnected and taken to the charging station.

Thirdly, the condition of the plates should be watched from time to time, and immediate action taken if a large amount of sediment collects below the plates, or if the plates themselves show signs of turning a yellowish grey.

Fourthly, the electrolyte should be kept up to the correct level, just above the tops of the plates.

Equally important is the fact that the electrolyte (which is, of course, diluted sulphuric acid—oil of vitriol) should be kept at about the same strength.

Sixthly, it pays occasionally to drain the accumulator of acid, to wash out with distilled water and to refill with electrolyte.

Is It Large Enough?

It is quite a simple matter to find if your present battery is large enough for its job. Examine the figures given, usually, on the label at the side of the container, and ascertain the capacity of the battery for a

continuous discharge. The capacity for an interrupted discharge may also be given, and it will be about twice the continuous figure, but we are not interested in this.

Then find the total of current consumed by the set: this is done by adding together the filament consumption of all valves, the voltage being disregarded. Three 6-volt 0.1-ampere valves will thus consume 0.3 ampere.

Number of Working Hours

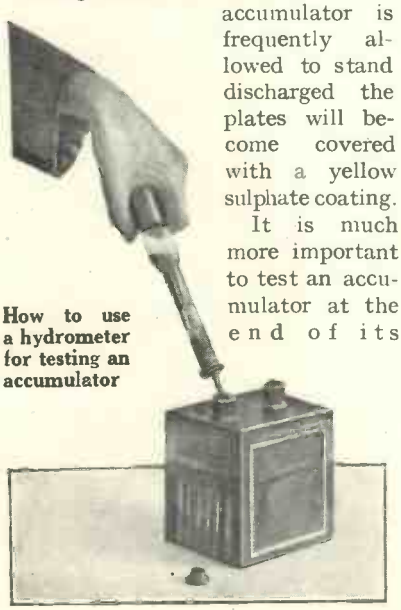
Finally, divide this total into the actual capacity, which you will find measured in ampere hours. The result gives you the number of hours for which, in theory, it should be possible to work the set before the battery becomes quite exhausted. As it is quite the wrong thing to do, however, to run an accumulator until it is completely discharged, this theoretical figure should always be considered to be about a third above the actual period of time.

Always test an accumulator by means of a voltmeter placed across its terminals, when it is handed to you at the charging station. If freshly charged, it may register as much as 2.25 volts *per cell* on no load. The voltage should certainly not be under 2 volts per cell when the accumulator is taken home and used in the set, with the filament switch "on."

Falling Voltage

Never let the voltage (when the battery is working) fall below 1.8 volts per cell. This is the normal discharge condition voltage, and if an accumulator is frequently allowed to stand discharged the plates will become covered with a yellow sulphate coating.

It is much more important to test an accumulator at the end of its charged period than when it is new. *Immediately the battery becomes discharged it should be sent for re-charging.* Voltmeter tests are not always accurate enough for this purpose, in that the voltage delivered by a cell does not necessarily indicate its true condition.



How to use a hydrometer for testing an accumulator

The most intimate and accurate guide to the state of charge is obtained by testing the acid strength. The chemical action which takes place during charging and re-charging alters the specific gravity (that is, the weight of the acid in the battery, compared with the weight of a similar volume of water).

It is not the work of a chemist to test acid strength, for a simple hydrometer can be purchased for a few shillings from most radio dealers.

This article explains how to test an accumulator to find out the state of the charge, keep up the level and strength of the electrolyte, and wash out the sediment which accumulates in the bottom of the container—in short, how to get the best possible service out of your low-tension battery.

A number of hydrometers are illustrated in accompanying photographs, and it will be seen that they are by no means fearsome pieces of apparatus.

The *modus operandi* is as follows: The nozzle of the hydrometer (usually a length of rubber tubing) is inserted in the vent cap of the cell to be tested, and by squeezing and releasing the bulb a small quantity of acid is withdrawn into the glass barrel. The rubber tubing is then held between finger and thumb so that the acid cannot leak, and the hydrometer is then removed.

Inside the barrel will be seen a float, engraved with "charge," "half-charge," and "empty," or a number of figures; alternatively, the barrel may contain a number of coloured pellets, which float at various heights in the acid.

Another group of hydrometers. Every Accumulator owner should have one

The float or pellets "sink or swim," according to the strength of the acid. If figures only are given on the float, then the label on the side of the container should again be consulted.

Essential Data

Here will be found the specific gravity or strength of the new acid, acid in a fully-charged battery, and acid in a discharged battery (giving 1.8 volts per cell). In most batteries the electrolyte specific gravity is a charged cell is 1220 (sometimes written 1.22), and in a discharged cell 1170 (1.17). The float figure on the acid level is the one to be noted, and if this is approximately 1170, or the discharge value stated by the makers of the battery, then it is time to pay a visit to the charging station.

If charged at an excessive rate, the plates of a battery will shed some of the paste, the positive (red) plates discharging most. Another sign of excessive charging is shown when a battery is warm when handed to you. *Moral: Change your charging station.*

Excessive Discharging

Yellow stains form on battery plates as a result of excessive discharging, or of allowing the accumulator to stand in a discharged state for a long time. If the stains are only slight, they can be removed by thoroughly washing out each cell, and by a process of slow charging and discharging. *Moral: Never let the accumulator get into such a state again.*

QUEUE

Wireless Magazine, November 1928

More Revelations from Savoy Hill

Secrets of the Echo Room

Every listener will find some facts of interest in this article, which has been specially written for the "Wireless Magazine" by FRANK ROGERS. *Many of the points raised have never been dealt with in print before, and readers will be able to glean much of real interest from the author's revelations*

THE development of broadcasting has been due, as most other things have, to an unending series of experiments; trying this, deducing that, trying again and modifying the deduction, and so on, making a relentless inroad into Nature's fastnesses.

An early difficulty was to prevent external noises reaching the microphone without interfering incidentally with the ventilation of the studio. This trouble was very real for some time, causing the once-familiar announcements, "Will you please stand by for a few moments——," which indicated that the room had at last become absolutely unbearable, and everyone was moving to another.

As though to exaggerate this ventilation problem, the discovery was made that sounds were echoing round the walls and returning into the microphone. The only method of stopping this was to hang draperies of velvet or casement cloth from the walls and ceiling, thus practically stifling the studio.

The first impulse of the B.B.C. was to explore the field of ventilation with a view to scrapping the draperies. The problem as they saw it was to "kill" all echoes, without impeding the free flow of the air. But this outlook was modified before long. All the echoes did not require killing; some, in fact, were strongly needed for musical effect.

Research Set on Foot

Immediately this new point was realised, research was set on foot to reveal plainly which items were best suited by a following echo-period, and the duration. In due course these figures were obtained: The spoken word in an ordinary studio is best served by an echo lasting from .25 to .75 second, a voice solo 1.2, a military band also 1.2, chamber music or a fiddle solo about 1.5, and a chorus from 1.6 to 2 seconds.

The experiments now underwent a change of front. No longer was it desired to kill utterly all echoes, but, what was far more difficult, to treat them variously and achieve the decimal point accuracy of the figures given above. It was manifestly impossible to do this by any system of studio-deadening, and so it was that the Echo Room first came into being.

Layers of Curtains

Meanwhile, as a makeshift while experiments were being conducted, each studio was equipped with a layer of three or four curtains, any or all of which could be pulled aside at will. When no echo was required, as, for instance, when the spoken word was being broadcast, they were all left in position so that the studio was dead. When, on the other hand, the item needed a degree of echo, they were pulled away, few or many according to the effect desired.

All this time attempts were continued to construct the ideally dead studio, as it had been decided to standardise all studio performances and add the echo from the Echo Room. Among the many interesting points which came to light at this stage was the distinction various "deadening" agents made between high and low notes. The best all-round results were given by hair felt, but even this allowed the lower ones to escape. A wooden door, conversely, killed these alone.

Ultimately a composite material was built up to embrace both extremes. This was let into the walls to a depth of 1½ in. to 2 in., and the studios could henceforth be looked upon for all practical purposes as absolutely dead. This triumphal result was subsequently crowned by the installation of a ventilating system which finally removed all temperature troubles.

Now that the studio performance was entirely without echo, the second part of the new scheme was put into operation. A second microphone conveyed a "copy" of the sounds to the Echo Room, into which they were emitted from a loud-speaker. This room is of medium size, walled with concrete, and bare of furniture or carpets. The loud-speaker stands in one corner, and facing it in the opposite corner is a third microphone leading upstairs to the control-room.

The controller now has at his disposal the original studio version, together with the Echo Room copy. This is free to echo backwards and forwards without any impediment, and can be blended with the original in whatever proportion the controller desires. He can regulate its input to a shade with mathematical exactitude.

Fading In or Out

If the number going through needs a minimum of echo effect he can practically fade-out his third microphone, or if it requires an amount corresponding to a period of 1.2 seconds he can fade-in this effect with absolute precision. Thus every type of item appearing in the B.B.C.'s programmes can be given that background of echo which is adjudged necessary by reason of its nature. Further, it must not be forgotten that the studio is now hygienic and less awe-inspiring to the artiste.

This system opened new possibilities in broadcasting, in the way which all experimenters know that one thing leads to another. If a song is given in one studio, and three or four people clap their hands in another and their noise is sent through a separate Echo Room, it is possible to super-impose this exaggerated result upon the original number to give the effect of a turn in a theatre.

In a similar way a small organ can be made to sound like a cathedral recital. Uncle Noises with a few conspirators clapping and shouting can also "relay a championship bout from the Albert Hall."

It was, in fact, only a short while

ago that a prominent official of the B.B.C. gave out that they were not in the least dependent on the music-halls for their shows, it being far easier to do the turns "at home," and manufacture what was required by way of atmosphere and crowd effects.

Formula for Echo-periods

I may add that the acoustic experts have studied all the large halls in the London area, and reduced their atmosphere to a formula in terms of echo-periods. They claim that a studio performance can be converted into an imitation of a relay from any of these without the listener detecting the illusion.

The microphone in general use is the Reiss, which is placed at one end of the studio for reasons of musical balance. The size of the studio likewise depends upon the number going through. Height is of no great consequence, provided it lies somewhere between 20 ft. and 40 ft.

One is so constantly hearing grumbles about anything happening to belong to one's own country that it is comforting to reflect how in broadcasting, at any rate, we appear to hold our own.

Perhaps I may repeat an illuminating little story I recently enjoyed. An American lady had occasion to call at 2LO one afternoon to see a friend. Some delay occurred and she was asked if she would care to listen-in to the programme to help pass away the time. She was grateful, but disliked radio on the score of distortion and "murder" of the tune.

The Obliging Loud-speaker

Almost immediately a loud-speaker was turned on in the next room. When her friend was able to get down, almost the first words with which he was greeted were : "I like your music over here; I have just been hearing a rehearsal." And, of course, considerable surprise was expressed when the obliging loud-speaker was pointed out.

It might almost be that in the matter of wireless reproduction we are, to use the words of another American on another branch of our activities, "farther ahead than some people think."

On another Page of this Issue B.B.C. Officials write of Picture Broadcasting Developments

Brightening Wales

RECENTLY I visited the National Museum of Wales, at Cardiff, again and was agreeably surprised to hear the strains of music as I entered. The National Orchestra of Wales was there, and what a change ! The dull place had become bright; the dead things seemed to have found voices; music and museum had become synonymous.

I always enjoy art galleries and museums, the days always being too short when I go there. Music in a museum will make the days shorter still. Even those who thought a museum a dull place will not be able to hold that opinion for long, if the example of Cardiff is to be followed.

What has been done in the National Museum of Wales can be done in other museums and art galleries. It is a jolly way of brightening up England and getting music into dull places. Already the attendances at the Museum Cardiff have increased tremendously.

What some of the exhibits and sculptures would say one can only guess. They might object to this modern innovation, but music in noble buildings where sculpture and painting have their home brings all the arts to a common meeting place. Music helps to a better understanding of the other arts.

We often criticise the B.B.C., but in this case it has done Wales and the country generally a great service. It has succeeded in bringing the Cardiff City Council, the National Council of Music for Wales, and the Museum authorities into co-operation. It also undertook to support the scheme financially and Mr. Warwick Braithewaite, the musical director of the Cardiff station of the B.B.C., is the conductor. In return the B.B.C. broadcast concerts from the Museum very frequently.

What the B.B.C. Has Done

To sum up. What the B.B.C. has done through this new departure which has survived its experimental stage is to give the public cheap music, to give Wales a National Orchestra, to bring various authorities into co-operation and to brighten the Museum by bringing the Arts together.

Here is very fertile ground for the B.B.C. to go on working in. Why not brighten up one or more of the London museums and art galleries?

E. B. R.

A Chummy Four Modification

Here are details of an interesting modification to the Chummy Four (WIRELESS MAGAZINE, *June*, 1928), *from a reader.*

"Although I have made up many wireless sets, my knowledge of the art is very limited, in fact my railway carriage friend, 'Adams,' says I know less than nothing about it. When I told him I was going to build a Chummy Four he voiced the usual banter, but it is I who banter now, being the owner and builder of a portable set which anyone can be justly proud of—so simple and yet so efficient.

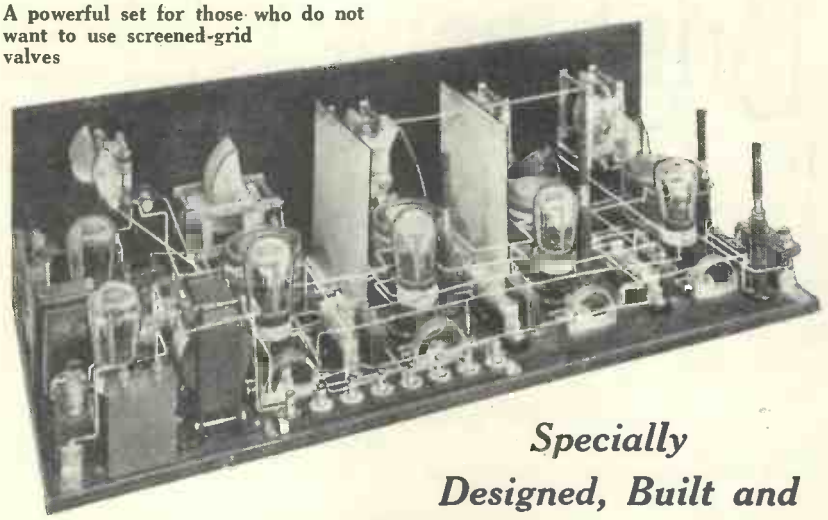
"I have made a little alteration in the case, for the reason that it does not appeal to me to have the cone loud-speaker in such close proximity to the batteries. The enclosed photos may be of interest, as they show the cone as a separate unit, yet forming part of the lid.

"By this arrangement the loud-speaker can be drawn out of the lid and placed upon a peg on the top of the case and revolved to face any position—or in the home can be hung on a wall—at a picnic the set can be placed out of the way and yet receive delightful music by simply arranging the little loud-speaker to suit the party, instead of arranging the party to suit the loud-speaker.

"The Chummy Four is the portable to make. I use it every evening at my home in St. Albans, Herts."

These photographs show clearly the position of the loud-speaker

A powerful set for those who do not want to use screened-grid valves



The Eagle Six

Specially Designed, Built and Tested by J. H. REYNER, B.Sc., A.M.I.E.E.

FOR some considerable time we have felt the need at the Furze-hill Laboratories of a good up-to-date receiver which should be suitable for receiving almost any station. Such a receiver must have the following qualifications :

Special Features

1 —It must be selective.

2 —It must be powerful and able to receive really distant stations without difficulty as long as atmospheric conditions will permit.

3.—The quality of reception must be good. If this condition is to be attained, consistent with condition 1, then at least four tuned circuits must be employed.

4.—It should be capable of receiving on the long waves and the short broadcast band with equal facility.

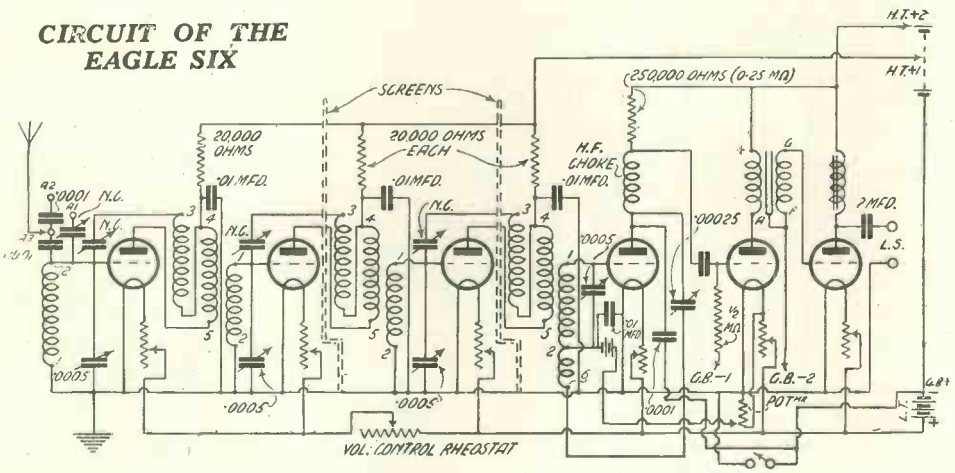
Ease of control is obviously not a consideration in this instance, the paramount requirement being a good performance.

The introduction of the screened-grid valve has undoubtedly assisted our ideas of high-frequency amplification and we felt that if some of the more modern methods were applied to the old circuits an exceptionally sensitive receiver would result.

After a considerable period of experimenting, a circuit and layout were evolved which were not only compact in form, but which gave remarkably good amplification on each of the three high-frequency stages. There were four Q coils, in close proximity to each other, "pulling their weight" in a most desirable manner. Naturally, a few modifications had to be made to the original circuit before these results were obtained, but the final arrangement was distinctly satisfactory.

The circuit diagram is shown below. It will be seen that the well-proved split-primary coupling has been employed throughout, in conjunction with the usual neutralising condensers. The somewhat complicated looking batch of condensers in the aerial circuit is in reality a very simple method of obtaining any desired degree of selectivity in this circuit.

CIRCUIT OF THE EAGLE SIX



Circuit of the Eagle Six, which comprises three neutralised split-primary high-frequency stages, a detector, one resistance-coupled low-frequency stage, and a transformer-coupled low-frequency stage. Each of the first four valves is provided with a filter circuit. For fine control of each valve a separate baseboard resistor is provided for each filament. The wavelength of the whole set is changed by one simple switch

Reasons for Anode-bend Detector

Anode-bend rectification has been employed for two main reasons : Firstly, the selectivity of such an

arrangement is superior owing to the fact that no grid current flows in the detector circuit and therefore no increased damping is caused. Secondly anode-bend rectification is more efficient as regards reproduction and volume output than the grid leak detector, if preceded by a number of high-frequency stages; in other words, the anode-bend detector is capable of handling a far greater grid swing than the grid-leak detector without distortion.

Special Filter Circuits

It will be noted that three filter circuits are incorporated in the H.T. leads to the high-frequency transformers. This is an important feature, for it was found that such an arrangement prevented high-frequency feedback from one stage to another through the high-tension battery and therefore kept the set stable despite the compact layout. This did not reduce amplification per stage. The 20,000-ohm wire-wound resistances in the filter circuits are each shunted by a .01-microfarad condenser.

Low-frequency Side

Following the detector valve is a single stage of resistance-capacity coupling, followed by one L.F. transformer stage, a well-tried and popular arrangement. It should be observed, however, that the .25-megohm anode resistance which is supplied with the unit was found to be too high and a resistance of 100,000 ohms was substituted for the best results.

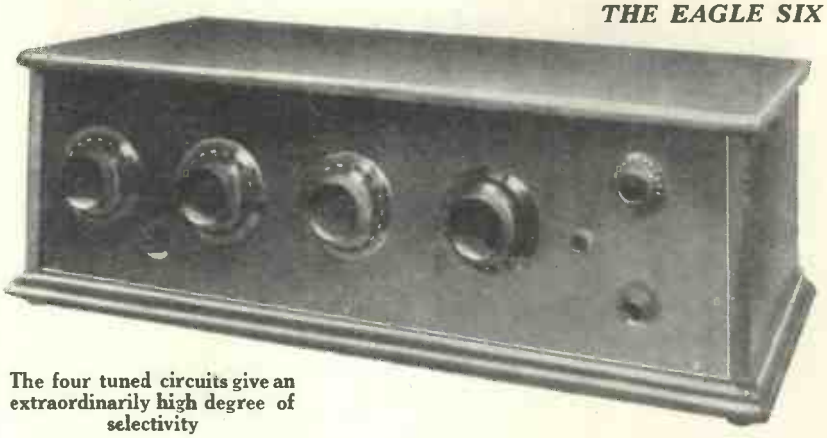
Finally, an output filter is employed, this serving to protect the loud-speaker and to minimise battery feedback so that the set can be used either with batteries or an eliminator.

The importance of the layout need hardly be stressed. The relative positions of the components have been worked out very carefully and any alteration will almost certainly result in a serious loss of efficiency.

Mounting the Q Coils

Special care is also needed in mounting and finally fixing the Q coils in position; it is obvious that if the lever controlling the coupling on the switches is to move easily and without slip the coils must be placed in line.

THE EAGLE SIX



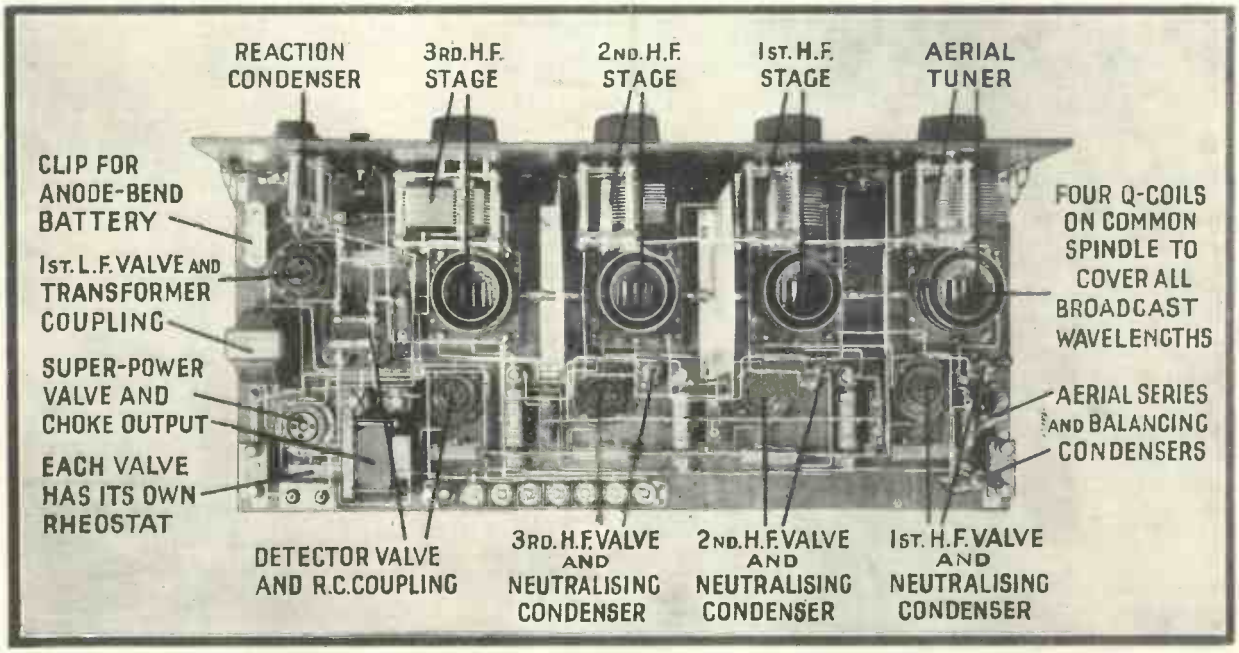
The four tuned circuits give an extraordinarily high degree of selectivity

From a study of the photographs of the completed receiver it will be noted that two ordinary aluminium screens are used.

Particular care must be taken in placing and connecting up the neutralising condensers; the leads from these components to the grids have been made as short as possible. It is important to keep the connections from these condensers to the neutralising winding (terminal No. 3) on the H.F. transformers well away from the screens and other wiring.

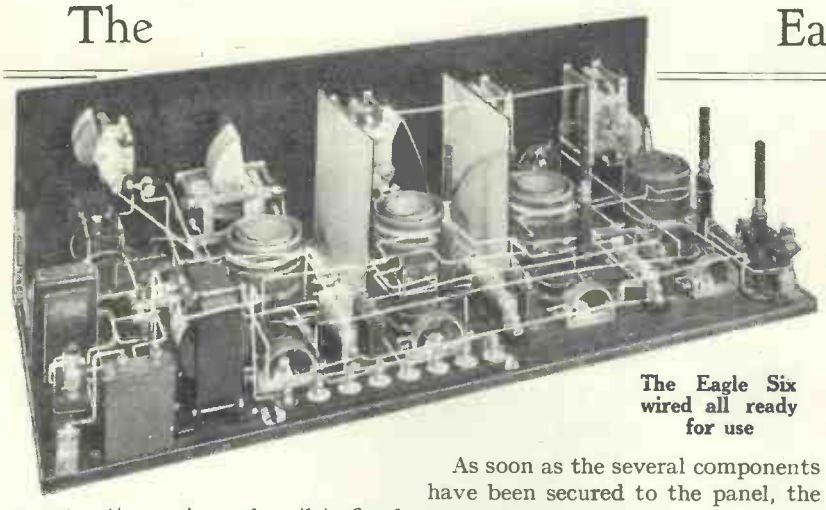
The best procedure to adopt is to arrange the coils in position without screwing them down, clamp the coupling rods together and then actuate the lever, simultaneously moving each coil slightly until the switch operates with the least effort.

When the best position has been found for the coils and these are approximately in line, they can then be screwed down to the baseboard



This plan view clearly shows how the Eagle Six is arranged, and no reader will have difficulty in following the layout

The Eagle Six (Continued)



The Eagle Six wired all ready for use

one at a time. As each coil is fixed in position, operate the switch to see that it has not changed its position. The importance of mounting the coils carefully cannot be over-stressed. The end of the spindle is extended through the cabinet so that the switch is operated from outside.

Placing the Screens

The screens should be placed exactly in between the second and third Q coils, and the third and fourth Q coils, and should be earthed. The best way of earthing them is to solder a lead to a tag, fixing this firmly to the screen by means of a small nut and bolt.

The ebonite panel should be marked out on the back in the normal way; this can be done quite easily with the aid of a full-size blueprint. This is No. W.M. 106 and can be obtained for half-price—that is, 9d., post free—if application, accompanied by the coupon on page iii of the cover, is made by November 30.

Positions of Condensers

It will be noted from the photographs that the first three tuning condensers are mounted vertically, whilst the fourth is mounted horizontally, this arrangement being necessary in order to obtain a suitable layout on the baseboard. The reaction condenser is of the single-hole fixing type, as also is the potentiometer for controlling grid-bias to the anode-bend rectifier, and the on-off switch on the extreme right.

A hole should be drilled for the volume control, placed in between the first and second tuning dials. This volume control operates by dimming the filaments of the first two high-frequency valves.

As soon as the several components have been secured to the panel, the remaining components should be mounted on the baseboard. The panel may then be fixed to the baseboard by means of small panel brackets. A terminal strip has been

THIS SET HAS BEEN SPECIALLY DESIGNED FOR THOSE WHO WANT A POWERFUL RECEIVER USING ORDINARY THREE-ELECTRODE VALVES

used for battery connections and this should be fixed down to the baseboard.

On the extreme left a small piece of ebonite raised from the baseboard on a wood support carries the aerial and earth terminals, whilst on the extreme right a similar piece of ebonite carries the loud-speaker terminals.

The wiring can now be started. It will be noticed from a glance at the blueprint or the reduced reproduction on page 337 that each terminal point is marked with a small letter of the alphabet; these letters indicate in what order wiring should be undertaken. First connect all those points marked *a*; then those points marked *b*; and so on.

Grid and Plate Leads

It will be noticed that the grid lead to the aerial coil is taken to terminal No. 2 and not to terminal No. 1 as is usually the case. Be careful to keep the plate and grid leads to the high-frequency valves well away from each other, in order to avoid possible interaction. Soldering connections on to the terminals Nos. 1, 2, and 6 of the Q coils may present some difficulty, particularly in the detector stage, owing to the proximity of the panel; some of this wiring, however, may be accomplished, if desired, when the panel is not in position.

Earthing the Transformer

Remember to earth the shroud of the low-frequency transformer; two small screws are mounted on each side of the shroud for this purpose.

COMPONENTS REQUIRED FOR THE EAGLE SIX

1—Ebonite panel, 30 in. by 8 in. (Becol, Parfait, or Raymond).
4—.0005-microfarad variable condensers with dials (Cyldon, Igranic, or Burndept).
1—Q aerial coil (Wearite or Lewcos).
3—Q high-frequency transformers (Wearite or Lewcos).
1—.00025-microfarad variable condenser (Cyldon Bébé, Peto-Scott, or Bulgin).
1—On-off switch (Lissen or Lotus).
1—Panel potentiometer (Lissen, Igranic, or Peerless).
1—Panel rheostat, 7 ohms (Lissen, Igranic, or Peerless).
4—Dial indicators (Bulgin or Belling-Lee).
3—.0001-microfarad fixed condensers (T.C.C., Dubilier, or Trix).
4—Neutralising condensers (Gambrell).
4—.01-microfarad fixed condensers (T.C.C., Dubilier, or Trix).
3—20,000-ohm wire-wound resistances with holders (Mullard, R.I. and Varley or Lissen).
6—Baseboard variable resistors, 15 ohms (Peerless).
6—Anti-microphonic valve holders (Lotus, W.B., or Formo).
1—High-frequency choke (Climax, Wearite, or Lewcos).
1—Resistance coupling unit with .25-megohm anode resistance and .5-megohm grid leak (Dubilier).
1—Clip for anode-bend battery (Bulgin).
1—2-microfarad fixed condenser (T.C.C., Dubilier, or Lissen).
1—Low-frequency transformer (Gecophone 4 to 1, Ferranti, or Igranic).
1—Output filter choke (R.I. and Varley, Ferranti, or Parmeko).
2—Screens (Wearite or Parex).
8—Block terminals, marked: H.T. +2, H.T. +1, H.T.—, L.T. +, L.T.—, G.B. +, G.B.—1, G.B.—2 (Bulgin).
4—Terminals, marked: Aerial, Earth, L.S. +, L.S.— (Belling-Lee).
2—Terminal strips, 2 in. by 1 in. with wood supporting blocks (Ready Radio).
1—Cabinet with 12 in. baseboard (Caxton).

Uses Four Q Coils

On the right of the baseboard a clip is provided for the detector grid bias; a 4½-volt battery tapped at every 1½ volts is suitable. A .01-microfarad fixed condenser by-passes the grid battery and potentiometer, and this must not be omitted or considerable loss of efficiency will result.

The Q-coil Spindles

It is most important to connect a flexible lead to earth (or L.T.) from the switch spindles on the Q coils; failure to do this will result in lack of stability on the long wavelengths in most cases.

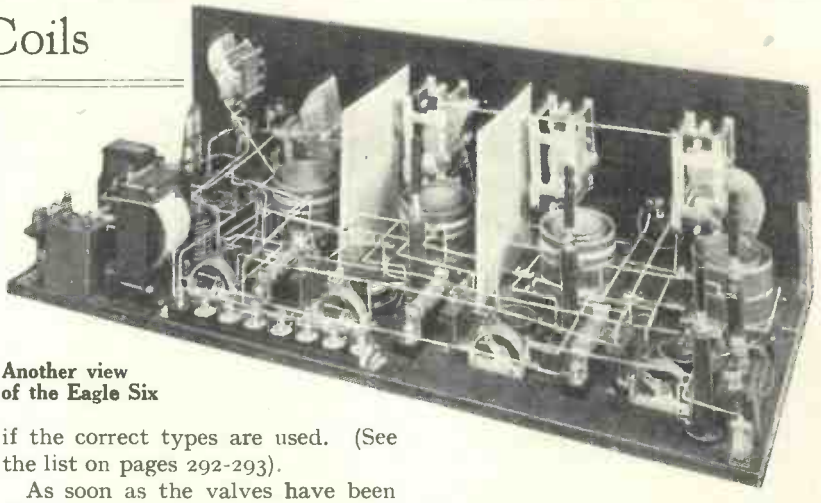
The types of valves for use in this set are not hypercritical. The first four valves should be of the H.F. variety having A.C. resistances varying from 20,000 to 40,000 ohms; the first low-frequency valve may be one of the many L.F. valves now on the market, while the last valve should be a super-power valve having an A.C. resistance below 6,000 ohms.

What Voltage Valves?

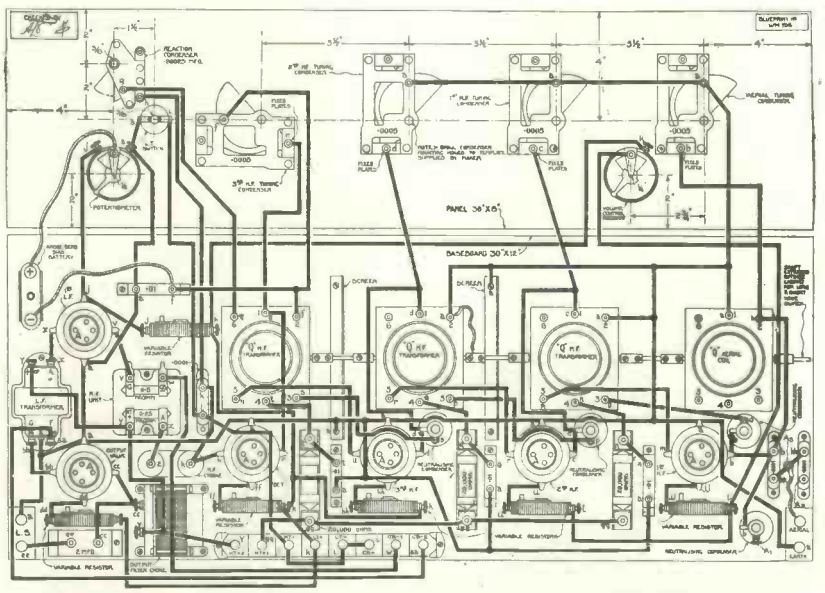
As regards the question of filament voltages one might expect to obtain optimum results with six-volt valves; two- or four-volters, however, are also quite suitable and give good results if the correct types are used. (See the list on pages 292-293).

As soon as the valves have been placed in position the various leads to the battery may be connected up. It is advisable to place a small low-current flash-lamp bulb in the lead to negative H.T.; in case of a short-circuit due to some faulty connection, the bulb will fuse rather than the valves, and before a new bulb is fitted the fault can be traced. If all is in order the usual click should be heard on switching on the filaments; see that the semi-fixed resistors are set in the "on" position.

The first adjustment of the receiver is perhaps a matter requiring a little care, because it is necessary to neutralise the several H.F. valves. First of all set the neutralising condensers about midway. There are six complete turns of the condenser going from minimum to maximum. The condenser should, therefore, be screwed all out and screwed back again three complete turns.



Another view of the Eagle Six



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 November 30. Ask for No. W.M.106

Setting the Dials

Now set all the dials to the same reading. It will probably be found that the receiver will oscillate. This may be tested by tapping the grid of the detector valve with the finger, in which case a loud clicking noise will be heard. Adjust the third neutralising condenser until this stops.

Carefully retune the dials until the oscillation starts again and adjust the second neutralising condenser until the circuit again ceases to oscillate. Once again retune and adjust the first condenser until the set ceases to oscillate. The reaction condenser should, of course, be adjusted to its minimum position during this operation.

A Simpler Method

If the reader is within 50 miles of a local station a somewhat simpler method is available. Tune-in to the local station and then switch out the filament of the first H.F. valve by means of the appropriate rheostat on the baseboard. Put on a pair of telephones instead of the loud-speaker and retune all the dials. Then adjust the neutralising condenser until the signal strength vanishes or is a minimum.

Switch on the first valve and switch out the second and repeat the process, carefully retuning each time. Repeat the process once again for the third valve, when the receiver will be satisfactorily neutralised.

J. H. Reyner's Eagle Six (Continued)

DAYLIGHT TEST ON EAGLE SIX

SHORT WAVES

Station.	Wavelength.	Dial Reading.
English Relay	284	34
Belfast	306	50
Newcastle	312.5	54
Bournemouth	326	72
Cardiff	353	91
London	361.4	101
Madrid	375	110
Manchester	385	114
Hamburg	396	118
Cork	401	120
Grenoble	416	128
Frankfurt	428	134
French Station	462	145
Langenberg	473	150
Daventry 5GB	491.8	156
Munich	536	170

LONG WAVES

Croydon	900	42
Hilversum	1,088	84
Kalundborg	1,153	96
Koenigswusterhausen	1,250	108
Motala	1,380	121
Daventry	1,604	142
Radio Paris	1,765	160
Huizen	1,875	166
Kovno	2,000	180

Neutralising should be carried out on the short-wave position, when it will be found to hold good on the long-wave position. It can, if necessary, be carried out on Daventry, but the neutralising is not so crisp and a silent spot will probably not be obtained but only a minimum. In general the neutralising is not critical and a wide latitude is permissible, but patience is required in order to get the receiver adjusted.

Do Not Despair!

Particularly if the reader is not well versed in the ways of high-frequency circuits, he should not despair if he takes some considerable time to get the receiver correctly neutralised.

If any serious difficulty is found it is best to work the receiver back from the detector. Remove the third valve and connect the aerial to the anode socket of this valve. This makes the receiver a detector and two L.F. set and it should behave quite satisfactorily as such.

One Stage of H.F. Only

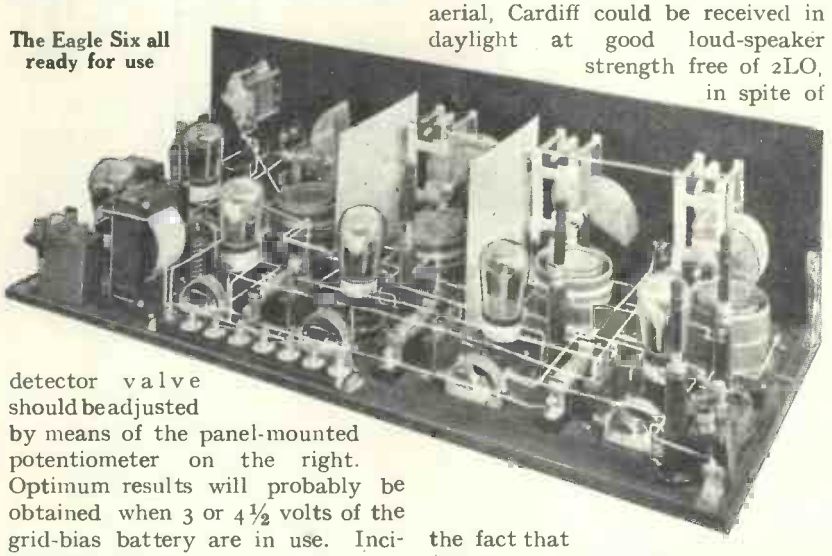
Then remove the second valve, replacing the third valve, while the aerial should now be connected to the anode socket of the second valve holder. This gives one stage of high-frequency amplification and the stable position of the neutralising condenser can be found fairly easily. Then work back one stage further, giving two H.F. stages, which can again be controlled fairly easily and finally bring in all three stages.

Q-coil Switch Contacts

If the high-frequency stages are not tuning properly, suspect one of the switch contacts in the centre of the Q coil; this may have come out of order during transit. You will notice that there are three contact points; in the short-wave position two of these are supposed to be in contact and in the long-wave position the third makes contact, while the other two are disconnected.

As soon as the short-wave position is functioning correctly and the high-frequency circuits are tuning properly the range switch may be thrown over to the long-wave position; a small readjustment of the dials should then give results. Again, if one of the circuits is not tuning correctly suspect the switch contacts which may be tested separately by holding down those supposed to be in contact with the aid of a pencil or fountain pen.

When it is evident that the circuit is functioning correctly various adjustments may be made to improve the results. The bias on the grid of the detector valve should be adjusted by means of the panel-mounted potentiometer on the right. Optimum results will probably be obtained when 3 or 4½ volts of the grid-bias battery are in use. Incidentally, this battery is not placed across the potentiometer and does not, therefore, supply any current. The detector grid-bias adjustment should preferably be made on a fairly weak station.



The Eagle Six all ready for use

Selectivity is controlled by altering the capacity of the aerial lead to the grid of the first high-frequency valve. The normal capacity between the aerial and grid should be .0001-microfarad. If, however, some additional selectivity is required, the aerial may be tapped on to the end of the second .0001-microfarad condenser, which places the two condensers in series and gives a total capacity of .00005-microfarad.

Increasing the Selectivity

Increased selectivity is further obtained by tapping the aerial on to the far end of the neutralising condenser and adjusting the capacity to give the required balance of signal strength and selectivity. This device is particularly valuable for receiving distant stations when operating within a few miles of the local station.

When the series aerial capacity is reduced to very low values the signal strength is naturally also reduced, but on account of the exceptional amplification obtained from the three high-frequency stages excellent signal strength and selectivity can be obtained simultaneously.

Cardiff in Daylight!

When testing the receiver in our laboratories, using a normal P.M.G. aerial, Cardiff could be received in daylight at good loud-speaker strength free of 2LO, in spite of the fact that 2LO, which is 12 miles away, is received exceptionally strongly at the laboratories. Such an achievement is hardly possible with two stages of high-frequency only.

To those accustomed to operating gang-control receivers, the tuning of a multi-control set may seem at first

(*Continued on page* 370)

Wireless Magazine GRAMO-RADIO SECTION

THE FIRST SUPPLEMENT OF ITS KIND PUBLISHED BY ANY RADIO PERIODICAL

CONTENTS

This Thermion auto-electrical gramophone and radio receiver comprises wireless set, amplifier, gramophone and electric pick-up, and moving-coil loud-speaker. It is made by C. Haddon Poupard & Co., of 82 Wanstead Lane, Ilford

Record Limitations

ONE would think that as modern gramophone records, and some old ones, too, can give results very near to perfection, complete perfection should not be hard to attain.

Of course, if expense is no great object, one may reproduce the latest electric recordings by means of a highly-complicated power amplifier and several coil-driven loud-speakers.

Cheapness

But such things are not for *hoi polloi*—until power amplifiers and moving-coil loud-speakers approach nearer to the cheapness of the Yorkshireman's proverbial "muck."

And even these do not ensure *absolute* perfection, for the gramophone records themselves set a limit on purity and so forth. Delve for a moment into record technicalities, and see why this is.

In order that records shall be convenient in size, it is necessary to compress the whole spiral groove into a maximum record-face diameter of 12 in. This places a limit on the spacing between adjacent grooves of the spiral in which the needle runs.

If you think this out you will see why it is that the low notes (which need the widest zig zagging in the grooves) are cut off if the grooves are compressed unduly.

High notes, on the other hand, are reduced in volume owing to the fact that a very high tone requires a zig zagging groove of smaller radius than the needle can follow accurately. This, of course, is more a fault on the part of the needle, needle-holder, and pick-up or sound-box than a fault in the record. But it could be cured, probably, by the use of a more suitable record material.

Special Records

Most commercial pick-ups are satisfactory, and most amateurs who have entered the gramo-radio field have suitable amplifiers Limitations, such as they are, are set by the records themselves, and it is to be hoped that one day we may have special records for pick-ups.

QUEUE.

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 every two questions 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.

DESIGNING YOUR OWN GRAMO-RADIO AMPLIFIER

By Bernard A. Barton

ONE of the vaunted claims for gramo-radio is that it enables gramophone music to be reproduced by means of a wireless set. This is quite true, and there must be many thousands of enthusiasts who are using pick-up equipment connected directly to the normal low-frequency side of their receivers.

Special Problems

But, as will doubtless have been gathered from the fact that special gramo-radio amplifiers have been described in the WIRELESS MAGAZINE, amplification of pick-up impulses presents problems of its own.

To obtain the very best results from electrical gramophone reproduction it is almost essential to design a special amplifier for the job, though it does not follow that this special amplifier will not be suitable for radio work.

Indeed, as this amplifier will be very similar to a perfect-quality power amplifier, it may prove to be an improvement over the present L.F. side of the radio set *in certain circumstances*. Its limitations for radio work will be obvious after appreciation of the following.

Why does the low-frequency section of a good-quality receiver not fulfil all the demands of gramo-radio amplification? Comparison shows this quite clearly.

Average Radio Set

The *average* radio set is worked either at a reasonable or an extreme distance from a broadcasting station; in few instances only are sets worked under the very shadow of the transmitting aerial.

This brings about the following set of conditions: (*a*) Unless many stages of H.F. are employed the input to the first L.F. stage of the set will be comparatively weak; (*b*) this weak input will be of reasonable purity, if detection is good, and for ordinary receiving *slight* distortion may be allowed; (*c*) except for dancing or public-address work a large output will not be needed, and loud-speaker strength may be a little less than that obtained with a loud needle in a high-class cabinet gramophone.

All this is the exact reverse of what should happen in the case of a good gramo-radio amplifier; (*a*) The input from the pick-up to the first L.F. valve is much greater than that provided by a detector valve, even when tuned to a near-by station; (*b*) this input will be limited in purity by imperfections in the gramophone record and in the pick-up itself. For good results practically *no* distortion can be tolerated; (*c*) the volume given by a gramo-radio set must at least equal normal gramophone sound output. To be convincing, it should be even a trifle louder, combined, of course, with faultless reproduction.

Ideal Specification

The specification of an ideal gramo-radio amplifier can be cited as follows. Unless an electrostatic pick-up is employed the simplest coupling between this component and the grid of the first valve will be by means of a transformer. If the pick-up output is large, then one stage of amplification may be deemed sufficient. A large power valve, or one stage of push-pull amplification, must be used.

In most cases, however, the minimum should be two L.F. stages. The method of coupling may be a *good-quality* transformer or a condenser-resistance unit. *This coupling is the main link in the set.*

The final stage must, in order to give the loud-speaker a fair chance, include a large power valve (or, alternatively, a push-pull arrangement), with ample H.T. and a choke-and-condenser output circuit. If "super" volume is required, two middle stages of resistance-coupled amplification should precede the power valve.

This can also be done if the limit of purity is desired, for the four-valve R.C. arrangement would be working at "very small throttle," so to speak, whereas a two-valver might be working "all out."

Summary

Summing up this lengthy detailing, we arrive at the following list:

Set A.—(Where the pick-up input is reasonably large, and where no large volume is required.) One stage of power amplification, transformer-coupled to the pick-up; alternatively, one stage of push-pull L.F. "boosting," comprising two ordinary L.F. valves coupled by a split-secondary transformer (or a normal transformer with two .5-megohm resistances in series across the secondary) to the pick-up.

Set B.—(For all normal work, and providing loud-speaker volume at least equal to that given by a directly-reproduced record.) Two stages of amplification; transformer-coupling between the pick-up and first valve, transformer or R.C. coupling between the valves, and a choke-and-condenser output circuit. A power valve must be used in the last stage, or, alternatively, two ordinary valves in a push-pull circuit.

A Four-valve System

Set C.—(For exceptional volume, or for an unusual degree of purity if the set is worked well below its limit.) A four-valve arrangement with resistance-coupling between the valves and a choke-output circuit for the loud-speaker. All-transformer coupling would be

almost unmanageable in amateur hands, owing to the possibility of L.F. oscillation, and would be unnecessary for ordinary use, owing to the excessive volume obtained from the combination.

This, then, is the list of alternatives, and perhaps you are surprised that there are so many alternatives in a simple L.F. arrangement!

Selecting the Right Circuit

No difficulty should be experienced, knowing one's own particular needs, in selecting the right circuit for the job. This wins half the battle, the remaining difficulties being in the fitting of "extras" and in finding the right values for the components.

Most pick-ups on the market are of the magnetic type, and, as mentioned, transformer coupling is the easiest to arrange. Multi-ratio transformers find a useful sphere in this work, as the primary winding should more or less match the pick-up solenoid. A good-quality 1 to 4 ratio (general purpose) transformer can be used with most pick-ups, but the manufacturers of this latter component usually give advice on the subject, and this should be followed faithfully if the best results are desired.

Without a Push-pull Transformer

If push-pull amplification immediately follows the pick-up, as in Set A in the foregoing list, there is no real need to use a push-pull transformer.

Shunt the secondary with two .5-megohm leaks, as explained previously, taking the centre of the leaks to the grid-bias tapping and the outside ends of the secondary windings to the grids of the push-pull valves.

Easy volume control should be provided, for otherwise much of the charm of gramo-radio is lost. Most of the volume controls on the market consist of a high maximum value variable rheostat.

Connections for Volume Control

This can be connected (*a*) across the pick-up terminals, (*b*) in parallel with the secondary winding of the pick-up—to—valve transformer or of the intervalve transformer, or (*c*) in shunt with the loud-speaker. Arrangement (*b*) is to be preferred, for (*a*) is apt to be noisy, and (*c*) upsets the working characteristics of the last stage.

Dimming the filaments is the crudest volume control, and is wrong on every score except simplicity.

In the first stage should be used a medium-impedance L.F. valve; anode voltage about 80, grid-bias 1½ to 3 volts, and independently variable filament rheostat. This latter is important, as in a good-quality L.F. amplifier it is quite wrong to group the filaments of valves handling totally different inputs. An R.C. valve must be used in this first stage if it is followed by resistance-capacity coupling; very little grid bias will be required, and a potentiometer control may be an advantage. This will act to some extent as a volume control.

If the first stage is the last, then a power valve—taking about 100-150 anode volts and capable of handling the full grid-swing given by the pick-up—must be used. Medium-impedance L.F. valves may be used in a push-pull circuit.

By-pass condensers should be inserted liberally in the circuit, for this is the only sure way of preventing L.F. oscillation. All high-tension tappings should be shunted to negative H.T. with a 1- or 2-microfarad condenser. Small condensers, of about .0001 microfarad, should be placed across the primary of the intervalve transformer and across the loud-speaker or output choke if there is the slightest sign of L.F. howling

Condensers of this value are not large enough to bypass L.F. impulses, and so cause loss of signal strength, but they do much towards stabilising an amplifier and by-passing parasitic oscillations.

Three Gramo-Radio Amplifiers

For those who do not want to design their own:

True-Tone Amplifier.—Three-valve unit with transformer input to first valve which is resistance-coupled to two valves in parallel with choke output. Described in WIRELESS MAGAZINE, January, 1928. Blueprint post free for 1s.—No. W.M.47.

Gramo-Radio Amplifier.—Two-valve unit with transformer input and push-pull amplifying stage; choke output. Described in WIRELESS MAGAZINE, June, 1928. Full-size blueprint for 1s.—No. W.M.72.

Super-power Unit.—Described on page 364 of this issue.

Paralleled Valves

Instead of employing a large power valve, or a push-pull arrangement, in the last stage, two normal-capacity L.F. valves may be paralleled by connecting grid to grid and plate to plate. If the valves are not of similar characteristics the last stage may be unstable. This can be prevented, in many cases, by connecting between grid and grid a very small L.F. choke—more to damp out parasitic oscillation than to prevent the full-strength L.F. impulses reaching the grids.

Battery considerations come outside the scope of this article, but it must be pointed out that ample anode *current* is a *sine qua non*. A gramo-radio amplifier is, primarily, a true-reproduction power amplifier capable of handling a large input and giving a large output. The large output can only be obtained by an ample supply of anode "juice," and most of the troubles experienced can be traced to starving of H.T. L.F. interaction is particularly likely to be caused, while distortion is inevitable.

Output Chokes

Output chokes have been recommended for all large-output amplifiers; they are essential if a moving-coil loud-speaker be used. The best choke circuit to employ is that in which one loud-speaker lead is at earth potential, for this definitely anchors the reproduction side of the set.

From the mechanical point of view there are two little things to remember when laying out a gramo-radio amplifier. Screening of transformers (and of the valves themselves, in the case of a multi-stage arrangement) prevents a host of minor troubles arising. Secondly, the valves must be guarded against vibration, both mechanical and aural.

Audio Howling

Frequently howling is set up by sound waves from the loud-speaker causing the valves to vibrate at audible frequency in antiphonic holders. This is a thing to guard against in the case of large amplifiers. Felt or cotton-wool packing tied round the valves will prevent this audio-frequency "ring."

Test Records for Gramo-Radio

By H. T. BARNETT, M.I.E.E.

IN entire contradistinction to the test records I wrote about recently, records that were difficult to reproduce except on perfect apparatus, now I will mention some really beautiful records likely to come out quite well even on inexpensive sets.

GRAND ORCHESTRA.—*Fountains of Rome*, two discs, at 6s. 6d. each, H.M.V. Exquisite modern music by the Italian composer, Respighi.

SALON ORCHESTRA.—*Dolly's Dancing*, played by the Paul Godwin Orchestra. Brunswick, 4s. 6d. This is just the light kind of music one would expect from the title.

PICTURE PALACE ORCHESTRA.—*Incidental Music to "Monsieur Beaucaire,"* played by Frank Westfield's Orchestra. Parlophone, 2s. 6d.

CHAMBER MUSIC.—*Suite for Strings*, Purcell, two 12-in. discs, The National Gramophonic Society, 58 Frith Street, W.1.

STRAUS'S WALTZES.—*Artist's Life* played by the Orchestra Mascotte, with Edith Loraine. Parlophone, 3s.

PIANOFORTE.—*Soirée de Vienese* (Schubert-Liszt), played by Arthur de Greef. H.M.V., 6s. 6d. *Valse Brilliante* in F. (Chopin) Op. 34, No. 3, played by Victor Staub. Parlophone, 3s. *Soliloquy*, Dance transcription, played by Rube Bloom. Parlophone, 3s.

MILITARY BAND. — *Maritana Selection*. Beltona, 2s. 6d.

TZIGANE.—Popular *Lolita*, played by the A and P Gypsies. Brunswick, 3s.

CINEMA ORGAN.—*Chérie*. Homochord, 19 City Road, 2s. 6d.; an uncommon performance, the vocal refrain being sung *sotto voce* and very prettily.

DRAWING ROOM ENTERTAINER.—I could write half a page in praise of Mr. Ronald Gourley's charming pair *The Dicky Bird Hop* and *Doing the Dominoes*. Electron, 3s.

SOPRANO.—*Einsam in Trüben Tagen* (Elsa's Dream), sung by Elizabeth Rethberg. H.M.V., 6s. 6d.

EXHIBITION JAZZ.—*Together* and *Souvenirs*, played by Paul Whiteman and his Concert Orchestra. H.M.V., 4s. 6d. A record to make even an old fashioned grandmother a jazz enthusiast, so pretty it is.

DANCE RECORDS.—*The Man I Love*, played by Sam Lanins Orchestra. Parlophone, 3s. *Dainty Miss*, piano and band. Electron, 3s.

ENSEMBLE.—The best four-and-sixpenny record of soloists, chorus, and grand orchestra I ever had is *Lohengrin*, No. E10693, Parlophone. Shut your eyes and you will find it difficult to realise you are not sitting in the dress circle of the Berlin Opera House.

Prolonging the Life of Your Records

WHEN you come to think of it, there is no real reason why modern records should ever wear out! The continual passage of a pick-up needle along the sound grooves should simply tend to burnish the record composition, and not to wear it. Given ideal conditions this longevity should easily be obtained.

Careless handling of records is the cause of a deal of trouble which many people try to cure by means other than remedying it at its source; for, after all, the records are the source of all sound energy relayed via pick-ups and amplifiers.

Careless Handling

Provided that a pick-up is correctly placed and mounted so that it bears on the record face with just sufficient pressure and no more, the record can become worn only by misuse or careless handling.

The composition of modern records is not ideal, for it is a commercial compromise. It is easily damaged by excessive damp or heat, the records are easily broken or scratched. The following points, therefore, should be observed.

Storing the Disks

When in store records should be kept quite flat or else supported vertically in slots. The covers or albums should not be exposed to a free circulation of air, which may carry moisture to the edges and which will spread through the grain, and the greatest care must be taken to ensure that through careless storing the records do not become warped. Nothing hastens wear so much as mal-alignment.

Before a record is placed on the turn-table it should be rubbed over both surfaces with a silk squab or a piece of soft velvet.

The turn-table itself should also be similarly cleaned, to prevent the "scratchings" from records previously played from getting into the sound grooves of the new one.

It is quite easy to hold records only at the extreme edges, where there are no sound impressions, and this is advisable as dirt or grease from the skin is readily absorbed by the record composition.

Out of Hand

Incidentally, moisture from the skin makes the edges of records very slippery, and many a record has come to a bitter end through this cause, to the dismay of the holder, who can only say that it just slipped out of his hand! BIM.

IF YOU WANT A REALLY GOOD GRAMO-RADIO AMPLIFIER, READ ABOUT THE SPECIAL TWO-VALVE UNIT WHICH IS DESCRIBED ON PAGE 364 OF THIS ISSUE

WHAT A RECORD IS MADE OF

THERE was a craze some years ago for making panels for wireless sets out of old gramophone records. Perhaps that was the reason why the impression grew that gramophone records were made of ebonite. Actually nothing could be further from the truth.

Modern records are, of course, made by forming in a mould, under pressure, a mixture maintained at a high temperature, usually by steam. Barytes (a sulphate of baryta), and not ebonite, is the chief constituent of most records; slate powder or powdered silica are also sometimes used.

With this chief element is mixed, in fairly small proportions, carbon black, shellac and gum. Mechanical mixers ensure an even mixture and the slabs are then placed between the master mould faces and the heat and pressure applied. Extreme accuracy is necessary in the moulding process, for faults lead to badly-centred records and "swingers." M. L. B.

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AUTOMATIC PELMANISM!

DID *you forget to switch off?* Don't be disturbed if the question has caught you napping, but make certain next time!

After all, there is some excuse for forgetting to turn off the "juice" from a gramo-radio amplifier. A radio set which is left "on" usually announces the fact sooner or later by emitting a blast of morse, while even the "rustle" during the so-called silent intervals at the local station is not inaudible.

No such noises can be heard via a pick-up, and it is easy, having stopped the turn-table, taken off the record and folded back the tone-arm, to forget to turn off the amplifier.

The simplest plan is to fix a small tell-tale flashlamp bulb near the turn-table. The lamp should be wired in parallel with the amplifier filaments, so that the tell-tale glows when the gramo-radio outfit is working. The current consumed by the bulb is not of great moment, for the amplifier is not working continuously, as is the radio section.

With the automatic record-stopping arrangement fitted to some types of gramophone it is quite simple to arrange a leaf-contact spring touching the vertical arm of the stopping device. The contact should be connected to one side of the filament switch, and the vertical arm mechanism to the other.

Thus, when the tone-arm reaches the centre of the record the amplifier will be switched off. I. W. MacB.

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THE PIANISSIMO BRIGADE

TIME was when unmusical amateurs were said to like plenty of "beef" behind their loud-speaker reproduction, at the expense of purity. That's as may be, but recently I came across another type of gramo-radio-ite whom one can only describe as a member of the *pianissimo* brigade.

Proud of the latest in pick-ups and power amplifiers, he ran through about half a dozen records for my delectation. True, there was no surface noise whatever, but I would prefer needle scratch to the ephemeral whispers which drifted faintly out of the loud-speaker.

Anything above *piano* was, to this super-critic, a raucous noise, despite the fact that the equipment was good and the volume could have been doubled without affecting purity. I confess with shame that I like *reproduced* volume to have some relation to the *original* volume. Whispers won't do unless the recorder is a whispering baritone.

And when Christmas comes I shall give this pianissimo man a pick-up needle specially compounded of tallow and soft soap. QUEUE.

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HOW FAST!

"I LIKE that bit," she says. "Let's have it over again a little slower, so that we can hear what the man says."

Obediently the male flicks back the pick-up and sets the speed regulator to "Slow." A gruff mumble, reminiscent of a cow calling its young, issues forth from the loud-speaker.

"We'd better have it as it was," she says. "It was better at the proper speed."

"Yes, it is," says he.

It is!

The plain fact is that gramophones are "speeded," not in order to give variations of tempo (except for dancing, and so on), but for alterations in pitch. The utmost care is taken when recording in order to see that the speed is correct, and the record makers' figures should be noted before each disc is played.

Formerly the accepted speed was 80 r.p.m., but several prominent manufacturers nowadays record at a speed slightly less than this; 78 r.p.m. is the usual figure, while some records are still made at 80 r.p.m.

Do not rely on the speed regulator unless you know it to be accurate. It is, of course, an easy matter to chalk a mark on the outer edge of the turn-table, to set this latter revolving and to count the number of revolutions per minute. QUEUE.

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GRAMO-RADIO WITHOUT A SET!

HERE is a new use for pick-ups. It can hardly be classed with gramo-radio, for the radio and amplifier are entirely absent!

If a pair of phones be connected to the tags of a pick-up lead, it will be found that, when the pick-up is working in the normal way, the gramophone can be heard very loudly on the phones. The volume is greatly increased if a 1½-volt cell be connected in the pick-up—phones circuit, in such a direction as not to demagnetise the pick-up.

Doubtless you will be able to find many uses for this novel application. Where wires are carried about the house, so that people in one room may listen-in with phones, while the set and loud-speaker are used in another room, this "no amplifier" pick-up idea will be found useful.

The gramophone can be kept where it is needed most—that is, near the radio set—but it can be heard at a distance (on the phones) without the necessity of working the gramo-radio amplifier.

It also allows of the radio set and the gramophone being used at one and the same time, for the listener to the gramophone can clamp the phones on his head and listen in without worrying the radio "fans." J. D. C.

WHEN RADIO GOES OUT— GRAMO-RADIO COMES IN!

PHILIPPICS have been written and said about wireless sets, for a reason which I did not quite understand until recently.

The other day I was the silent party in an argument between an unofficial recruiting sergeant for the B.B.C. and a man who was trying not to be persuaded to "go in for wireless."

So Cheap

"It's so cheap," explained the recruiting sergeant. "For ten shillings a year you get an average of eight hours' entertainment per day, for seven days a week and fifty-two weeks in a year, unless it's a leap year, which works out at about——"

"But I don't get eight hours' entertainment a day," complained the unwilling one. "I get seven-and-a-half hours of stuff I don't want, and the rest of the time's my own! I know the B.B.C. isn't to blame. But I want to pick and choose; and I can't pick and choose with radio."

That's where radio goes out. As a sequel to this dialogue, I must explain that our united efforts induced the grouser to seek a radio dealer, but he was not only going to buy a wireless set. He ordered, at the same time, an electrically-driven gramophone and pick-up.

A Weighty Statement

So far as possible the B.B.C. have overcome the "picking and choosing" difficulty; but I feel bound to make here a weighty statement. *Enthusiasts would do 25 per cent. more listening if they could pick their own programmes.* This is where gramo-radio comes in.

Electrical reproduction certainly does change a cheap gramophone into a good one, and it makes electrically-recorded discs come to life. Above these advantages, in my opinion, is the fact that gramo-radio gives every set-owner a broadcasting station of his own, at which he can select his programmes at will.

It is never likely to supersede radio entirely, for perhaps you remember all that was said in the early days, in favour of radio and *against* the gramophone—that radio was *living* and the gramophone "canned," that radio gave an infinite variety of programmes, and so on. These still apply, but added to them are all the advantages of the gramophone!

How are you going to effect gramo-radio? If it is a question of making up a new set, well, pick-ups can be added to many of the receivers described in the WIRELESS MAGAZINE. Moreover, a number of special gramo-radio amplifiers have been dealt with in recent issues.

Gramophone equipment should be chosen not so much to suit your pocket, but to suit your needs. If you have pretensions towards being "musical"—horrid expression—then you will not have satisfaction with less than a three- or four-valve resistance-coupled amplifier, a moving-coil loud-speaker and a turn-table and pick-up of reasonable quality.

Per Contra if you are at present contented with a modest two-valver and a small horn or cone-type loud-speaker, then you will possibly not be a "stickler" for quality and luxurious equipment would be wasted. If you have a cheap wireless set and a cheap gramophone, then you will obtain increased enjoyment from *both* by reproducing the gramophone electrically. It will give you better gramophone reproduction, and it will give the wireless set increased scope.

"How is it done?" is not a question you are likely to ask if you read the WIRELESS MAGAZINE thoroughly.

One word of advice, though. At least two stages of amplification are needed for good reproduction, even if they are not worked at full strength. If, therefore, you intend to convert a two-valver to gramophone reproduction, make use of a circuit which allows of the detector being used as an amplifier for gramo-radio.

Use a volume control, because this is yet another advantage of gramo-radio over direct reproduction. The simplest system is to control the volume at its source, by shunting the pick-up with a high-value variable resistance.

Just to settle all doubt as to whether gramo-radio is worth while, here is a convincing list of advantages:—

Cheapness.—If you are starting out in gramo-radio with no gramophone or wireless equipment, you will find that pick-up, turn-table mechanism *and* a wireless set cost less than a first-class gramophone.

Reproduction.—A good wireless set is always better, from the point of view of reproduction, than a good gramophone. Via a pick-up, however, gramophone reproduction becomes very nearly equal to radio reproduction. With high-class records it is practically impossible to distinguish between "radio" and "gramo-radio." *Verb. sap.*

Effect on Records.—With a properly-mounted tone-arm and pick-up, wear on the surface of a record should be negligible. Electrically-reproduced records will last, in many instances, ten times as long as records mechanically reproduced. To the possessor of a large stock of good records this is a most important factor.

Volume and Volume Control.—By electrical amplification almost unlimited volume can be obtained, which is an inestimable advantage for dances and so on. As explained, volume control by means of a variable resistance is easy to carry out, and adds to the charm of gramophone reproduction in a small room.

I suggest that one of the easiest ways to be convinced of the superiority of gramo-radio over mechanical reproduction is to visit one of the cinemas in which gramo-radio on a large scale has been installed. There are many such. J.K.D.

Half Hours with the Professor

AT THE TRANSMITTING END

"I HAVE a letter here," said Megohm to Young Amp one day, "from a correspondent who wishes to know how the currents in the transmitter are turned into wireless waves."

When the Receiver is Useless

Megohm put down the letter on his desk and regarded the Amp thoughtfully. "Well, my boy," he said at length, "what do you know about it? We have often discussed points affecting the reception of signals, but when all is said and done, the receiver is useless without the mechanism which converts the sound waves into wireless waves in the first place."

"Yes," agreed the other, "that is right, of course, but s'matter o' fact, I have never worried very much about it."

"I don't suppose many people do," was the reply, "but anyhow let's hear what you think about it."

"What? How it works, you mean?"

"Yes."

"Lumme," said the boy, "how do I know? All I know is that a bloke stands in front of a micaphone and spouts."

Tolerably Correct

The Professor smiled. "That is tolerably correct as far as it goes, but it doesn't take us very far. What is a microphone anyhow?"

"Well, I don't quite know," answered Amp. "I know somehow that it converts speech into wireless waves and I suppose it has a mica diaphragm or something."

"Why should you suppose that?" interrupted the other. "Oh, I see," he added with a sudden flash of enlightenment, "mica and micaphone, eh?"

Amp nodded. "You said it," he added, feeling very pleased with himself.

"I'm afraid I did," agreed the Professor sadly. "Where on earth you get these funny ideas from, I do not know. The instrument which we are discussing is a *micro*phone and not a *mica*phone. The word literally means 'very small sound' and is derived from the fact that the instrument which bears its name will convert very small sounds into electrical currents."

"Well, that's what I said, anyway," agreed the Amp quite unabashed. "What does it matter if I do spell the thing the wrong way? No, perhaps I oughtn't to say that," he added hastily, noting Megohm's pained expression, "but at any rate I got the idea, didn't I?"

Converting Sound Waves

"No, I don't think we could even consider you've got that correctly. All the microphone does is to convert the sound waves into telephone currents. These are low-frequency currents, quite different from the high-frequency waves which we have to control later in the apparatus.

"There are various forms of microphone. The simplest forms contain carbon granules in a suitable receptacle and the variations in air pressure caused by the speech or music are arranged to impinge on a diaphragm of a suitable character. The motion of this diaphragm is arranged to cause compression of the carbon granules.

"Now it is a property of carbon granules that the resistance depends upon the pressure. When the granules are packed closely together, the resistance is low, whereas, if they are only loosely packed, the resistance is relatively high."

"I see," interrupted Amp, enthusiastically, "then the air pressure causes the resistance of the carbon to vary."

Proportional Variations

"That is right," answered the Professor, "and the variation is more or less proportional to the air-pressure variations. All we have to do, therefore, is to pass a current through the microphone and then the speech waves will cause variations in this steady current. That is the first link in the chain. We then pass the currents through a transformer which extracts the varying currents from the steady current which is no longer required."

"Then," broke in the boy, "I suppose they can amplify these currents if they want to just as with ordinary broadcasting?"

"Exactly," was the answer. "In practice, the currents are amplified with suitable apparatus many hundreds of times until ultimately they operate the modulators of the transmitter."

"Oh, ah," said the Amp, "I've heard of those before. What on earth are they?"

Modulators

"Modulators are valves arranged to control the output from the oscillating valves themselves. The transmitter consists of a glorified version of a simple reaction circuit such as a Reinartz circuit in a receiver. Instead of keeping the circuit at the point of oscillation, however, we allow it to oscillate definitely and, moreover, to oscillate with the greatest efficiency. Therefore, we make slight modifications, but the circuit is generally similar. Here," continued Megohm, "let us sketch a very rough circuit."

Half Hours With the Professor (*Continued*)

So saying he drew a piece of paper forward and sketched out the right-hand portion of the circuit shown in Fig. 1. "You will see that in order to obtain the best efficiency, the

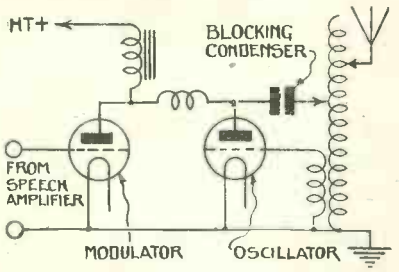


Fig. 1.—Skeleton transmitting circuit

anode circuit is tuned instead of the grid circuit, as is more usual, in receivers. The high tension is supplied through a high-frequency choke and the high frequency currents are fed from the valve to the tuned circuit through a blocking condenser.

"This corresponds to the ordinary reaction condenser, but it is made fixed because we wish the circuit to oscillate continuously. The reaction coil is in the grid circuit and is coupled to the tuned circuit in order to produce the necessary regeneration."

"There isn't any tuning condenser?" exclaimed the Amp.

"The tuning condenser is formed by the aerial capacity, my boy," answered the Professor. "As we cannot vary this easily we tune the circuit by tapping the inductance."

"Oh, of course," said the Amp, "I ought to have spotted that myself. What is the other tapping for, though?"

Most Efficient Working

"The anode feed from the valve, do you mean?" queried Megohm. "That is only connected across part of the circuit in order to obtain the most efficient working condition, which occurs when the effective impedance of the oscillating circuit bears a certain definite relationship to the resistance of the valve."

Amp studied the diagram for a moment or two and then he said: "Yes, I've got that all right, Professor. Now, where do the modulators come in?"

"Modulating valves are added to control the high-frequency oscillations. A circuit such as this would radiate continuous waves which would produce no sound in the ordinary broadcast receiver unless it happened to be oscillating. We have to vary the strength of the waves from instant to instant in accordance with the telephonic currents produced by the microphone. Then we shall receive the varying currents at the receiver which we can understand as telephony. That is clear, I take it?"

Amp nodded his head in response.

"The way this is usually carried out in modern transmitters is by varying the high-tension voltage applied to the oscillating valve. To do this, the high-tension supply is taken through a low-frequency choke coil and not only the oscillator valves but a number of modulator valves are also supplied from the same source.

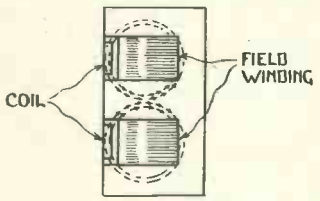


Fig. 2.—Diagrammatic sketch of magneto-phone

"Now these modulator valves are simply ordinary valves drawing their high-tension current from the same source. If we make the grids of these valves positive, then the anode current will increase. This will cause a voltage to be developed across the L.F. choke in opposition to the normal H.T. voltage so that the total anode voltage is reduced. Thus, the oscillating current in the aerial circuit will decrease.

"Conversely, if we make the modulator grid negative, the anode current will decrease and the oscillating current will increase. Thus, by arranging matters correctly, we can cause the voltages impressed on the grids of the modulator valves to vary the actual strength of the oscillating current in the aerial in strict proportion."

The boy remained silent for some time regarding the modulator circuits which the Professor had added to the diagram. These are shown on the left-hand side of Fig. 1.

Finally, he said. "Oh, that's very interesting, Professor. I did not realise that there was so much of interest in the transmitter. I suppose, really, they have almost as many problems as the receiving enthusiast."

"At any rate, they have their problems," agreed the Professor, "and, as you say, they can be very interesting ones. Now," he added after a pause, "is there anything else you would like to tell me about transmission before I reply to this letter?"

More About the Microphone

"Don't rag a fellow, Professor," said Amp with a grin. "Since you ask me, I should like to know more about the microphone. Are all microphones of the simple type you described?"

"No," answered Megohm. "For a long time the B.B.C. used what was known as a magneto-phone. This consisted of a very light coil freely suspended in a strong magnetic field. The air vibrations caused this very light coil to flutter in space and the movement of the coil in the magnetic field set up currents in the coil" (*see Fig.* 2).

"Like a moving-coil loud-speaker backwards?" suggested Amp.

"Precisely. It is the same process reversed. The system was less sensitive than the carbon microphone and required more amplification."

"What did they use it for then?" asked the boy.

"Because it gave a better response at the ends of the audible scale. The very low and very high tones were better reproduced than with

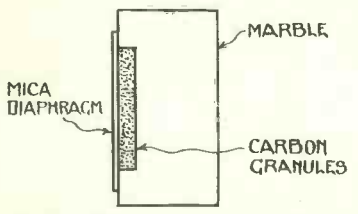


Fig. 3.—Reiss carbon microphone

the ordinary carbon microphone."

"Oh, I see. Then is that the type they are using now?"

"No, as a matter of fact they have gone back to the carbon microphones,

(*Continued on next page*)

These photographs show how the original Chummy Four design was adapted by an Ewell reader of the "Wireless Magazine." It will be seen that the layout of the actual set remains the same as the original, but the case has been modified considerably. The receiver and batteries are arranged in the body of the case, while the loud-speaker is accommodated in the lid. The monogram "M.C." over the loud-speaker represents "My Chummy"!

(*Continued from preceding page*)
but in a modified form. The present type of microphone consists of a marble block having a very shallow recess of large superficial area. This is covered with a thin sheet of rubber or mica and the space in between filled with carbon granules. Like this," he added, drawing the sketch shown in Fig. 3.

Very Good Response

"This type of microphone has a very good response and it is somewhat more sensitive, so that the amplification need not be so great. We can, however, put out frequencies on a broadcast transmitter ranging from 40 to 4,000 with comparative ease, which is a distinct advance upon the early practice."

"Um," grunted Amp, "jolly interesting. Well, any other time you want to know anything from me, Professor, please let me know. Anyhow," he added, as he disappeared round the door, "I was right about the micaphone, 'cos they have got mica diaphragms after all."

MEET AMP AND THE PROFESSOR AGAIN NEXT MONTH

The Weakest Link!

A WIRING diagram may be regarded as a chain of components, each of which is dependent on another. Which is the weakest link in the chain, and which should we try to avoid in all circuits?

We can eliminate as "safe" all components having positive "through" contacts, such as coils, transformers, and even condensers, which provide a continuous circuit for A.C. current. Rheostats and potentiometers of the wire-wound type can be classed with those components giving positive continuity.

This leaves us with grid leaks and anode resistances not of the wire-wound type, which, as they always provide imperfect contact, must surely be the weakest links.

If, however, the makers of the leaks and resistances used in your set guarantee them to be accurate despite all temperature and climatic changes, or if your set has an anode-bend detector and no resistances, then the problem of the weakest link remains unsolved. The weakest link is, in fact, the missing link!

BIM.

When Changing the G.B.

A TIP which should be noted when adjusting grid-bias values to the grids of large power valves is that it is wise to switch off the H.T. before pulling the G.B. leads from their sockets.

When the leads to the grid are disconnected the negative bias is temporarily reduced; this will cause an excessive anode current to flow for a short period, which is detrimental to filament and battery longevity. After a time the isolated grid will assume a negative charge from the electrons shot off from the filament, and this tends to reduce the anode current to its normal value.

To prevent this temporary excess flow, however, it really is a good plan to switch off while the G.B. leads are not connected to the battery. M.

AN AMATEUR'S IMPRESSIONS OF CANADIAN RADIO

By The Rev. E. Ebrard Rees

Note the homely atmosphere of this Canadian broadcasting studio

ON a journey right across Canada from Quebec to Victoria, B.C., having experiences before the microphone, and listening through more than fifty different sets, I was surprised at the tremendous differences there are between our English radio and the Canadian.

The differences vary fundamentally on two opposing tendencies. In England we have a highly developed programme, perhaps unequalled anywhere except in certain German centres. In Canada the programme is exceedingly poor. It is monotonous; it is intermittent.

However used one is to a station, it is never definite whether there's anything on at a particular hour on any Canadian set wavelength. We have our children's hour, set and specialised talks on music and art, and other technical subjects, weekly or fortnightly, and they vary only in time or place with sufficient excuses.

Haphazard and Irregular

Canadian radio is haphazard and irregular. The listener is never sure whether the programme of the newspaper will be carried through. Surprises one gets, but they are generally from the special to dance music or theatre music. Compared with Canadian radio programmes, the B.B.C. stands in a most favourable light.

The Canadian radio stations are mostly privately owned. Some theatres have their broadcasting stations, from which they broadcast a few items to whet the appetite of the listener for more. These stations are employed as a means to bring the people to the theatre.

A Comedian

A comedian broadcast one verse of a popular song from a West Canadian theatre; then the announcer explained who the comedian was and what crowds he was drawing. We heard the applause and a further appeal for us to come along and swell the cheers the following day.

Curiously enough, all the five theatre broadcasting stations I listened to were advertising perfume. Not the same perfume, either, but three rival perfumes. In the American theatre broadcasts, also, perfumes and beauty parlours and chiropodists were being boosted all the time.

I did not hear an advertisement for silk stockings or wearing apparel from theatre studios.

The Canadian rival railways also have their chain of radio stations, from which one can hear some dance music, an occasional chamber-music concert, and a variety artiste.

Much time is given by these studios to travel talks descriptive of areas and foreign countries, changes in railroad time-tables, and the advertising of articles which, directly or indirectly, mean more business for the railway company in tourists or freight.

Religious Broadcasts

These studios were once rented by certain religious sects for complete control in the broadcast of their creeds and beliefs. Of late months railway company studios have quitted religious matters.

Then there is the Press broadcasting station. Every daily newspaper that counts in Canada has its own wavelength and broadcasting station, and the programmes are about the best in the country.

A favourite programme is "A Request Programme." Listeners and readers 'phone their requests, and if lucky in the queue their favourite is played that evening.

In Toronto the announcer stated that as they had over two hundred requests to hand that evening, the request programme would be continued for a week. It would be a change, at least, if the B.B.C. lived from hand to mouth in this manner for one week. But supposing there came a request for Sir Harry Lauder or George Bernard Shaw!

Sectarianism on the Ether

There are also many churches in Canada that have their own broadcasting machinery. Controversial and sectarian religious matter fits well in Hyde Park or in a church or chapel, but, as a parson, I do object to sectarianism on the ether.

Somehow, the ether seems too vast and expansive for the propagating of narrow creeds and the bellowing of shibboleths. However, there are wonderful organ recitals sent out not infrequently from a few

of these churches. And organ music is as expansive as the ether itself, whoever the composer or organist.

Turning to the other end—that of the listener—one was amazed to find the high standard in sets. The range, reception, and tone of all the sets I listened to in Toronto, Quebec, Montreal, Calgary, Vancouver, and Victoria were astonishing.

Buying Good Things

When a Canadian buys anything he buys a good thing. The sets I listened to in hotels and private houses were expensive, if compared with our prices. I did not see a set anywhere—outside the radio stores—worth less than £50.

Five valves were ordinary; six- to ten-valve sets were not uncommon. The cases were of the four-foot high style and were beautiful to look at. Direct current was in general use also.

I inquired at a radio stores for a crystal set and the dealer laughed. He had heard of crystal sets, but he did not know that adults used them. He was under the impression they were children's toys.

He had nothing in stock less than five-valve sets, and on my insisting to talk of three valves he assured me that only five-"tubers" would be of any use.

The chain or series of stations is a great boon in Canada. Two or twenty stations will take the same programme one evening, and although the three hours' difference in time between New York and Vancouver makes a difference, I was able to hear New York through a chain of stations at Vancouver.

The chains are called "Blue," "Black," "Red," etc., and although most of the stations in a chain may be in America, some links may be in Canada.

I noticed with great interest that stations came through much clearer from the east than from the west. A good set would get a station five hundred miles east distinctly, but find only one at the two hundred miles west with equal clarity.

Need for More Authority

Canadian radio needs greater central and executive authority, which will reduce the chaos of the distribution of wavelengths into cosmos. At present some provinces charge a licence fee of two dollars, others a dollar, some none. Anyone may broadcast and listen in some provinces without permission or consent.

The crux of the situation lies in propaganda and advertising. It pays to advertise with a broadcasting set. A perfume company's managing director assured me that his sales had gone up eleven-fold since he started on the air, eight years ago, and he has saved half his advertising expenses by putting his wares on the air instead of on paper.

No wonder, for his perfume is mentioned in beautiful language before the announcement of every item from a certain studio.

Few are the amateur wireless fans in Canada—I mean those who are interested enough to make their own sets and experiment. In Toronto I saw only one wireless shop in which one could buy all the parts necessary to build a complete set.

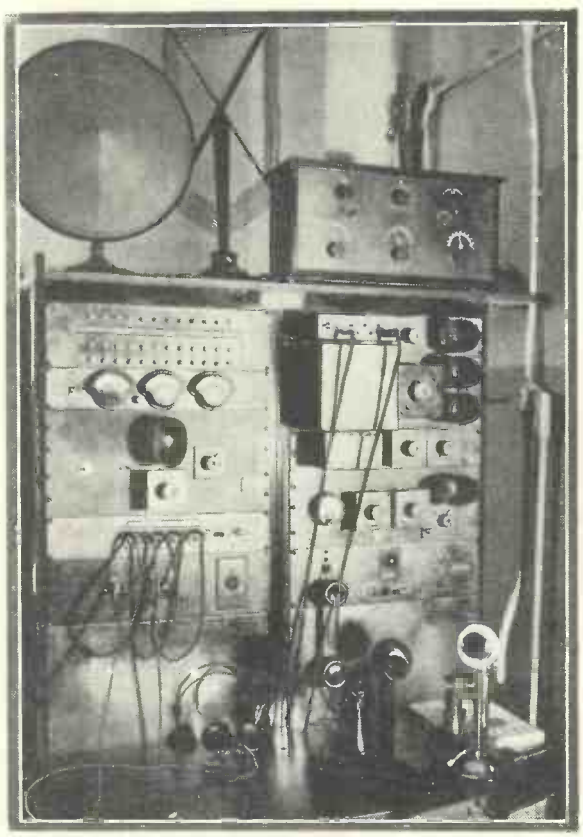
Huge Prices for Odds and Ends

Odds and ends were sold at huge prices. Valves of various makes and designs were on sale. But the listener buys the complete set, and sends for the wireless engineer if and when anything goes wrong.

There are fewer listeners in the country in ratio to the population than there are in England, Canadian life not being so conducive to evenings at home as ours. Radio is catching on in certain areas, nevertheless, and a boon is expected during the next winter.

At a little village called Depew, situated hundreds of miles from the nearest broadcasting station, up in the heart of the expansive forests, there are five houses. Each house had an aerial and a listening-in set, and the reception was perfect. The householders assured me that the nearest radio fan lived no less than a hundred miles away.

They feel the pulse of the world in their isolation and radio has made them happy.



Control desk of a Canadian broadcasting station. On the top of it is a cone loud-speaker for checking the quality of the programme being transmitted

Two-valver's 1,000-Mile Loud-speaker Range!

EXTREMELY cheap to construct, the Crusader (WIRELESS MAGAZINE, *June*, 1928) *is a simple two-valver that will receive on all wavebands. This letter, from a Cape Town reader, is evidence of the results it will give* :—

As a regular reader of your magazine, I have the pleasure of informing you that, having constructed the two-valve all-wave receiver, namely, the Crusader, which appeared in June, I was never so much surprised at the results I obtained on the ordinary waveband. I might also state I tune in Durban and Johannesburg on the loud-speaker; the latter is 1,000 miles distance.

The results obtained on the Cape Town, Durban, and Johannesburg waveband are as good as any four- or five-valve receiver I have heard.

In concluding, let me say I have wired up most of the three-, four-, and five-valve receivers which have appeared in your magazine from time to time, but the Crusader is the best adapted for this country.

Secrets of Success with the Screened-grid Valve

An Article of Outstanding Interest by W. JAMES

I HAVE found that the screened-grid type of high-frequency valve is not so popular with amateurs as it should be, for the very good reason that the best method of using the valve is seldom explained to them.

For reasons which are not at all clear a plain tuned-anode coupling is nearly always recommended. But according to my understanding of the properties of the screened-grid valve, this is the wrong coupling.

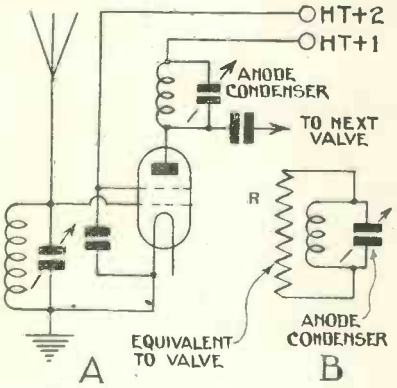


Fig. 1.—Typical Screened-grid Circuit

My experiments indicate that the tuned-anode circuit should only very occasionally be employed—otherwise broad tuning, poor amplification, and lack of stability are bound to result. These are, of course, the very matters of which amateurs complain.

Unsatisfactory Results

Why should the results tend to be so unsatisfactory when a tuned-anode coupling is used? There are several reasons. Let us examine a typical circuit such as Fig. 1. The screened-grid valve we will assume has a magnification factor of 140 and an anode impedance of 160,000 ohms.

Then the pure high-frequency magnification that will be obtained when the anode circuit is quite an ordinary one, comprising a coil of solid wire and a .0005-microfarad tuning condenser, is about 70. That is, the anode circuit voltage is about 70 times the grid circuit voltage. (We have assumed the anode coil to be 3 in. in diameter and wound with No. 24-gauge double silk-covered wire).

Considerable Magnification

The amount of magnification for the single stage is therefore considerable, for with certain balanced or neutrodyne radio-frequency circuits employing ordinary valves, a magnification of only 15 to 20 is obtained.

It therefore seems that there is no difficulty in securing theoretically, at all events, a large magnification with a tuned-anode circuit. But how about selectivity? High magnification is of no great value unless we are able to select the desired signals.

Fig. 1 may be re-drawn to show clearly that the selectivity of the tuned-anode circuit when connected to the valve is much poorer than that of the circuit by itself. In fact, the selectivity of the anode circuit when joined in series with the valve, as in Fig. 1, is approximately equivalent to that of a circuit with approximately twice the losses taken by itself.

The tuned-anode circuit is, in effect, shunted by a resistance equivalent to that of the valve. As a result, when the impedance of the valve is low the selectivity will be poor, whilst when the valve has a high anode impedance it will not greatly affect the selectivity of the circuit.

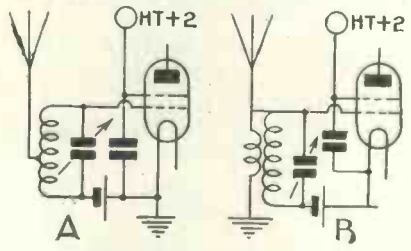


Fig. 2—Aerial Couplings

To explain this point more fully, let us assume the impedance, or more correctly, the effective resistance, of the circuit at the resonant frequency is 100,000 ohms. Then if the valve has an impedance of 100,000 ohms, the coil will tune as though its losses were twice as great as they actually are. This is because the impedance of the valve is equal in magnitude to the effective resistance of the tuned circuit.

Thus, the circuit of Fig. 1B, where R represents the impedance of the valve, is equivalent to Fig. 1A, as regards selectivity. Obviously if the impedance of the valve is reduced, the tuning is made broader as the effect is as though the losses of the coil were greatly increased, while increasing the impedance of the valve will make the tuning sharper.

Poor Selectivity

The theoretical characteristics of a plain tuned-anode circuit such as Fig. 1 are therefore large magnification and poor selectivity.

The screened-grid valve has a grid which is screened from the anode, but the screen actually comprises a wire mesh which does not perfectly shield the grid. In addition, the supporting wires for the electrodes, and the external connections to the grid and anode, have a little capacity. The screening is, therefore, not perfect by any means, and there is a small but definite capacity between the anode and grid.

We will assume the anode coil and tuning condenser to be enclosed within a metal box in order that they will not couple with the grid circuit or aerial. Then the only factor which need concern us is the anode-grid capacity of the valve and its connections.

Although this is very small it is sufficient to pass a current from the anode circuit to the grid circuit, and, obviously, the strength of the current will depend upon the difference in voltage of the anode and grid.

It will also vary with the frequency, increasing as the frequency is increased. Thus, if the difference in voltage remains constant there will be twice as much current flowing from the anode to the grid circuit at 250 metres as at 500 metres, because the frequency corresponding to 250 metres is twice that of a 500-metre wave.

The difference in voltage between the anode and grid obviously depends upon the nature of the tuned-anode circuit. If the tuned anode is a good one the magnification will be considerable. We have assumed an ordinary coupling with which a magnification of about 70 is obtained and as a result the voltage of the anode is approximately 70 times that of the grid.

An anode circuit having a very poor tuning coil might give a magnification of only 30. In this instance the anode voltage would be only about 30 times as great as the grid voltage. The amount of current which passes through the stray capacities from the anode circuit to the grid circuit therefore depends on two factors.

One of these is the amount of magnification and the second is the wavelength or frequency. With ordinary circuits the magnification increases as the wavelength is reduced and, therefore, the amount of current passed from the anode to the grid circuit increases by two factors as the wavelength is lowered.

Now the current which passes from the anode circuit to the grid circuit through the residual capacity produces a reaction effect, which may be so strong as to cause the grid circuit to oscillate. Naturally the amount of reaction required for oscillation will depend upon the nature of the grid circuit.

If this is a poor one including a coil with large losses a relatively great amount of reaction will be necessary before it oscillates. But, on the other hand, if a reasonably well-made grid coil is used and the aerial is coupled to it as in Fig. 2 in order that its losses shall remain reasonably low, the circuit will oscillate with only a small amount of reaction.

What happens in practice? Experience indicates that with a magnification of 70 the grid circuit will oscillate unless the coil used is an extremely bad one. And when it is a bad one its tuning will be very broad and the signal strength poor. It is therefore necessary so to modify the aerial circuit that reasonable selectivity be obtained.

This can be accomplished by connecting the aerial to a point on the coil or by employing a primary winding as in Fig. 2. A two-fold gain is, therefore, obtained, for by increasing the selectivity we have also improved the signal strength. But with a selective grid circuit of this type the circuit will be unstable.

Steps are, therefore, usually taken to reduce the amount of amplification because by so doing the difference in voltage between anode and grid is reduced, which in turn lessens the reaction and so stabilises the circuit.

This, however, is not a satisfactory procedure. Surely it is bad practice to throw away amplification and selectivity in order to obtain stable working when there is an alternative.

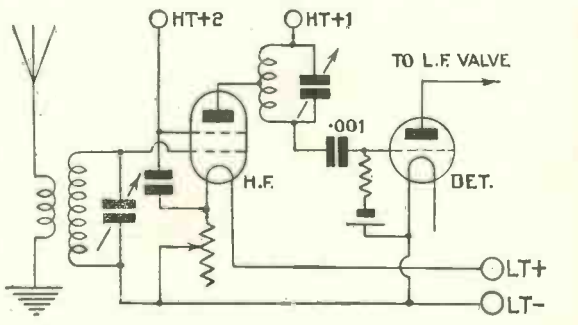


Fig. 4a.—Tuned-anode coupling

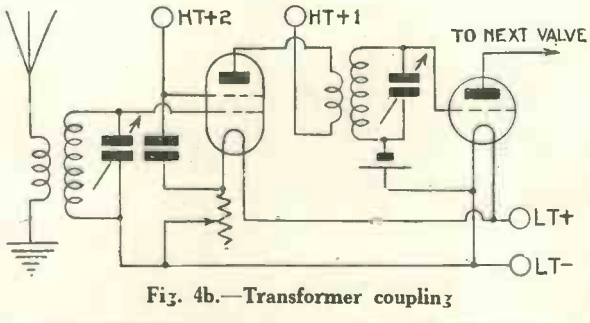


Fig. 4b.—Transformer coupling

Let us connect the anode circuit as in Fig. 3. Using the same anode coil as before the voltage actually developed at the anode of the valve will be approximately 30 times the grid voltage. But the voltage set up across the ends of the whole anode coil will be about 60 because there is a two to one ratio step-up in voltage.

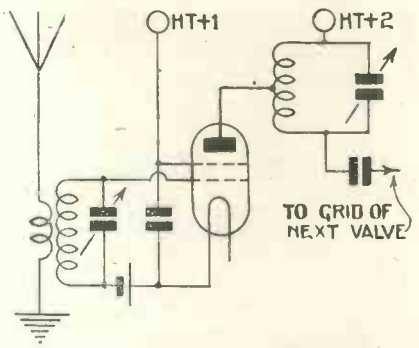


Fig. 3.—Anode circuit

We have, therefore, lost very little amplification in the anode circuit, but we have gained several things.

In the first place, the amount of current which passes from the anode to the grid through the stray capacity is approximately halved. Therefore, the amount of reaction is reduced and the circuit will now probably be quite stable, even though a well-made grid circuit is employed.

Secondly, the selectivity of the whole circuit is greatly improved, because now the damping effect of the anode of the valve is considerably reduced. The damping effect is actually only about one quarter as much as it was before.

The circuit of Fig. 3 is, therefore, much superior to that of Fig. 1 in all respects. It is much more selective and will in all probability be quite stable. Further, on the whole it gives much greater magnification. This is because the aerial circuit may be reasonably efficient, and it will, therefore, develop larger voltages across the grid and filament connections than the circuit of Fig. 1.

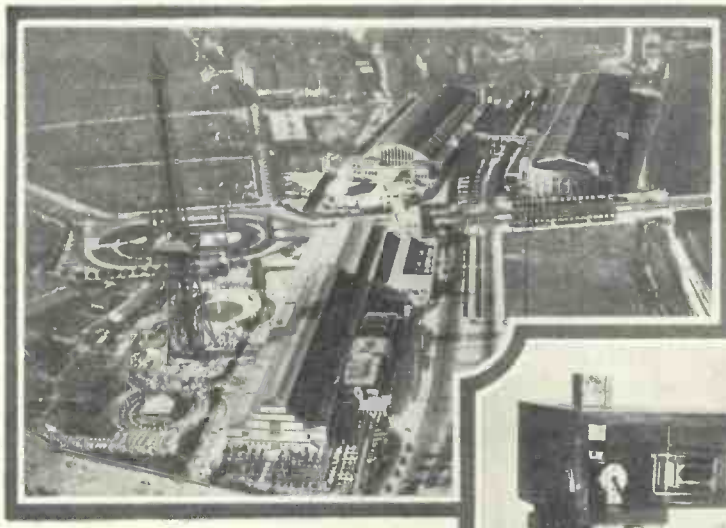
The total magnification provided by the stage is, of course, the product of two factors. One of them is the ratio of the voltage set up across the ends of the anode coil and the grid voltage. This is the pure high-frequency amplification. The second is the ratio of the actual grid voltage to the grid voltage which would

(*Continued on page* 368)

At the Berlin Radio Show

TELEVISION AND WIRELESS PICTURES PROMINENT

By H. de A. Donisthorpe



The Berlin Radio Exhibition, showing grounds, buildings, and mast of the broadcasting station with restaurant half-way up

Berlin, September 1928.

THE Berlin Radio Exhibition has once again presented the radio wares of its country to the listening public of Germany in a form that is palatable and pleasing. There is little doubt that our Radio Exhibition authorities here could learn a good lesson from Berlin as how to present radio to the world, whether that public be radio "fans" or mere sight-seers.

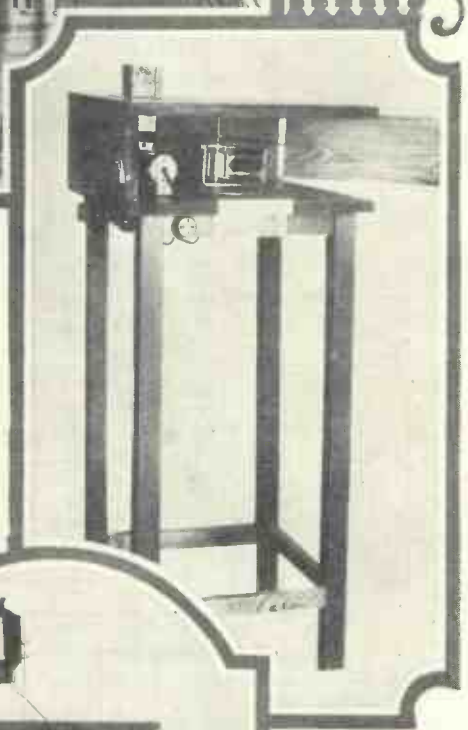
Larger Show

The Berlin Exhibition has grown considerably since last year, and in order not to crowd the various exhibitors, the show was extended into a further hall.

Notable Events

The exhibition this year synchronised with two notable radio events. First, the celebration of the twenty-fifth year of Germany's premier radio company, the Telefunken Company, and secondly the autumn meeting of the delegates of the Union Internationale Radiophonie, which is the union of the broadcasting organisations of the various European countries. This latter-named event synchronised no doubt rather by arrangement than coincidence.

As was the case last year, the best exhibit can be attributed to the State department of Germany, which in a very comprehensive manner presented to the public all the ramifications of the existing German broadcasting system. Under this exhibit were to be seen displays by the State broadcasting department, the State post office, and the police department.



Von Mihaly television receiver

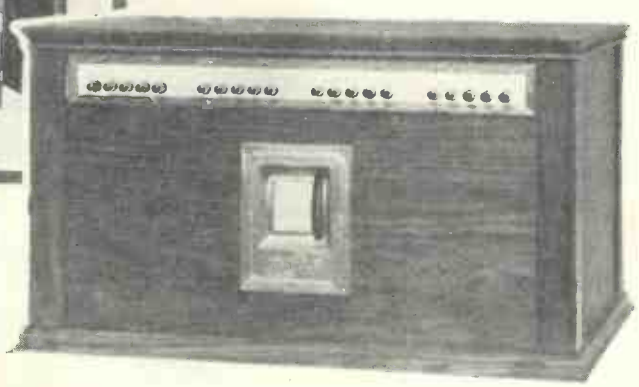
Von Mihaly television transmitter

Father of Radio

Dealing with these exhibits in detail, and taking the State broadcasting department's efforts first: Here the public were treated to a eulogy and tribute to Professor Henrich Hertz, who can be termed, perhaps, as the father of radio, since he was the discoverer of the electro-magnetic wave. This exhibit consisted of a series of photographs and descriptions depicting the life of this famous scientist. There were also to be seen various pieces of his apparatus as were used in his original experiments.

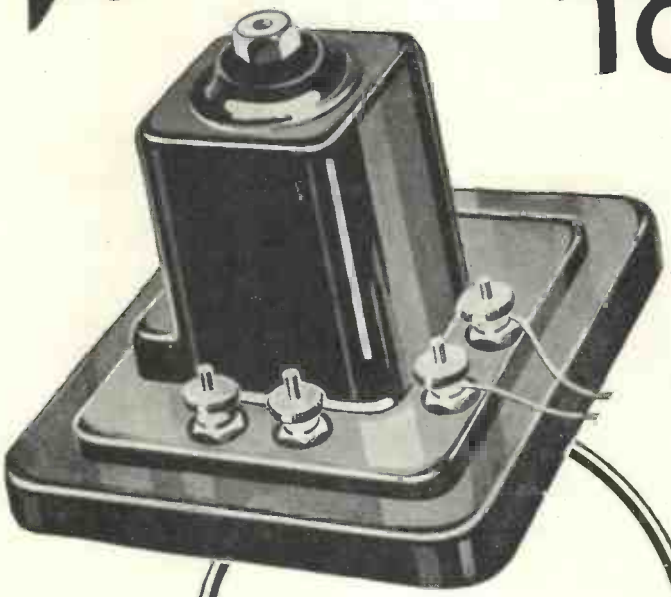
In addition to this the State broadcasting

(*Continued on page* 355)



Unique German set, known as the Kramolin Automatic receiver

DON'T RESTRICT WIRELESS TO ONE ROOM



Let your retailer demonstrate to you how you can have wireless in every room in your house when you fit the Lotus Remote Control.

IS YOUR wireless at every fireside—ready to switch on at the touch of a plug? The Lotus Remote Control provides simultaneous reception with independent control throughout the house. There's no interference—no weakening of signals—no extra current consumption. YOU can instal it, it is so easy. Neat, efficient, and reliable, the Lotus Remote Control is *the* wireless convenience of this winter.

Get a free blueprint from your retailer and ask him to demonstrate.

LOTUS REMOTE CONTROL SUITS ANY SET

The Lotus Remote Control is made for every type of receiving set, as follows:—

	RETAIL PRICES
Complete outfit for 2 rooms for a set using L.T. Accumulator and H.T. Battery, including 1 Lotus Relay, 2 Filament Control Wall Jacks, 2 Jack Plugs and 21 yards special 4-strand wire	30/-
Complete outfit for 2 rooms for set using L.T. Accumulator and H.T. Eliminator	45/-
Complete outfit for 2 rooms for any make of circuit using All from the Mains Set	47/6

In each case, each additional room, 7/6 extra.

LOTUS REMOTE CONTROLS

Made by Garnett, Whiteley & Co., Ltd. Broadgreen Road, Liverpool.

Causton.

Here it is

The wonderful NEW Cossor Melody Maker

A YEAR AHEAD IN DESIGN

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This wonderful new "Melody Maker" gives "knife edge" selectivity .... better tone ... enormous volume .... longer range .... it will bring you programmes from over 20 stations .... amazingly simple to build .... no drilling .... no soldering .... no wireless knowledge required.... it's as simple as Meccano ..... everything you need packed in a sealed carton .... even the tools .... and the handsome all-metal cabinet .... *and* the three Cossor Valves .... absolutely nothing more to buy .... fill in the coupon now!

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W. M. Nov.

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CA 5909

At the Berlin Radio Show (*Continued from page 352*)

department showed a number of statistics which were set out in such a manner as to be of interest to all. To us in England it was interesting to note that the licences in Germany for the reception of broadcasting had increased from 1,713,899 listeners to 2,284,248 since last year.

Other Statistics

Other statistics were also interesting, showing the numbers of listeners in the various countries of the world, which placed Germany third on the list after America and ourselves.

Another interesting exhibit under this section was the display of a number of cartoons that had appeared in the different papers all over the world many years ago, long before the invention of wireless, just after the introduction of the telephone, which prophesied the coming of broadcasting.

One of these pictures depicted a wealthy gentleman in his home showing this "new" invention to some of his guests, the "broadcasted" music being turned on from taps from what resembled the ordinary bathroom hot and cold water system.

Early Valves and Sets

The State post office department had on exhibit a collection of valves and radio receivers dating from the commencement of radio to the present time, similar to those exhibits to be seen to-day at the South Kensington Museum. This department also sponsored a television exhibit of apparatus designed by Von Mihaly.

This apparatus was in operation, and there were two separate demonstrations, one a simple one transmitting merely shadows and the other the transmission of photographs held in front of the television "eye." The reproduction of this latter case was quite reasonably good and made use of the neon lamp at the receiving end so that the image was of an orange hue. Movement was also registered by the apparatus.

Another Television Exhibit

The other television exhibit was due to the Telefunken Company and consisted of a very elaborate display of apparatus, but the results could not be described as very much better, if at all, than that of Von Mihaly. There was, however, one interesting experiment given, and that was the transmission of a cinema picture. The film was projected by means of a projectoscope, having behind it a very powerful illuminant, on to a ground glass screen about four inches square.

This screen was fitted directly in front of the television "eye" and traversing disc. The remainder of the transmitter appeared to be similar to that of this country, with which we are already familiar.

At the receiving end a special form of apparatus was used employing the usual revolving discs, and the "light signals" so obtained were thrown on to a revolving drum around the edge of which were fixed a very large number of small mirrors arranged parallel to the central axis of the revolving drum. From these mirrors the pictures, through a series of optical instruments, were then projected on to a ground-glass screen about three foot square in size.

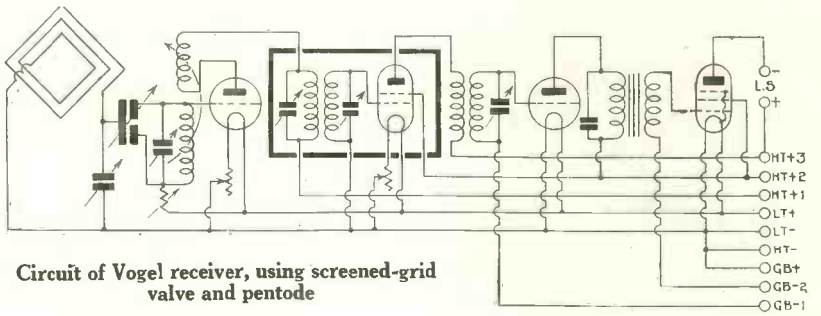
The resulting moving picture to be seen was quite good, but the definition was rather poor. These two demonstrations go to show what we may expect at future exhibitions, and to prove that television has come to stay, whether it be of the system to-day employed or whether it be of some new process.

The Fulton picture transmission was also on display and was shown actually working. The results obtained appeared to be very good, and this exhibit was particularly popular with the visiting public. This was not the only exhibit showing the transmission of "still" pictures as there were two other firms, Telefunken and Lorenz, who displayed this new application of radio. The former firm actually demonstrated their apparatus, but it would appear from the gear employed that this system was not intended at the moment for the use of the general listening public, such as the Fulton apparatus, which is simplicity in itself.

The Lorenz system was being displayed by the police departments, which employ it for the transmission of thumb prints and photographs of criminals.

Another "Stunt" Exhibit

There was one other "stunt" exhibit worthy of mention, and that was the display of a Phonofilm. It was rather different from our ideas of such a film, where a picture is shown of some persons singing or talking with sound reproduction synchronised with the movement of the object photographed. Here in the German film a picture is given of, say, a travel round Berlin, and the pictures are accompanied by a synchronised talk of what is being shown—the talk was given in the first place when the picture was actually photographed.



Circuit of Vogel receiver, using screened-grid valve and pentode

Apparatus for Listeners

So much for the out-of-the-ordinary exhibits, and now for a description of the apparatus exhibited available for the listening public. Generally speaking, it can be said that the standard of reproduction by German sets is far behind that found in this country, and that at the same time the sets do not present a very attractive appearance.

This latter may be due to the fact that the desire for cheap

(*Continued on next page*)

At the Berlin Radio Show (*Continued from preceding page*)

receivers appears to be the cry of the day. Portable sets again do not appear as yet to have found a market in Germany, there being only two such sets shown. In one case six valves were employed to give results inferior to those with which we associate portable sets to-day. In this six-valve portable a pentode was employed in the last stage, so that the set may be said to be practically equivalent to a seven-valve set, although in practice the pentode does not quite give the same output as two valves.

German Screened-grid Valves

Screened-grid valves have made their appearance in Germany and there are one or two valve manufacturers putting these valves on the market, but, strange to say, the set manufacturers do not seem to have taken advantage of this fact, as there were only two sets to be seen at the exhibition that employed such valves.

The circuit of one of these sets, a four-valver, is shown. This arrangement is due to the Vogel Company of Berlin. This receiver employs a screened-grid valve, a pentode, and two ordinary valves. It will be seen from the diagram that the screened-grid valve is used in the second stage of high-frequency amplification.

Many "Mains" Receivers

Generally speaking, there is little worthy of notice amongst the German receivers, but considerable attention seems to have been given to the production of sets that work direct off the electric-light supply. There was a large number of such sets shown, and a special series of A.C. valves have been produced by the more important German valve manufacturers in order to meet this situation.

These valves consist of both indirectly-heated and directly-heated cathode valves, the latter, perhaps, being the most popular. There was also a large number of eliminators for use in conjunction with existing sets. There is no doubt that there is a big campaign afoot to popularise mains working, and so to remove the bugbear of radio reception, the battery trouble.

There was the usual plethora of loud-speakers. These in general were fitted in gaudy cabinets, and the results obtained from the majority of them were far from good, the quality being bad so that racuous signals resulted.

Most Progress in Transmission

In conclusion it is safe to say that Germany has made most progress on the transmission side of broadcasting. The German broadcasts are excellent, the programmes are well chosen and the blending of items is such that our organisation here in England would do well to take a lesson from them. Broadcasting in Germany is what the public wants, and not like it is here, where the public is given what the B.B.C. consider is good for our consumption.

Radio Chaos in Chicago :: BY A RECENT VISITOR TO THAT CITY

IT is impossible to appreciate the chaos of American radio until one experiences the manner wireless works in one of the great cities. Take Chicago, for example, and in the matter of radio this city is as good as any for order, and much better than some.

Thirty Stations of 100 Watts

Chicago has thirty broadcasting stations with a power of 100 watts or more. The stations of less than 100 watts are bewildering in number and quality. The stations of 100 watts and over cover the waveband from 208 to 526 metres, which means that the average listener can seldom hope to get any station outside Chicago unless he has a set to get wavelengths above 526 metres.

As most of the Chicago sets are made for Chicago stations, the radio fan is confined to his own noise and that of his city, day and night, unless he is keen enough to build his own set. This seldom happens.

Among the thirty stations are three newspaper studios that are competing for higher circulations for their periodicals, day and night. In doing so they do not always hit above the belt. Partisanship of the bitterest kind is often introduced, and at election times there is a deadly war on the air.

The wireless trade has a number of good stations—eleven in all—but as these are owned by seven different companies, who are manufacturers of sets or parts of sets, there is a rivalry here again that prevents radio becoming the medium of education and entertainment, as it should be.

Extolling Valves and Coils

To hear a valve extolled from one station between every item on a programme, and a coil proclaimed as the finest ever invented on the other, makes advertising an annoyance rather than a fine art. It is a pity that the trade stations do not lead the way and get one amalgamated station of real worth to the listener.

Not to be denied the propagating agency of the air, Labour has a station—483.6 metres and 1,500 watts.

The Chicago Federation of Labour loses no time, for its programme is full of lectures on economics and pictures of a new world under the coming regime of a Labour Government.

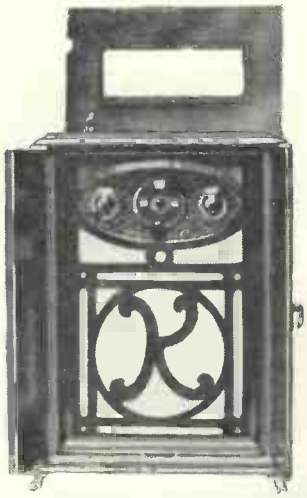
Hotels and theatres have their broadcasting stations; so have three churches and a theological college. Then there are those stations owned by private companies and private individuals which advertise anything from a collar stud and a handkerchief to a pyjama suit and an overcoat.

Free Musical Advice

A music company gives free advice on all the latest music, and Lane Technical High School gives listeners the main movements in education.

The ether is jammed, and if the writer had to live in Chicago he would dismantle his set and keep rabbits instead. E. E. R.

The Proof of the Pudding!



A Shepherd's Bush reader's version of the British Broadcast Two

Full-size blueprints of all the sets are available for constructors—see particulars elsewhere in this issue

Whatever claims we ourselves make for sets described in these pages are looked at with a sceptical eye by some readers, but "the proof of the pudding is in the eating," and these unsolicited testimonials prove that our statements are substantiated. If you are going to build your own set you cannot beat a "W.M." design!

BRITISH BROADCAST TWO

THIS little two-valve receiver (WIRELESS MAGAZINE, *December*, 1927) *has proved very popular, and the following letter from a Shepherd's Bush reader is of interest:*

Having constructed along original lines the British Broadcast Two, described in your December issue, I submit photographs of my version of the same (in two positions, open and shut), which may be of practical interest to your readers.

The arrangement struck me as being an ideal one for a lady's set, being unusually simple to operate. The cabinet is divided into three sections: the topmost carries the receiver, the lower front section houses a cone loud-speaker, and the back part contains the batteries, which are accessible by means of a drop door. Fixed in the lid are instructions for operation.

The set makes a very acceptable gift, and in the example illustrated the design of the loud-speaker front incorporates the initial of the recipient. I find that the selectivity of the British Broadcast Two is good and the quality of the reproduction is superb.

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CHUMMY FOUR

FROM all quarters come letters in praise of the Chummy Four (WIRELESS MAGAZINE, *June*, 1928). *Here are the views of a Leyton reader:*

I must congratulate you on the superb Chummy Four, which is the best portable I have yet heard or operated. Indeed, a northern friend of mine who was in London recently was so enthusiastic about its capabilities that I regretfully let him take it back with him.

I intend to build a similar set with the additions described in the July WIRELESS MAGAZINE.

I tried it out and London came in too loud. Then with a little tuning 5GB and Langenberg came in, and several others, but they are very strong. All the stations in the test report can be received on a good night without any difficulty, but at present there is a lot of fading. But of all the WIRELESS MAGAZINE sets I have made this is the best.

It is the first time I have made a portable set, also used a screened-grid valve, and I think it is a credit to the WIRELESS MAGAZINE Staff to produce such a good set. It certainly does as is advertised.

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1928 FIVE

ALL multi-valvers have a particular attraction for overseas readers, a fact to which our post-bag continually pays witness. Here is a letter from a South African reader about the 1928 *Five* (WIRELESS MAGAZINE, *January*, 1928):

I wrote you some time ago with regard to the very poor results I was getting from a WIRELESS MAGAZINE 1927 Five receiver, and as this receiver (now 1928 Five) is at present giving entire satisfaction, I think it only right to tell you so.

I have rewound the three coils in accordance with your 1928 Five, and therein lies the secret of the transformation.

The set is completely stable, and yet so sensitive that I rarely use the fifth valve. The reaction control is of great assistance for searching, and I have, of late, listened to numerous overseas stations between 250 and 400 metres. Last night foreign signals were exceptionally strong indeed, and although atmospherics were troublesome I was able to tune in music from five or six stations. Three of these direct on the loud-speaker and one station between 335 and 340 metres I was able to tune in direct on the loud-speaker without recourse to the carrier wave.

I moved round the dial a little and picked up a strong transmission on practically the same dial position as our South African relay station Pretoria comes in on, and as Pretoria works on 325 metres I believe this station to be Bournemouth. The announcements were made in English, most of which could be followed, although the titles of the items were not clear and neither could I recognise any of the jazz tunes played.

I held the music from this station without a break (on phones) for an hour and a half, during which time dance music was coming through. At 1 a.m. (S.A. time) the chiming of the clock and striking of the hour eleven o'clock came through very clearly, and the station immediately closed down. These stations, I might mention, were all received with one L.F. stage only in circuit, as I found the usual static trouble with the second stage in operation.

I have been following your Gramo-Radio Section with great interest and I am seriously thinking of constructing the Connoisseur's Six.

Very many thanks for the 1928 Five.

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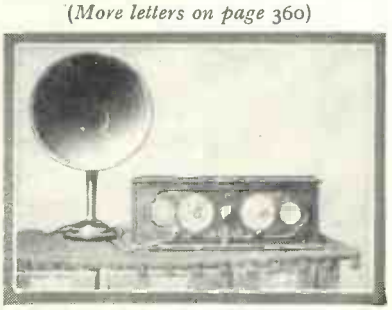
REVELATION FOUR

ALTHOUGH it is now over a year old, the Revelation Four (WIRELESS MAGAZINE, *July*, 1927) *is still giving good service. Here is a letter from a Glasgow reader about it:*

Having completed and tested out the Revelation Four for the past two months, kindly allow me to congratulate you and your staff on the efficiency of this receiver. I have had excellent results from this set, and for selectivity it is A1. It is very gratifying to one to enumerate station after station with the greatest simplicity of control.

I recommend this receiver to anyone who is looking forward for a star set.

(*More letters on page* 360)



The Revelation Four as constructed by a Glasgow reader

The Proof of the Pudding

(Continued from page 358)

FIVE-POUNDER FOUR

PROBABLY the most popular "four" we have ever published, the Five-pounder Four (WIRELESS MAGAZINE, *August*, 1928), *is a really good set. This letter from a Pound Hill reader is sufficient evidence of what it will do :*

Having just completed and tested your Five-pounder Four, I thought I would let you know how pleased I am with it. The results have been most satisfactory, it being very selective; tone and volume are excellent. I am giving a log of stations I have received on loud-speaker.

Stations received are : 5XX Daventry, Radio-Paris, Kalundborg, Motala, Hilversum, Königswusterhausen, Warsaw (on phones), 2LO London, 5GB Daventry, Manchester, Bournemouth, Cardiff, Berlin, Langenberg, Frankfurt, Stuttgart, Copenhagen, Brussels, Madrid, Leipzig (faint), Katowitz, Vienna, Budapest. Some others not yet identified on phones.

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ALL-THE-WORLD FIVE

BELOW a Levenshulme reader gives details of some results with the All-the-world Five (WIRELESS MAGAZINE, *June*, 1928), *which, it will be remembered, incorporated two screened-grid valves :*

Probably it will interest you as to how I find the All-the-world Five. In one week's trial I had the following results, taking the local station, Manchester volume (terrific) at 100 per cent.

LONG-WAVE COILS	
Huizen	20%
5XX (Daventry)	100%
Königswusterhausen	70%
Kalundborg	75%
Hilversum	90%
Radio-Paris	45%
SHORT-WAVE COILS	
Milan	20%
Munich	70%
5GB (Experimental)	100%
Stuttgart	75%
Manchester	100%
Dublin	75%
Cologne	100%
Newcastle	30%
Liverpool	90%
Leeds	80%
Stoke	75%
Sheffield	50%

All these stations were received on the loud-speaker.

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LINEN-DIAPHRAGM LOUD-SPEAKER

THIS new loud-speaker (WIRELESS MAGAZINE, *September*, 1928) *was an instant success. Here is the opinion of a Birmingham reader, and his wife :*

I have made up your new linen loud-speaker and the results are all you claim for it and more !

I kept to your dimensions except that I used 1-in. thick battens for the two strips which connect the two cones together and I screwed the Bluespot unit (adjustable type) complete with its three-ply backing on to a ½-in. thick by 2-in. wide strip which I in turn screwed on to the two 1-in. battens.

Also I screwed the small cone *between* the 1-in. battens and not *on* them. The result was that I was able to press both the cones straight on to the spindle of the Bluespot unit.

And a further tip—I put the collodion on *after* the complete thing had been assembled.

Using 150 volts on the power valve the results resemble a moving-coil loud-speaker without the thump of the moving coil. I have heard every loud-speaker on the market, moving-coil, experimental and otherwise, but have never heard anything like this—and, just a whisper, my wife *likes* it !

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FIVE-GUINEA THREE

ALTHOUGH its place has now been taken by the Music Charmer, the Five-guinea Three (WIRELESS MAGAZINE, *November*, 1927) *is still giving good service to many readers. Following is a letter from an amateur in Antwerp :*

Some time ago I chanced to pick up your WIRELESS MAGAZINE for November, 1927. I was in search of a neutralised tuned-anode circuit. I found it—the Five-guinea Three. I have added another valve, and it is simply wonderful to hear it.

Such purity and clarity I thought were only possible in £30 receivers. I get from Antwerp, Langenberg roaring in on the loud-speaker at 10.30 a.m., and 5GB roars in at 4 p.m.

I can get about twenty stations, long and short waves, so I guess this is enough for anyone. All stations I receive come in at fine loud-speaker strength, enough to fill a good-size room with music.

It is the best set I have ever heard. A fellow living next door has a screened-grid valve set, and it is not a patch on mine, though I do say it myself.

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PHŒNIX FIVE

SURELY eighty-five stations on the loud-speaker is enough to satisfy the keenest of enthusiasts who ever took up radio ! That is the record of a Wallasey reader with the Phœnix Five (WIRELESS MAGAZINE, *January*, 1928). *Read his letter :*

Having a Phœnix Five receiver, made from WIRELESS MAGAZINE, I find I can obtain about eighty-five stations, all at loud-speaker strength; but I would like to mention that I cannot obtain a loud-speaker that will take the volume, although I am using the components exactly as specified to every detail in the set.

The set is really excellent, and is working from an H.T. eliminator, and gives all that is desired, with one exception, due to incorrect loud-speaker to cope with volume.

I have recommended several of my friends to either purchase or make up this set, and two have already done so, with practically the same results as I am obtaining myself.

That Set You are Going to Build !

FOR the guidance of readers who are desirous of building a new set this winter, we recommend one or other of the following receivers.

ONE-VALVE SETS

REFLEXED ONE FOR THE LOUD-SPEAKER.—*Gives two-valve results with one valve. Uses plug-in coils. Full-size blueprint for* 1s., *post free. Ask for* – – – – *W.M.*66

TWO-VALVE SETS

BRITISH BROADCAST TWO.—*Hartley circuit with two-pin plug-in coils (centre-tapped). Full-size blueprint for* 1s., *post free. Ask for W.M.*44

CRUSADER.—*An extremely cheap and efficient two-valver for reception of any wavelength band, including the very short waves. Transformer coupling. Full-size blueprint for* 1s., *post free. Ask for W.M.*69

TWO-DAVENTRY TWO.—*Covers both upper and lower broadcast bands by means of simple switch. Full-size blueprint for* 1s., *post free. Ask for W.M.*97

THREE-VALVE SETS

FIVE-GUINEA THREE.—*Tuned-anode neutralised H.F., detector, and transformer L.F. Uses two-pin plug-in coils. Full-size blueprint for* 1s., *post free. Ask for W.M.*29

MUSIC CHARMER.—*Detector, resistance-coupled L.F. and transformer L.F. Plug-in coils. Can be built for £3* 10s. *Full-size blueprint for* 1s., *post free. Ask for* – *W.M.*60

BRITANNIA THREE.—*Similar to the Music Charmer, yet a little more elaborate. Full-size blueprint for* 1s., *post free. Ask for W.M.*67

FOUR-VALVE SETS

GRAMO-RADIO FOUR. — *Detector, resistance-coupled L.F., and one stage push-pull transformer L.F. Dual-range tuner. Full-size blueprint for* 1s. 6d., *post free. Ask for W.M.*70

SCREENED-GRID FOUR.—*Screened-grid H.F., detector, and two resistance-coupled L.F. stages. Six-pin binocular coils. Full-size blueprint for* 1s. 6d., *post free. Ask for W.M.*77

FIVE-POUNDER FOUR.—*H.F., detector, resistance-coupled L.F., and transformer L.F. Two-pin aerial coil and six-pin H.F. coil. Full-size blueprint for* 1s. 6d., *post free. Ask for* – – – – *W.M.*91

FIVE-VALVE SETS

EXHIBITION FIVE.—*Two split-primary neutralised H.F., detector, resistance-coupled L.F., and transformer L.F. Six-pin plug-in coils. Full-size blueprint for* 1s. 6d., *post free. Ask for* – – *W.M.*33

EMPIRE FIVE.—*Two screened-gria H.F., detector, resistance-coupled L.F., and transformer L.F. Six-pin binocular coils. Full-size blueprint for* 1s. 6d., *post free. Ask for W.M.*96

CONTINENTAL NOTES

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

HAVE you picked up the call of Radio Ljubljiana, the new broadcasting transmitter erected at Laibach in Jugo-Slavia? For some weeks now it has been testing on a wavelength of about 566 metres at odd hours during the evening and its signals have been received in many districts of the United Kingdom.

The new station, the second one to be installed in the Kingdom of the Serbs, Croats, and Slovenes, should be broadcasting regular programmes by the time these notes are in print.

Near Graz and Klagenfurt

Ljubljiana—pronounced Liubliana—was for many years known as Laibach, the chief town of the old Austrian province of Carniola; it is situated at about ninety miles South-west of Graz and at about half that distance in the same direction from Klagenfurt.

The station is of sufficient power to disseminate concerts over a large area and to supply the wants of districts which up to the present have been inadequately fed by its older and weaker colleague Zagreb (Agram). Moreover, up to its advent, the nearest broadcasts to be picked up by local fans were those emanating from the Austrian stations Graz and Klagenfurt, and to many the arrival of the Buda-Pesth high-power station proved a welcome change.

In a Morse-ridden Strip

For us, unfortunately, the wavelength of 566 metres is situated in a morse-ridden strip of the broadcast band, but a search should reveal the new-comer and if you pick up calls in Italian, English and what you may presume to be the Serbian language, log your condenser readings with a note to the effect that you have heard a transmission from Laibach, a distance of roughly seven hundred and eighty miles from London.

In the meantime, the Agram studio is on the air daily on 310 metres from early afternoon until 10.30 p.m., G.M.T. On one or two occasions it has relayed performances from the Ljubljiana Opera House, an entertainment which we may receive in future more frequently from the new transmitter.

The Jugo-Slav authorities are still considering the installation of a high-power station at Belgrade, in which the inhabitants for the present must content themselves with the small 250-watt transmitter temporarily erected as a stop-gap. Contrary to custom, the capital has not been favoured, for programmes from this station are irregular—they are few and far between.

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I cannot recall whether Radio Toulouse was the original station to use a metronome as an interval signal; if my memory serves me well, one of the German studios got there first. However, since 1926 the regular tic-toc of that little instrument has rendered Toulouse familiar to us all.

A Drastic Change

Now in view of the fact that many other studios have adopted the same style of signal, the Radiophonie du Midi has called for a drastic change. The dull metronome tick has been replaced by a more musical bell, which automatically registers seconds between items in the programme.

At first you might mistake it for a time signal, but you will quickly realise your error. If you hear eighteen strokes of the bell at 9.55 p.m., for instance, don't alter your watch; it is neither Greenwich nor local Toulouse time!

It will merely indicate that eighteen seconds have elapsed between the last item broadcast and the call "Ici Rrradio Toulouse" of that particularly voluble announcer.

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Talking of calls reminds me that the Leningrad transmitter, which has been off the air for some weeks, has now returned to the ether, after a thorough spring-cleaning with its little "innards" considerably invigorated. With the approach of longer nights and consequently more favourable conditions for the reception of long-distance transmission, you will find the voice of Leningrad of considerable power on about 995 metres or so.

When picked up some few nights ago the transmission was clearly received, and to my surprise a considerable portion of the entertainment was devoted to the relay of Motala, Warsaw, and Kalundborg broadcasts.

Relaying London

On many occasions during last winter both Moscow and Leningrad put over a portion of the London programme, capturing via 5XX for the benefit of their listeners, so I must assume that this phase of their activities is being developed.

By the way, although the official formal closing down announcement of the Leningrad studio is "Etim nasha Peredacha Konchajetsia," a phrase which, although not understood by me, sounds very musical, you may now and again catch the words "Das Veedanyia" which I may tell you is Russian for "Good-bye."

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I wonder which of the European broadcasting states possesses the greatest number of pirates. Obviously it must be a difficult job to obtain actual figures; in fact, no doubt an impossibility, but perhaps some computation could be made in proportion to the licences issued and the number of receivers sold.

Heavy Penalties in Germany

In the United Kingdom now and again we hear of legal proceedings, in which the culprit, on conviction, has been mulcted into relatively small fines; in Germany, the penalty frequently enforced is a more severe one, for it comprises a payment amounting to anything from £2 to £10 plus the confiscation by the police of the unlicensed apparatus.

In Soviet Russia, to own and operate such a set without Government authority ranks you amongst the criminal classes and to be listening entails a penalty up to thirty-six months incarceration in some insanitary and evil-smelling gaol, a correspondent informs me.

In this article are given full constructional details of a useful super-power amplifier that will meet the needs of many readers who want greater output from their receivers than they at present have available. There is nothing difficult about the construction of this unit, which can be relied on to give useful service, whether for gramo-radio or wireless

THE SUPER-POWER UNIT

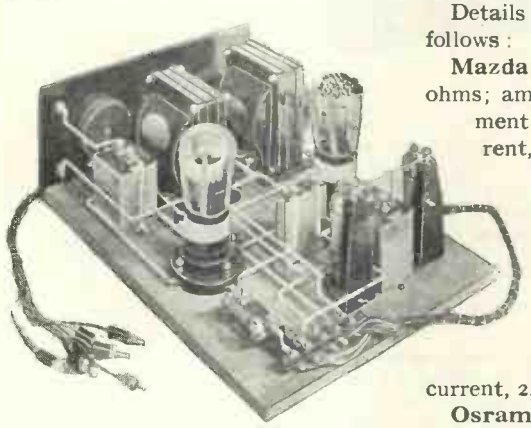
A GREAT POWER OUTPUT OBTAINABLE WITH REASONABLE HIGH-TENSION VOLTAGES

SPECIALLY DESIGNED, BUILT AND TESTED BY THE "WIRELESS MAGAZINE" TECHNICAL STAFF

The unit is protected by a simple wood or metal cover

WITH the great increase of popularity in the use of gramo-radio outfits and larger loud-speakers, many amateurs feel the need for adding a power amplifier to their existing equipment. The unit described here will deliver enough power to give really good output from any normal loud-speaker. Moreover, it is provided with an efficient volume control.

Many listeners believe that, short of using a valve that requires a prohibitive high-tension supply, great output can be obtained only by using two valves in parallel or "push-pull" for the final stage. But, with the new power valves that have just made their appearance on the market, this difficulty is overcome.



The Super-power Unit ready for use

Only 200 Volts High Tension

This super-power unit is intended for use with these new valves, which do not require more than 200 volts on their anodes. Last-stage valves for use with which this amplifier is specially recommended are the Mazda PX650 and the Marconi or Osram P625.

Details of these valves are as follows:

Mazda PX650: Impedance, 1,750 ohms; amplification factor, 3.5; filament voltage, 6; filament current, .5 ampere; H.T. voltage, 200; H.T. current, 23 milliamperes.

Marconi P625: Impedance, 2,400 ohms; amplification factor, 6; filament voltage, 6; filament current, .25 ampere; H.T. voltage, 250; H.T. current, 24 milliamperes.

Osram P625: Characteristics same as for Marconi P625 (see above).

We understand that the Mullard Company will soon be placing on the market a valve of similar characteristics, but as these are not yet available we are withholding details.

From these particulars it will be seen that there are now available three valves of the Marconi or Osram LS5A class, but needing only about half the anode voltage the latter require. Those who have a high-tension supply of 200-250 volts can, therefore, build a super-power amplifier without having recourse to paralleling or "push-pulling" their valves.

The unit illustrated here contains an input transformer, one stage of resistance-capacity coupled amplification and a final super-power stage with choke output to the loud-speaker.

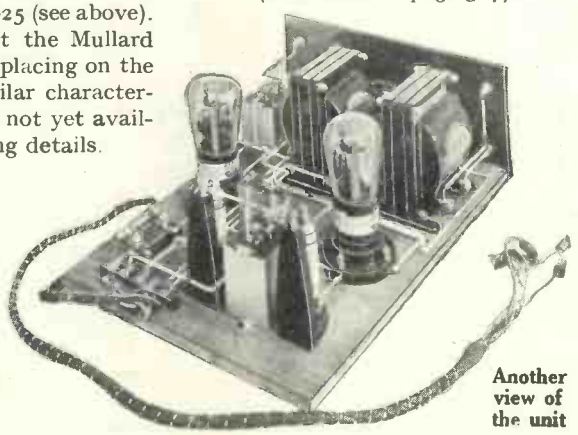
"Motor Boat" Stopper Included

The first valve is provided with a volume control and "motor-boat" stopper in the anode circuit so that the anode supply can be taken direct from the electric-light mains without any fear of low-frequency oscillation being set up.

No elaborate cabinet has been used, the unit being built up on a small panel and baseboard; the parts are protected when assembled by a simple wood or metal cover (see photograph above).

On the left of the panel are the two input terminals for connection to the

(*Continued on page* 367)

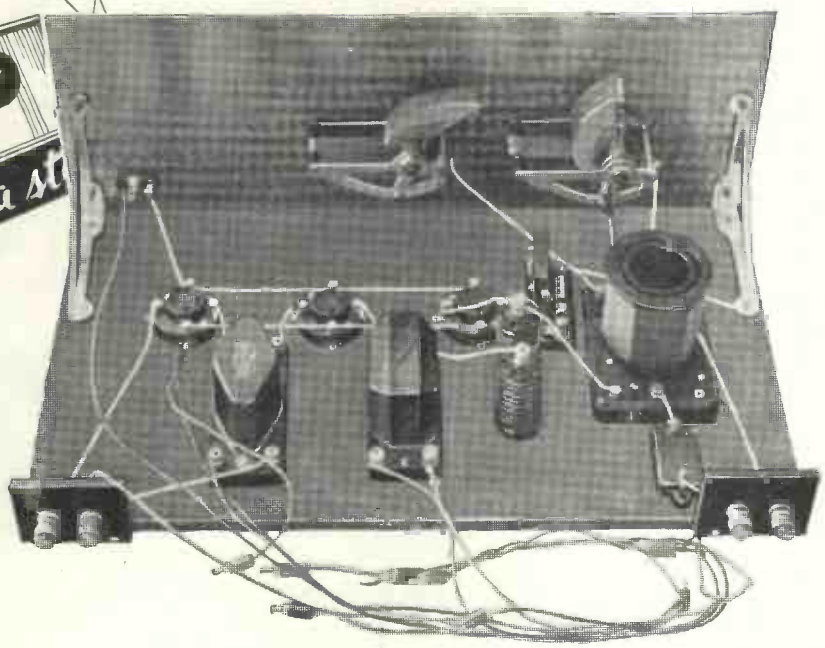


Another view of the unit

7 TIMES A STAR— Mullard Master 3*

Build the Mullard Master 3*—the most powerful "three" ever designed. Build it in an hour and tune in station after station. Enjoy its richness of tone, its wonderful volume and its amazing range. Switch from lower to upper wavelength range without coil changing and with the assurance that there are no dead-end coil losses.

Fill in and post the coupon now. You will receive full-sized plan and complete instructions for building and operating the wonderful Mullard 3*.



To
The Publishers,
"Radio for the Million,"
63 Lincoln's Inn Fields, London, W.C.2.

Please send me FREE complete instructions and Simplified Plan of Assembly for the Mullard Master 3*, with Vol. 2, No. 4, of "RADIO FOR THE MILLION."

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POST THE COUPON NOW

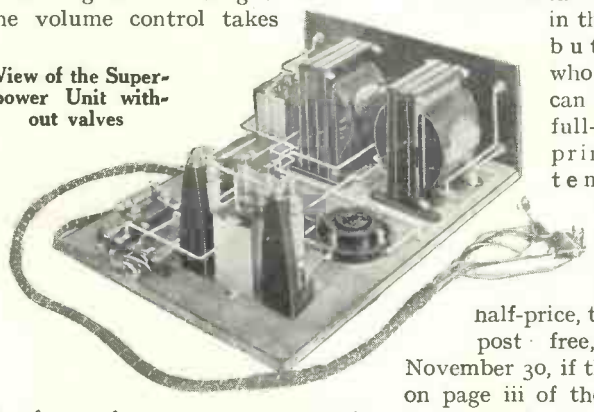
Mullard
MASTER·RADIO

The Super-power Unit (Continued from page 364)

main receiver or gramophone pick-up, while on the right are the two output terminals for connection to the loud-speaker. The three knobs are, from left to right: volume control on-off switch, and filament rheostat for the last valve.

Volume Control

The positions of these controls in the circuit will be clear from a glance at the diagram on the right. The volume control takes the form of a 1-megohm potentiometer connected across the secondary of the input transformer, the grid tapping being varied as required.



View of the Super-power Unit without valves

A 150,000-ohm wire-wound resistance and a .01-microfarad condenser comprise the coupling to the final valve. The "motor-boat" stopper, to which reference has already been made, comprises a 20,000-ohm wire-wound resistance, in series with the 150,000-ohm resistance, and a 2-microfarad fixed condenser.

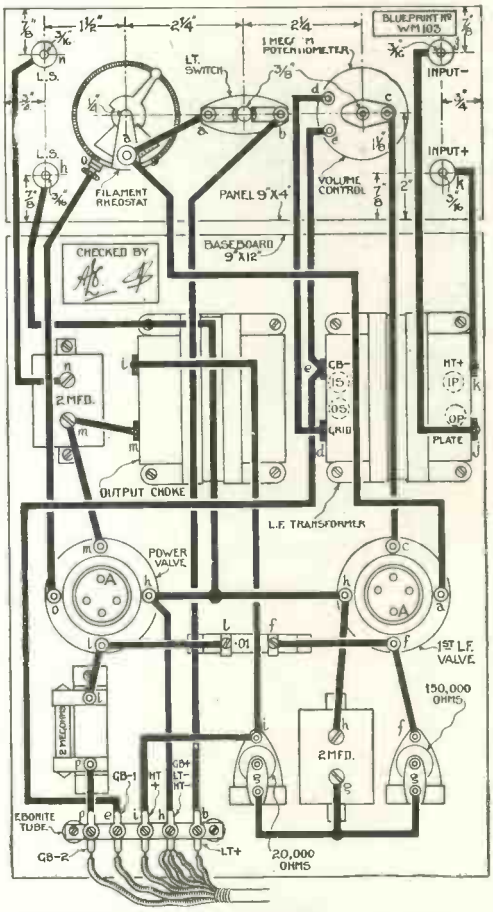
A complete list of all the parts needed will be found below. Most of the components will be familiar to regular WIRELESS MAGAZINE readers with the exception, perhaps, of the new Lissen wire-wound resistances. The cost of all the parts, excluding valves, is approximately £7.

All the necessary constructional details are given in these pages, but those who desire it can obtain a full-size blueprint panel template, layout, and wiring diagram for half-price, that is 6d., post free, up to November 30, if the coupon on page iii of the cover is fused. Ask for No. W.M. 103 and send your inquiry to Blueprint Dept., WIRELESS MAGAZINE, 58/61 Fetter Lane, E.C.4.

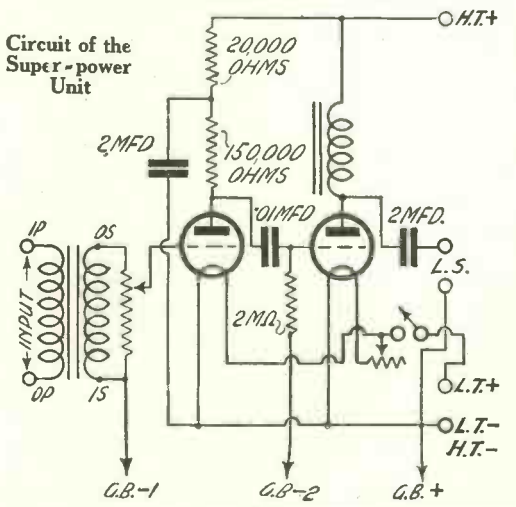
Assembling the Unit

No difficulty will be experienced with the construction of this receiver, none of the parts being at all crowded. Begin by drilling the panel, mounting the necessary components thereon, and then screwing it to the baseboard. The remainder of the parts are then laid out as shown.

(Continued on next page)



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 November 30. Ask for No. W.M.103

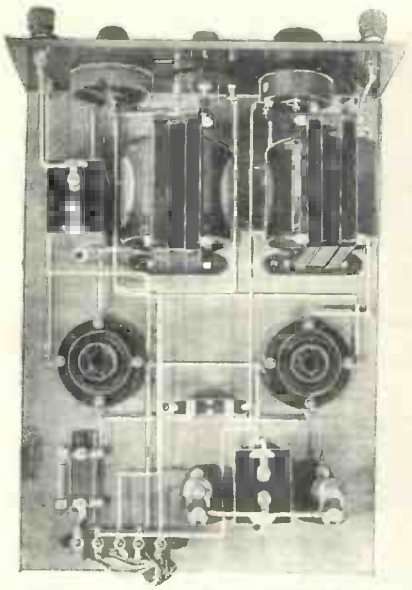


Circuit of the Super-power Unit

COMPONENTS REQUIRED for the SUPER-POWER UNIT

1—Ebonite panel, 9 in. by 4 in. (Becol, Pilot or Raymond).
1—1-megohm potentiometer (Gambrell Voluvernia).
1—On-off push-pull switch (Lotus, Lissen or Bulgin).
1—15-ohm panel rheostat (Lissen, Peerless or Igranic).
1—Low-frequency transformer (Ferranti AF5, Igranic or Gecophone).
1—Low-frequency choke (Ferranti B1, Igranic or Parmecko).
2—2-microfarad fixed condensers (Hydra, Dubilier or T.C.C.).
2—Anti-microphonic valve holders (W.B., Lotus or Benjamin).
1—.01-microfarad fixed condenser (Hydra, Dubilier or T.C.C.).
1—150,000-ohm wire-wound resistance with holder (Lissen, or R.I. & Varley).
1—20,000-ohm wire-wound resistance with holder (Lissen or R.I. & Varley).
1—2-megohm grid leak with holder (Dubilier, Lissen or Ediswan).
1—7-way battery cord (Lewcos).
1—Small ebonite strip with five soldering tags.
1—Wood or metal cover and baseboard 9 in. by 12 in.

The Super-power Unit (Continued from previous page)



Plan view of the Super-power Unit.

This part of the construction having been accomplished, wiring-up can be started. Here, again, the blueprint will save time for it shows clearly all the connections and, moreover, the order in which they should be made. For instance, first connect together the points marked *a*; then those marked *b*; and so on.

Testing the Super-power Unit

When this has been done, the unit can be tested, but before connecting up any batteries, see that the filament switch and rheostat are both in the "off" position.

It will be observed that for the sake of convenience, a seven-way battery cord is used for making the external connections. This is made possible by "commoning" the leads H.T.−, L.T.−, and G.B.+ on to one soldering tag on the baseboard.

To L.T.+ and L.T.− apply an accumulator of the voltage of the valves to be used, and to H.T.+ apply the maximum anode voltage recommended by the makers; this will vary from 200 to 250. The grid bias will depend upon the types of valves used and the makers' recommendations should be followed.

First-stage Valve

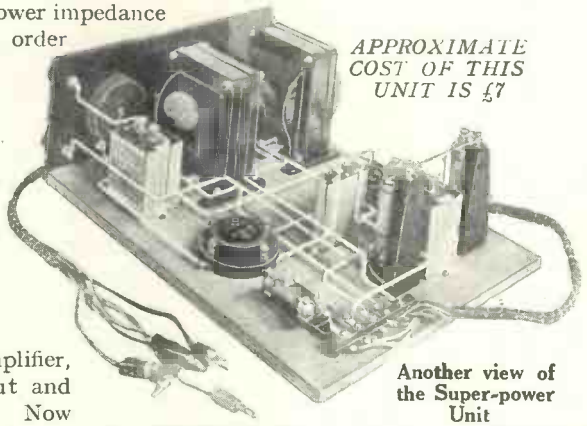
Although theoretically a valve with an impedance of one-third that of the resistance in the anode circuit gives the best results in a resistance-coupled amplifier it is recommended that the first valve in this unit should have a considerably lower impedance than 50,000 ohms, in order to get a sufficiently large grid swing and so avoid distortion.

For most purposes a valve with an impedance in the neighbourhood of 20,000 ohms will be suitable (see complete list on pages 292 and 293).

To operate the amplifier, connect up the input and also a loud-speaker. Now pull out the knob of the push-pull switch and turn on the rheostat for the last valve (on the extreme right). Turning the knob of the volume control to the right increases volume, while turning it to the left decreases the volume.

Final adjustments to the grid-bias tappings should then be made to get the best quality of reproduction.

Do you know the three chief advantages of our full-size blueprints? In the first place they act as panel-drilling templates, secondly as complete layout guides for the placing of components, and thirdly as very clear and distinct wiring diagrams. And remember that a blueprint of any set described in this issue can be obtained for half-price up to November 30th if the coupon on page iii of cover is used.



APPROXIMATE COST OF THIS UNIT IS £7

Another view of the Super-power Unit

Secrets of Success with Screened-grid Valves (Continued from page 351)

exist without the valve. This second ratio represents the magnification due to reaction.

A signal of one-tenth of a volt might, for example, be set up across the ends of the grid coil when the high-frequency valve is not working, that is, when its filament is disconnected. With the tapped anode coil the total pure high-frequency magnification is 60 and the voltage across the ends of the anode coil would be 6, were there no reaction effects.

But, owing to the reaction, produced as a result of the currrent which passes from the anode to the grid circuit, the signal is further increased in strength. This magnification due to reaction may amount to two or three; therefore, the total magnification obtained is 60 multiplied by two or three, and the actual voltage developed across the ends of the anode coil will be from twelve to eighteen.

The circuit of Fig. 3 is one that I can confidently recommend. Naturally a transformer may be used as in Fig. 4. The best ratio of the primary and secondary windings, or the best position of the tap on the anode coil, will obviously depend upon the effectiveness of the coils and the characteristics of the valve.

In practice one alters the primary winding or the position of the tapping until the best results are obtained from the receiver.

An anode-bend detector may be connected as in Fig. 4. The bottom end of the grid leak is joined to the negative side of a grid-bias battery. A leaky-grid detector would, of course, lower the amplification and broaden the tuning and, is therefore, not recommended, except when a very sensitive circuit having adjustable reaction is required.

A screened-grid valve high-frequency amplifier may be used in such a manner that considerable amplification with stability is obtained. But many circuits that I have seen are not suited to the valve.

The goodness of a valve—its value to you as a listener—is measured by what is known as "slope."

Mazda Nickel Filament Valves—because they, and only they, have nickel filaments—have higher slope values than any other valves of corresponding types. They are the best valves in the world, and are made in 16 types, covering every requirement of the 2, 4 and 6 volt user.

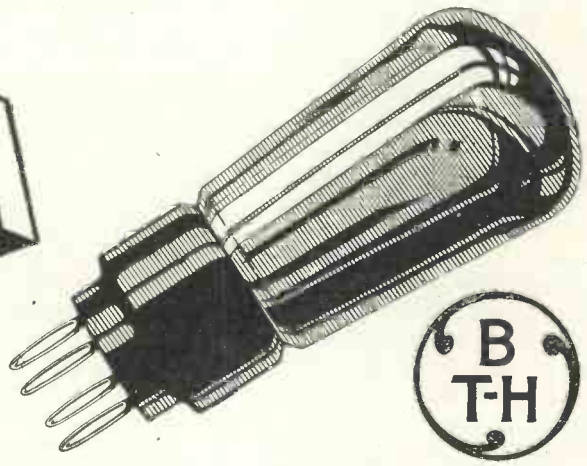
MAZDA

Steep Slope

NICKEL FILAMENT

VALVES

Ask your dealer for the valves with the nickel filament. They cost no more than ordinary valves



B T-H

The British Thomson-Houston Co. Ltd

3030

The Key-to-the-ether Two (Continued from page 327)

As soon as this condition is obtained, search round with the aerial condenser (on the left of the panel) until a transmission is picked up. When a station is heard, readjust the reaction condenser until the clearest reception is obtained. To change over to the higher broadcast band—that is, from approximately 1,000 to 2,000 metres—push in the knob of the change-over switch and carry on as before.

On the Ultra-short Waves

For reception on the ultra-short waves, remove the dual-range tuner from the six-pin base and insert in its place one of the two short-wave coils. Tuning is carried out as for ordinary broadcast reception. It will be found that the vernier attachment on the reaction condenser is very useful on the ultra-short wavelengths, as with its aid a very fine control can be obtained.

Nothing has yet been said about adjusting the potentiometer to which the grid leak is connected, but this is a most important point, especially for reception on the ultra-short waveband. The proper adjustment of this potentiometer will give a point where reaction is obtained without any overlap whatever, a condition most desirable on the lower wavebands.

Reaction Without Overlap

Reaction without overlap means that oscillation should start and stop at exactly identical points of the reaction condenser setting. Very often a set will start oscillating quite violently when the condenser is tuned to 40 degrees, say, but will not come out of the oscillating condition until the reading is reduced to 20 degrees or so.

This is an extreme case, admittedly, but much the same thing occurs on many broadcast receivers that are not properly adjusted.

Every user of the Key-to-the-ether Two should therefore take care to adjust the baseboard potentiometer in such a way that no reaction overlap occurs. When this has been done reception on the ultra-short waveband will be found to be very much better and also easier to accomplish.

Where, with some valves, it is found to be impossible to adjust the reaction properly with the aid of the potentiometer alone, the "motor-boat" resistance in the anode circuit of the detector valve should be changed as the value of this regulates the voltage applied to the valve.

With some valves, for instance, it may be found advisable to increase this resistance to as much as 50,000 ohms, although this should not be necessary in many cases.

USE A BLUEPRINT!

Tom at radio tried to shine,
Built a super-heterodyne.
Bang right off went seven valves!
Now young Tom his conscience salves
By stating that he hadn't seen
The list in "Wireless Magazine"
Of blueprints anyone can get,
For any kind of wireless set,
From crystal up to super-het.
The moral is to save all fuss
And use a circuit backed by us!

H. L. P.

There is no doubt if these adjustments are carried out and the tuning of the set is properly mastered the constructor will be in possession of one of the most powerful and efficient two-valvers it is possible to design with present apparatus.

It is difficult to estimate the range of any particular set on paper, but there is no doubt that the Key-to-the-ether Two when used with a pentode will enable a number of stations to be received at fair loud-speaker strength whatever part of the country it is used in.

Indeed, the results obtained will compare favourably with any normal three-valver.

High-tension Supply

There is only one other point that need be mentioned and that is the high-tension supply. If dry batteries are used with a pentode in the last valve holder use those of the super-capacity type.

The pentode takes a rather heavy anode current and will soon drain a high-tension battery of the normal size. The few extra shillings for a super-capacity battery will be money well spent.

The Eagle Six

(Continued from page 338).

rather difficult; half an hour's practice at the controls, however, should dispel any difficulty. It will be found that having once obtained a station it is a very simple matter indeed to tune in numerous others in a short period of time by moving each condenser separately through the same number of degrees.

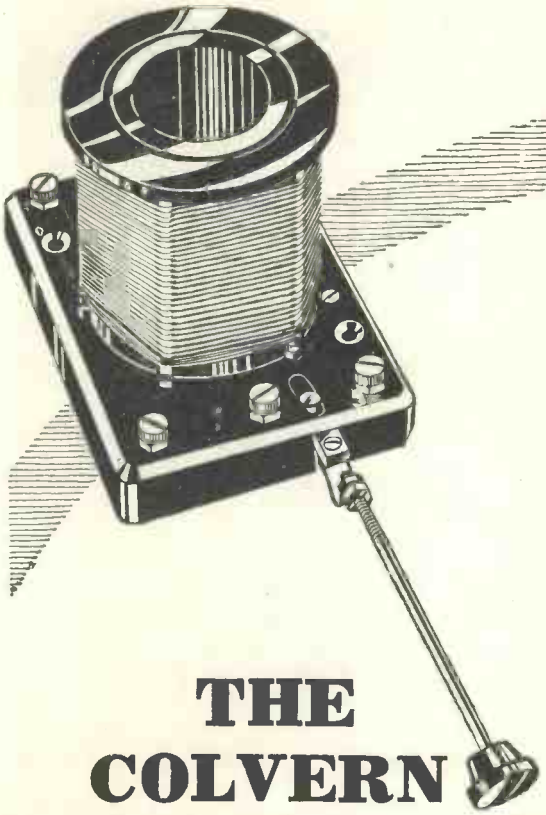
Same Dial Reading

Since log condensers are employed, it is a good idea to tune in a fairly distant station and then to unscrew the dials and rotate them slightly until they all read the same value. It will then be found that other stations will tune in at approximately the same reading on all the dials.

This does not apply to the aerial dial, which may differ considerably from the others.

One of the chief advantages of this six-valve set is found in the ease with which distant stations can be received in daylight; it is then that the advantage of three H.F. stages is most conspicuous.

Read About the Success of the Inceptor 3 on pages 314-315



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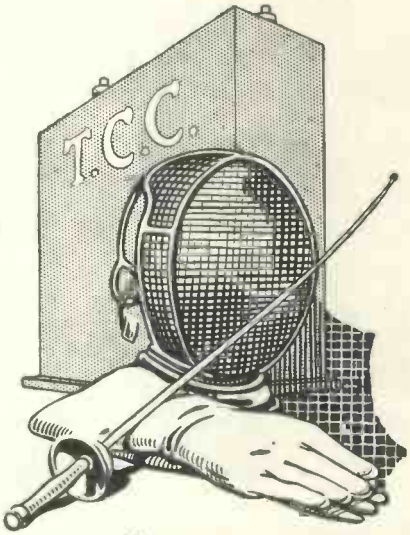

Safeguards

Just as mask and glove safeguard the fencer against injury, so do the letters T.C.C. safeguard you against faulty condensers.

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"T.C.C." Condensers are guaranteed. Everyone is individually tested before leaving the factory. You have never known a faulty "T.C.C." because such cannot pass the test-bench.

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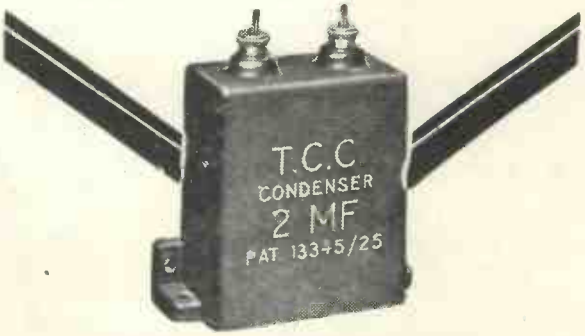

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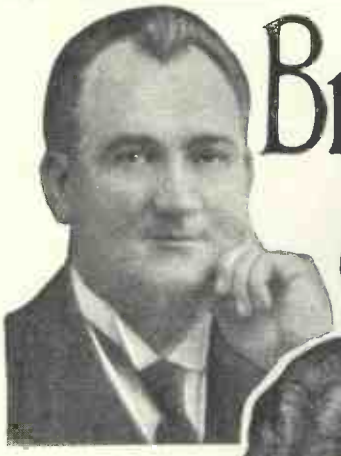
Broadcast Music of the Month



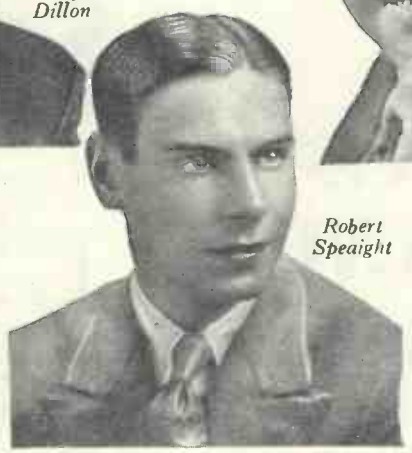
James Horvell

Gwladys Hay Dillon

Heddle Nash

Norman Long

Reviewed for the "Wireless Magazine" by STUDIUS



Robert Speaight

AS a result of the success of the "Proms" at the Queen's Hall, the B.B.C. has prepared an ambitious series of symphony concerts. These started on October 12 with Sir Thomas Beecham conducting, and included the Handel ballet, *The Gods Go A-begging*. On the twenty-sixth, Sir Henry Wood will conduct the B.B.C. Symphony Orchestra at a first performance, in England, of Casella's "Violin Concerto" with Josef Szigeti as soloist.

Some Noted Conductors

In this series some of the world's most noted conductors will be heard, including Sir Hamilton Harty, Granville Bantock, Sir Landon Ronald, Albert Coates, Ernest Ansermet, Albert Wolfe, and Gino Marinuzzi, of the Royal Opera, Rome.

The newly-formed National Chorus of 250 voices will perform first in November, when they will take part in a work based on Bunyan's "Pilgrim's Progress."

B.N.O.C. Relays

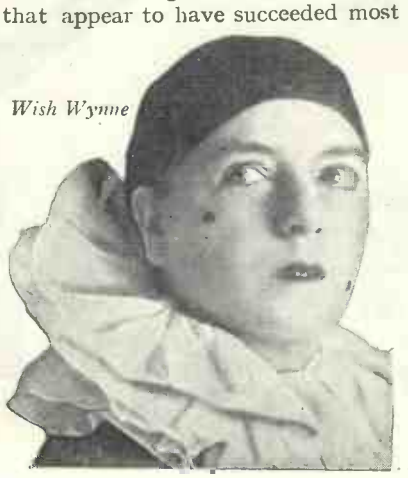
Interest always attaches to the B.N.O.C. tours, for the castes are admirable, and most of the artists are well-known to listeners. Operas performed by the company are to be relayed from Edinburgh, Glasgow, Leeds, and Manchester.

For the first time the Carl Rosa Company has been heard—from Cardiff recently when Act III of *Faust* was relayed. It was distinguished by the appearance of Herbert Langley as Mephistopheles.

Operas in the studio include this month: *Pelleas and Melisande* (Debussy), *Samson and Delilah*, and other well-known and lesser-known operas, too.

Drama has increasing attention paid to it. Many of the plays have been interesting, although the ones that appear to have succeeded most seemed to be those that have had theatrical runs, and are familiar to listeners. As an instance one might mention *The Man From Toronto*, Douglas Murray's amusing comedy that had so long a run at the Royalty Theatre some years ago.

A mystery play, entitled *Signposts*—given late in September, and *King Lear*, followed by Maeterlinck's play *The Betrothal*, all aroused interest. In the former, Edmund Willard played with all his accustomed art as King Lear, while another well-known actor included in the cast was Robert Speaight.



Wish Wynne

Ibsen Play Next Month

In the Maeterlinck play, outstanding parts were taken by Frank Denton and a brilliant young actress Phyllis Konstam. Next month, Ibsen's play, *The Pretenders*, will follow.

With such an abundance of vocal artists, it is difficult to decide on those that deserve mention. Outstanding performances have been given by Esther Coleman, whose art seems to become increasingly vital. She has wonderful range and exceptional diction.

Familiar Names

Nearly all the familiar names have figured in the programmes, such as Elsie Suddaby, Gwladys Naish, Kate Winter, Vivienne Chatterton and, in the provinces, some fine singing has been done by Lily Allen, another well-known broadcaster, and a good soprano, Alice Lille.

(*Continued on page* 374)

Broadcast Music of the Month (Con.)

Alec Chentrens

Edmund Willard

Male singers have been equally good and apart from the great artists of the operatic stage, an opportunity was given of hearing John Pennar Williams, the Welsh miner who won first prize at the recent Welsh National Eisteddfod, and Alec Chentrens, a singer who has figured prominently at the Glasgow and northern stations, and James Howell, an equally-noted oratorio and concert singer.

A Fine Bass-Baritone

An artist heard at most stations, though principally from Glasgow, is Elder Cunningham, a bass-baritone with a fine range and delivery. Robert Chignell, too, figures often as composer and singer and it is difficult to say in which capacity he scores most.

We are glad that the "Hours," such as Charlot gave us, are being continued in the experienced hands of Albert de Courville. But many familiar artists, always welcome, have been heard.

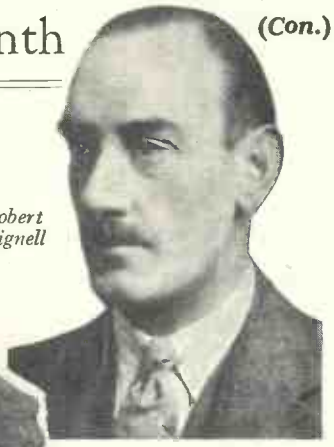
Some New-comers

New-comers who may succeed over the ether are Culley and Gofton, two Yorkshire artists, and Kathleen Hamilton.

Many famous instrumental soloists have been heard. The 'cello has been played by W. H. Squire and one of the finest of British performers, Cedric Sharp.

Ernest Lush

Amongst violinists, the name of Zacharewitch stands out. It would be difficult to equal his great setting of Omar Khayyam's *The Fantasy of Life*, or his latest work on the folk songs of England.



Robert Chignell

Estelle Steele-Harper

Hay Wrightson

Louis Pecskai, Sgeti, Samuel Duskkin have all been heard, while among the younger school of artists, mention must be made of Marie Wilson and Una Cheverton, a clever violinist heard more frequently a year or so ago.

With the piano comes Pouishnoff, Howard Evlyn Jones, Myra Hess, and Désirée MacEwan. In the provinces has been heard a promising pianist, Ernest Lush.

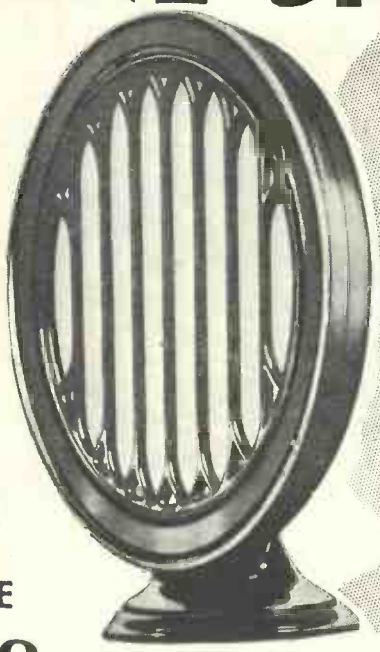
That the importance of the religious programme on the air has been recognised in America by the Federal Radio Commission is indicated by WMBI, the station of the Moody Bible Institution, occupying one of the eight cleared channels of the zone.

Lily Allen

Elder Cunningham

Una Cheverton

A CONE SPEAKER OF EXCEPTIONAL MERIT



HERE is the cone loud speaker you have been looking for! Just think—for £3 you can have a cone speaker of exceptionally good tone, giving sufficient volume for a large room, and having the all-round quality, finish and appearance of an instrument costing two or three times as much.

B·T·H

PRICE £3·0·0

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The British Thomson-Houston Co. Ltd

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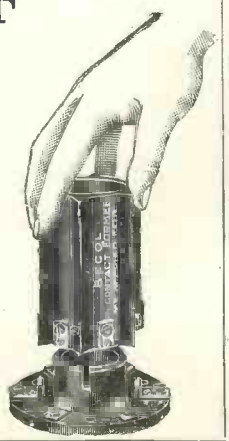

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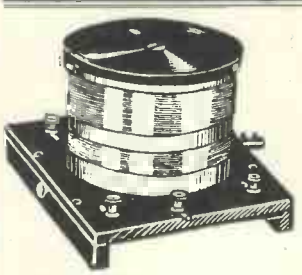


Finston "Q" COIL

The "Q" Coil is a very efficient type of tuning inductance and gives exceptional results, covering a waveband of 250/550 and 1,000/2,000 metres.

The Finston "Q" Coil was recommended by J. H. Reyner in his "Ace of Twos" receiver. (Amateur Wireless," September 22.)

AERIAL COIL **15/-** H.F. TRANSFORMER **21/-**
REINARTZ COIL **21/-**

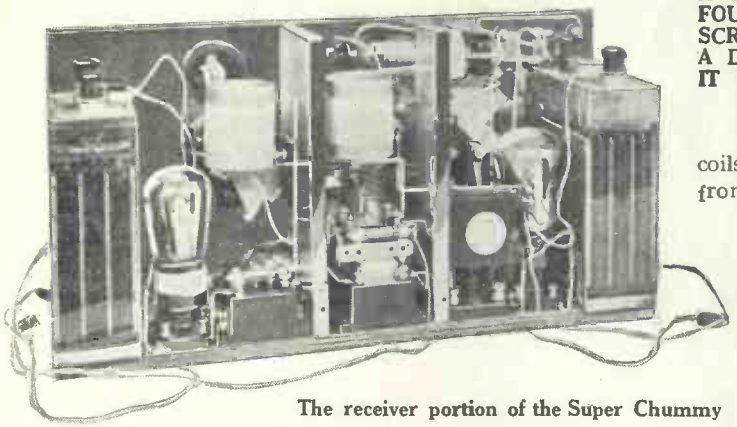
As specified and officially approved.

From all Dealers or

STONE MNFG. CO., 108/9 Great Saffron Hill, London, E.C.1.

More About the Super Chummy

A DEVELOPMENT OF THE FAMOUS CHUMMY FOUR, THIS NEW RECEIVER COMPRISES TWO SCREENED-GRID HIGH-FREQUENCY AMPLIFIERS, A DETECTOR, AND A PENTODE POWER VALVE. IT WAS FULLY DESCRIBED IN THE OCTOBER "WIRELESS MAGAZINE."



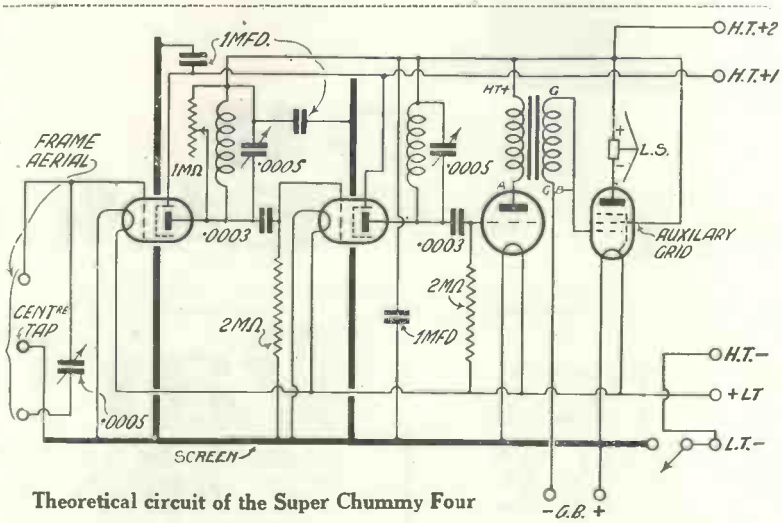
The receiver portion of the Super Chummy

WITHIN a week of its publication we heard from a number of readers who had built up the Super Chummy Four, which was fully described in the previous issue of the WIRELESS MAGAZINE.

There is no doubt that the Chummy Four and the Super Chummy—the former for outdoor portable use and the latter for indoor transportable use—are the most popular receivers of their kind that have yet been offered to the home-constructor.

Those who do not already know of the capabilities of the Chummy Four should read the letters from readers reproduced on page 358.

Two or three readers have complained that in spite of carrying out the screening recommended they cannot stop the Super Chummy from oscillating. At least one other reader complains that he cannot make it oscillate!



Theoretical circuit of the Super Chummy Four

A Simple Modification

In cases where oscillation is bad the modification suggested in connection with the Inceptor 3, on pages 314 and 315, is recommended also for the Super Chummy.

This modification consists in tapping the anode coils and can easily be understood from a glance at the original circuit diagram, which is reproduced here.

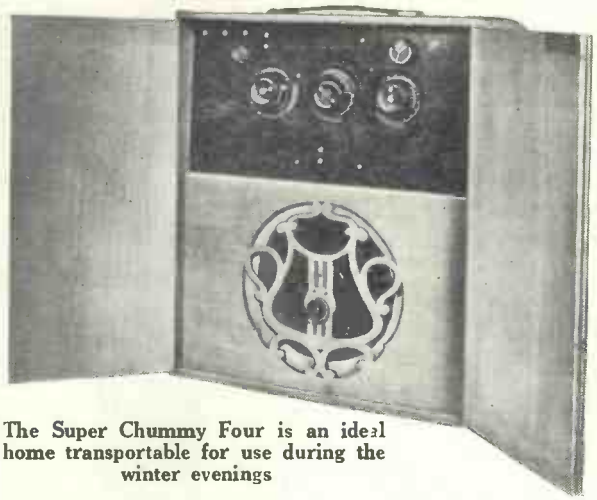
Instead of the leads from the anodes of the screened-grid valves being taken to the grid ends of the anode coils as shown they are tapped to the tenth turns from the H.T.+ ends. This arrangement increases the selectivity of the set and also decreases the tendency to oscillation.

Read W. James's Article

In this connection readers will be interested in the article by W. James, our new Research Consultant, which appears on pages 350-351 under the title "Secrets of Success with Screened-grid Valves."

Next month we can promise the results of an independent test of the Super Chummy carried out by J. Godchaux Abrahams, the well-known broadcasting authority.

If a pentode cannot be obtained, use a three-electrode power valve in the last stage. This should have an impedance of about 3,500 ohms.



The Super Chummy Four is an ideal home transportable for use during the winter evenings

As Good A Portable As Money Can Buy And Skill Can Contrive

Tested by J. H. Reyner, B.Sc., A.M.I.E.E., in the Furzehill Laboratories

Novelties & New Apparatus Tested

LISSEN SUPER L.F. TRANSFORMER

FOLLOWING up the success attained by their small popular-priced low-frequency transformers, Lissen, Ltd., have just placed on the market a

Lissen Super L.F. Transformer

larger transformer with a high primary inductance claimed to give high and even amplification on all normal frequencies.

The winding and a substantial core are housed in a neat and well-finished brown moulded case with terminals placed towards the base, two on each side. The casing is securely sealed, and is therefore damp-proof.

It might be considered that with an efficient instrument of this type some trouble would be experienced, owing to the fact that the transformer is not shielded in an iron case. This trouble, however, is more apparent than real, since with the modern appliances for eliminating low-frequency interaction an iron case is not always essential.

We tested the transformer on an inductance bridge at a frequency of 1,000 cycles and found that the primary winding had an inductance of approximately 60 henries when passing a steady current of 2 milliamperes. The step-up ratio is 3 : 1. We then tested the instrument in a low-frequency amplifier, and obtained as good volume and quality of reproduction as could well be expected with an instrument of this type.

At its price the transformer should prove popular. The address of the manufacturers is Friars Lane, Richmond, Surrey.

◆ ◆ ◆

LOTUS CONDENSERS

THE Lotus variable condenser is one of the latest products of Garnett, Whiteley & Co., Ltd. An examination of this component, which has been submitted for test, shows that the makers have upheld the efficiency and workmanship associated with Lotus products.

The brass framework which supports the fixed vanes and the spindle of the moving vanes is a massive structure and should be immune from mechanical distortion. The rotating spindle bears at one end on a single steel ball, whilst at the other the bearing consists of a cone in contact with a number of smaller steel balls.

With this arrangement the rotating spindle is perfectly rigid, but affords a pleasantly smooth motion. The fixed vanes are insulated and rigidly attached to the end plates by small insulated supports.

The shape of the plates has been designed so that the condenser obeys a logarithmic law. A sample .0005-microfarad condenser which we tested had a maximum capacity of .00050 microfarad and a minimum capacity of 14.5 micro-microfarads. The characteristic of this condenser was plotted and found to be truly logarithmic throughout the scale.

ILLUSTRATIONS OF SPECIALLY INTERESTING DEVICES SHOWN AT THE RADIO EXHIBITION ARE ILLUSTRATED ON PAGES 312–313.

The condensers are made in three sizes, having maximum capacities of .0005, .00025, and .00015 microfarad.

The address of the makers is Garnett, Whiteley & Co., Ltd., Broadgreen Road, Liverpool.

◆ ◆ ◆

LEWCOS HIGH-FREQUENCY CHOKE

SINCE broadcasting covers a wide band of wavelengths, varying from somewhat over 20 metres up to nearly 2,000 metres, it follows that if an H.F. choke is to function efficiently over this range it must be designed with particular care.

We have recently tested the Lewcos high-frequency choke, which is an efficient example of a high-range choke. The winding is placed in sixteen slots, cut in a cylindrical insulated former.

We found that the total inductance was as high as 350,000 microhenries, but, owing to the large number of slots and care taken in winding the component, it will choke quite efficiently on the ultra-low wavelengths and has a self-capacity of approximately 1.5 micro-microfarads.

We tested the performance of this component in our laboratories, and found that it gave excellent results throughout the broadcast range, and indeed, considerably above the Daventry, 5XX station.

The London Electric Wire Co. and Smiths, Ltd., are the makers, and their address is Church Road, Leyton, E.10.

◆ ◆ ◆

B.T.H. MOVING-COIL LOUD-SPEAKER

THE B.T.H. Company are one of the pioneer firms to market the moving-coil loud-speaker in this country. It is therefore to be expected that their products in this line would attain a high standard of efficiency.

We recently had the opportunity of examining and testing a B.T.H. loud-speaker unit which comprises a complete loud-speaker, including step-down transformer for use in the plate circuit of the final amplifier valve.

The magnet pot is supported at the periphery by pieces of thin leather securely clamped to a metal frame. A 1½-in. coil is fixed to the diaphragm and is fitted with a centring device which can be relied upon to keep the coil fully floating in the air gap. The whole structure is solid and not liable to damage.

We tested the loud-speaker on various amplifiers, and were surprised at its sensitivity. Working with a super-power valve in the last stage and 150 volts on the anode, excellent reproduction was obtained at good strength. Although the magnetic field current is greater than that required by some coil-driven loud-speakers, this appears to be amply compensated for by the increased sensitivity obtained.

B.T.H. Moving-coil Loud-speaker

This is certainly one of the most sensitive moving-coil loud-speakers which we have tested and we have no hesitation in recommending it.

The London address of the British Thomson-Houston Co., Ltd., is Crown House, Aldwych, W.C.1.

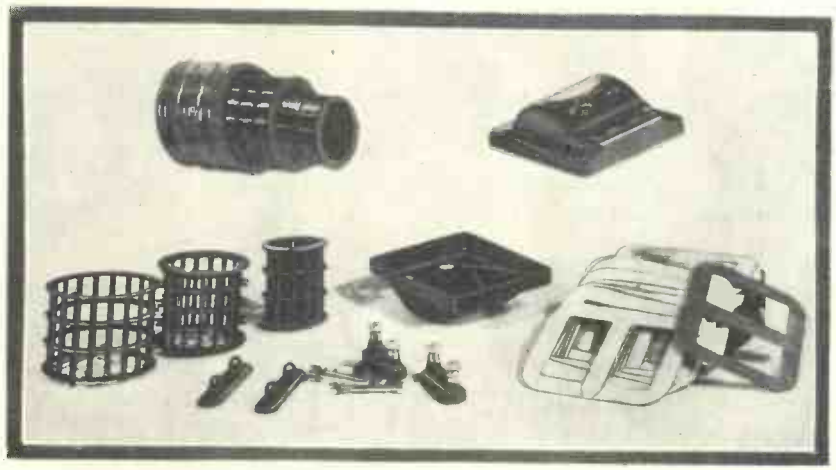
Ferranti L.F. Transformer

THE name Ferranti is associated with high-class radio components, the most famous of which are probably the low-frequency transformers bearing this name.

The most efficient and expensive of the Ferranti low-frequency transformers, the AF5, has been sent in for test and report. The appearance of this instrument is similar to that of the well-known AF3; a higher primary inductance, however, and a larger iron circuit have been utilised with the result that it has an exceptionally good performance as a low-frequency amplifier and is capable of amplifying frequencies as low as 30 cycles at almost the full amplifying value.

The primary and secondary windings are placed on special low-capacity insulated formers and have a small air space between them in consequence of which a substantially straight-line characteristic is obtained up to frequencies exceeding 4,000 cycles. We found the primary had an inductance of approximately 140 henries with a small polarising current of 2 milliamperes through the winding.

Tested in a valve circuit, it was possible to obtain almost full amplification out of any fairly high impedance detector valve with excellent quality of reproduction.



This photograph shows all the parts used in the making of a Ferranti AF5. Note especially the low-loss formers for the windings

On File at Savoy Hill!

QUESTIONS such as "What did Gladstone say in 18—?" are not likely to worry the B.B.C. now or in the future. Although not many people are aware of the fact, file copies are kept of all broadcast talks.

The manuscripts of talks have, of course, to pass the censor before they can reach the ears of the microphone; the necessity for censorship is not so great now that the B.B.C. embargo on controversy has been removed. Nevertheless, the manuscripts themselves, or duplicate copies, are carefully filed and indexed, so that reference can be made to them if any query arises.

It must be at least some consolation to the bugs, worms, and butterflies, whose habits have been so frequently dealt with via radio by learned professors (if the humorous writers are to be believed), that they are on file at Savoy Hill!

This, however, is not the whole extent of the B.B.C. "Hansard." Whenever an important outside item is being broadcast, such as the unveiling by H.M. the King of the Welsh National War Memorial, wax records are kept and filed. The reproduction to be obtained from these records is not very good, but is accurate enough to justify the claim of this section of the B.B.C. that it is actually "bottling" history.

Among the records in these files are religious services, horse-race broadcasts, running comments, eye-witness accounts, and speeches by the King, the Prince of Wales, and by film stars! F. L. B.

How to Choose a Battery Eliminator

A WARNING TO THE NOVICE!

RECENTLY I have had occasion to investigate the subject of battery eliminators, particularly in relation to their safety when used on the lighting and power mains for the operation of wireless receivers.

This generation has grown so familiar with the convenience of electric light and power for domestic purposes, and the safety of the apparatus available, that it accepts almost without question all apparatus offered for a specific purpose.

Implicit Confidence

Such implicit confidence is reposed in the manufacturers in respect of the safety of their apparatus that when buying an electric iron, an electric fire, or a vacuum cleaner, the first question asked is: "What does it consume?" Very seldom does anyone ask: "Is it perfectly safe?"

This confidence in the electrical manufacturers of Great Britain and their apparatus is not generally misplaced and it can be said that such apparatus as the leading electrical manufacturers place before the public is designed by experienced engineers with full knowledge of the electrical conditions to which the apparatus will be subject.

Very liberal safety factors are allowed, and very stringent tests are imposed.

There Are Dangers

Nevertheless, dangers exist in the use of improperly designed, inadequately insulated, or otherwise unsuitable apparatus on the electric-light mains. So long as the making of the apparatus is in the hands of manufacturers with the necessary knowledge, experience, and facilities, little exists to worry about; but the growth of wireless has introduced a very different state of affairs.

A considerable amount of apparatus is now in use on the mains constructed by people :—

(1) With very little electrical knowledge. They merely assemble so many components to a given diagram, which may be right or may not; they do not know and have no means of ascertaining.

(2) With no experience to guide them as to the safety factors which are necessary. This experience is gained only by exhaustive tests under service conditions, sometimes extending over long periods.

(3) With no facilities for submitting the apparatus to proper tests, such as insulation and breakdown tests, to mention two only.

A great danger arises from the use of factory-manufactured apparatus produced on a large scale at a low price by manufacturers no better fitted to produce the apparatus than the uninformed home-constructor except that they have production facilities.

The home-constructor does at least invariably use components on which some reliance can be placed, but the manufacturer of the "junk" apparatus builds up his eliminator of components that on inspection by any competent authority would receive instant condemnation.

Need of Adequate Dimensions

It is well known even to those with only a limited electrical knowledge that the paths along which current has to flow must be of adequate dimensions. For example, in the case of resistances carrying any appreciable current, they must, in order to be safe and satisfactory, be wound with wire of a gauge ample for the current they have to carry.

I was recently shown by one of the large supply undertakings in this country an eliminator which has been in use on their mains, and the resistances consisted of lines made very crudely with what appeared to be Indian ink on strips of cardboard.

The choke and the condensers—equally necessary components in an eliminator—were very little better, being of crude and inferior construction.

It is not difficult to appreciate that the quality of an eliminator both in respect of safety and performance is very largely dependent upon the components of which it is constructed. A high-grade eliminator cannot be built from low-grade components. High-grade components are essential, and high-grade components cannot be manufactured from low-grade materials.

Consequently, high-grade components and high-grade eliminators cost more because they embody the best materials made by expensive machinery installed to do each particular operation in the best possible way, and the assembly is carried out by skilled labour under the best possible conditions because only under good conditions can good work be maintained.

Beneficial to the User

All this is beneficial to the ultimate user who needs the best apparatus for his purpose.

The object of this article is to draw the attention of the great wireless public to the manner in which they are being exploited by unscrupulous "manufacturers" who, quick to take advantage of the popularity of radio, are seizing the opportunity to turn out huge quantities of "junk" apparatus at very attractive prices; prices probably lower than the labour and material costs of properly constructed units.

A battery eliminator is very largely an electrical problem and will, no doubt, best be dealt with by one or more of the leading electrical firms.

A Step in the Right Direction

One, if not more, prominent manufacturer is already taking steps to submit his apparatus to the principal supply authorities throughout the country with a view to having it approved by them and, concurrently, the supply authorities are taking steps to prohibit the use on their mains of apparatus which does not comply with certain specified requirements.

Sooner or later, definite legislation will come. Meantime, the owner of a wireless receiver contemplating the use of a battery eliminator should consider *firstly* the safety of himself his family, and his servants; *secondly*, the performance of which the eliminator is capable, its efficiency and reliability; and *thirdly*, and then only, its price.

POW-CHO.

Things You Ought to Know About

THE PENTODE

By CAPT. H. J. ROUND, M.I.E.E.

EVERYONE who has been to the Radio Exhibition has now seen the pentode, but many will still be puzzled as to why it can give better results than an ordinary triode power valve of the same size.

Grid Swing

In this series of articles several months ago I led up to the subject of the pentode by illustrating with graphs how the introduction of another grid into a power triode would enable us to get greater grid swings without running into grid current and I propose to recapitulate for the benefit of those who missed the article.

Let us consider an ordinary triode set for full power output by means of grid bias of say 20 volts, which I will suppose is the correct value for that valve.

Now, if the alternating voltage applied to the valve grid exceeds a peak value of 20 volts we shall run into grid current with all its blasting consequences.

The effect of grid current in most cases is to short-circuit the input transformer momentarily, thus distorting the wave shape.

Greater Output Current

But anyone can see that if we could only use our valves well up into grid current without getting this blasting effect, the output current from the plate circuit could be much greater.

This grid current is in the way of our using the power tube to its full extent.

In the previous article I described a four-electrode valve I had had made in which the grid consisted of two spirals interwoven with one another, but insulated from one another (Fig. 1) and I explained that we could put a static positive voltage on one spiral which would enable us to put more grid bias on the second or operating spiral and thus get a greater grid swing without grid current flowing to the active spiral (Fig. 2).

The reason for this was because we could consider the average of the two grid voltages as equivalent to the original grid voltage in the triode case.

Thus if +24 volts is put on one spiral and −24 volts on the other spiral—the total grid voltage is zero, and the plate current such as would flow in a triode with zero volts on its grid, but if the grid with −24 volts on it is now supplied with A.C. it can swing up to 0 volts without grid current and the anode current flowing will be that which we could get on a triode with the average of +24 volts and 0 volts or 12 volts on it.

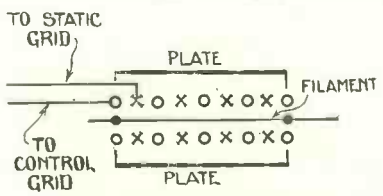


Fig. 1.—Two grids interwoven

We have thus dodged grid current and obtained more output from the valve.

I then pointed out that such an intermeshed spiral grid was not an easy thing to make and that the statically charged spiral could easily be put outside the active one provided more voltage was applied to it than before, and thus we arrive at a construction very like the shielded

(*Continued on page* 382)

The Pentode (*Continued from page 381*)

valve, although for a different purpose.

We can also do another thing which is impossible with the intermeshed arrangement and that is use a close meshed spiral for this outer static grid.

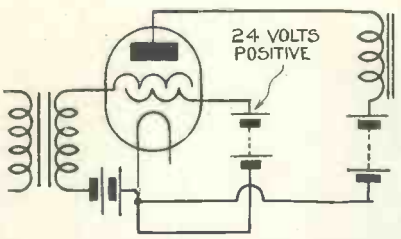


Fig. 2.—Circuit with interwoven-grid valve

Let us see what advantage this close meshed spiral is for the static grid.

In a triode, if the anode is connected to a circuit containing inductance or resistance, any rise of grid volts is accompanied by a rise of plate current, and a rise of plate current must necessarily mean a greater voltage drop in the outer circuit, or less volts between plate and filament as the total voltage in the plate circuit is constant.

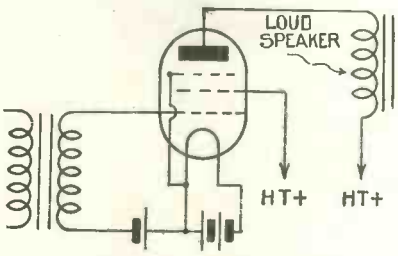


Fig. 3.—Pentode valve circuit

Again, in a triode this current flow is produced by the sum of the grid volts and the plate volts divided by the M value of the valve, so that obviously the increase of current promoted by the rise of grid volts is partly "negatived" by the fall of plate volts.

Rise of Grid Volts in Tetrode

Now in the tetrode a rise of grid volts is accompanied by a use of current to the screen grid plus the plate.

The outside circuit is connected only to the plate and any change of voltage on the plate is protected from having an influence on the total current flow because the screen-grid mesh is made sufficiently fine to reduce the effect of the plate volts to a negligible factor.

In fact the screen volts are steady and the plate volts can only make changes on the sharing of the currents flowing from the screen to the plate.

Quite small voltages on the plate will rob the screen of practically all current so that in effect we have a valve in which the plate current is proportional to grid volts, and no change of plate volts can react back as in the triode.

Biggest Possible Change

In fact within limits if a tetrode has a certain mutual conductance K measured in milliamperes per volt, we can say that whatever the plate circuit is, the current change per volt, grid change will be K, and this is the biggest change we can possibly get.

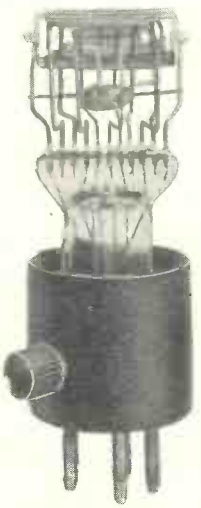
A simple example will suffice. Take a DE5 triode with an M valve of 6, and a mutual conductance of 1 milliampere per volt.

Attached to a power circuit of the right value, one volt change on the grid will only give ½ milliampere change in the plate circuit. Whereas if the DE5 is first converted into a tetrode, one volt grid change will give one milliampere change in the plate circuit.

Thus, not only have we got a valve which can give greater current changes in the plate circuit without blasting, but these greater current changes will be produced with no further expenditure of grid volts.

I have only spoken about the tetrode, for the pentode, which has one extra grid, only has that grid by reason of an accident. (See Fig. 3).

It is placed in between the screen and plate

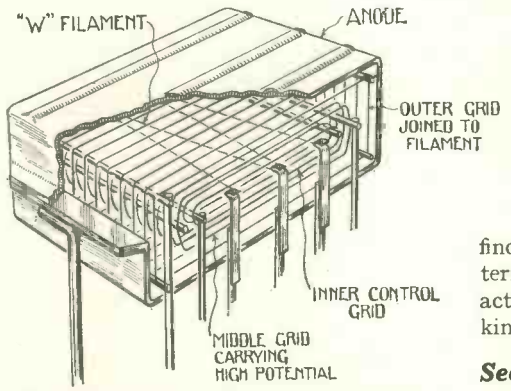


Internal construction of Mullard pentode

By Capt. H. J. Round, M.I.E.E.

(Fig. 3) to prevent what is called secondary emission effect. As this additional electrode is connected to the filament it is not available to play tricks with in the standard tubes.

Briefly, Figs. 4 and 5 give the



This diagrammatic sketch shows the internal arrangement of the electrodes in a Mullard pentode

characteristic of the same valve without and with this additional grid and it will be seen that the grid is merely making the valve behave as it should behave if secondary emission was not present. The explanation of this is really quite simple, but I will reserve it for a future article.

The characteristic of a pentode can be guessed very approximately from its equal sized triode.

Thus, let us take a P625, one of the new valves just issued. Draw its anode volts-anode current characteristic (Fig. 6).

Draw a vertical line PQ at the screen-grid volts to be used in the similar pentode. Then P would be a point on the equivalent tetrode curve if the P625 plate was turned into a grid and an additional plate added.

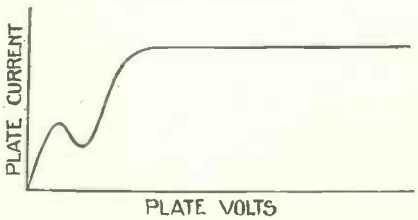


Fig. 4.—Characteristic of valve without extra grid

Slight Loss of Current

P is actually a little bit high because the screen grid will rob us of a little current and I assume a point about 10 per cent. down P_1 would represent the real point. P_2 represents another point determined in the same way for $V_g = -12$.

Now horizontal lines curving off rather steeply to o as shown, give the ideal characteristic for that pentode, the slope of the curve at zero volts being a bit in doubt in the pentode, but in the tetrode it is roughly the mutual conductance.

It is quite amusing to take the curves of any of the power valves now in existence and turn them into pentodes to see if there is any real gain, and to do this one wants to be quite familiar with the way of finding out how such a characteristic is used to determine the action of the valve with any kind of anode circuit.

Search for Data

I am afraid that if I went into this question here the editor would put a very big blue pencil mark through what I had written. He would, in doing so, underrate the seriousness of my readers in their search for information.

But I will not allow myself to be blue pencilled, particularly as I want to take up the more practical question of the re-design of circuits to be used with these pentodes.

Circuits for Pentodes

I have remarked before, and it is visible on the pentode characteristics, that quite a small voltage brings the anode current up to maximum, and after that no increase of anode voltage makes any difference.

In the real pentodes there is a gradual rise due chiefly to the screen grid not being finely enough meshed.

A conductor which behaves like this is rather unusual in anything but the valve business, and its resistance to alternating current is said to be infinite (in the practical pentodes it is very high), but its D.C. resistance is, of course, fairly low.

Now all intervalve transformers and our power output transformers

(*Continued on next page*)

The Pentode (*Continued from page 383*)

or chokes are designed to work with comparatively low resistance valves so that something new in design is necessary if we want to use the pentodes.

In fact, if we want to design an intervalve transformer to work with an ideal pentode we shall have to damp it with a shunt resistance.

The practical pentodes are actually about 50,000 ohms, and any transformer to use with them must have quite a large primary to prevent resonance, something like a 2/1 transformer will be all that can be allowed.

But the output circuit of the power valve pentode is quite puzzling, and the ordinary rules for triodes cannot be used.

Suppose our loud-speaker could be considered as a resistive load, then the best results will be obtained when the resistance is between equal and twice the resistance of the valve as a triode, that is with screen grid and plate strapped.

Best Loud-speaker Inductance

If the loud-speaker can be considered as only inductive then the best inductance will be again somewhere about the best one found for that valve as a triode, but with this difference.

Used as a triode the valve will give the higher notes much less loudly than the valve used as a pentode. The reason is fairly obvious, for whereas in the triode case, with a valve resistance of about 2,500 ohms, the currents will fall rapidly through the loud-speaker when the impedance ($2\pi n L$) much exceeds 2,500 ohms, in the pentode case $2\pi n L$ will have to go a long way to beat the very high resistance of the pentode so that the higher frequencies will be maintained.

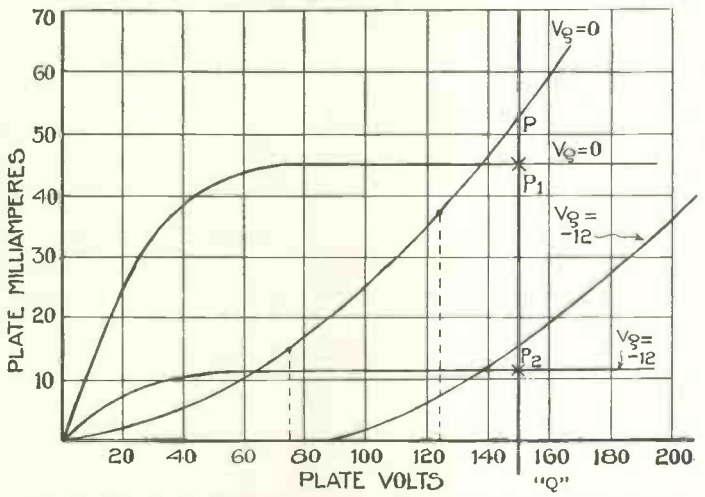


Fig. 6.—Diagram showing how to work out pentode characteristic from that of similar triode valve

One curious case I have run into, and that is using pentodes with a transformer-coupled R.K.

It is well known that the inductance of the windings of such transformers is decided by the valve and loud-speaker resistances considered as in parallel.

Thus, with a valve of 2,500 ohms,

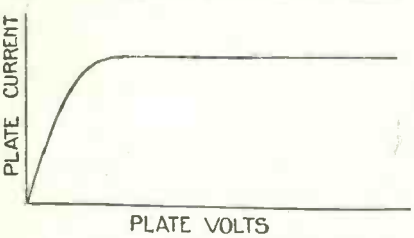


Fig. 5.—Characte istic of valve with extra grid

and a loud-speaker of equivalent 5,000 ohms (converted to this figure by multiplying the actual L.S. resistance by the transformer ratio squared), we have only got to be careful that the transformer primary

(*Continued on page* 386)

The Pentode

(Continued from page 384)

is greater than 1,660 ohms, at say, 70 cycles, so that the valuable low frequencies are not shunted away from the loud-speaker.

Now when using the pentode the inductance will have to beat 5,000 ohms. That is, it will have to have nearly twice the number of primary and secondary turns used with the triode transformer. Nearly all those who start using pentodes will get a considerable change in tone.

Improved High Frequencies

Horn loud-speakers particularly will have their high frequencies improved, intelligibility will be greater.

Theoretically, the R.K. should be improved, but in practice I have not found pentodes of much advantage, as one usually has to repress the high tones in the R.K. introduced by diaphragm resonance, even when using triodes.

Feed chokes for loud-speakers have to be calculated out afresh in the same way.

Microphone Nerves

THERE *are* microphone nerves. They are the peculiar bane of the studio not infrequently. It never occurred to me that I had nerves until I broadcast for the first time about five years ago. Every time I have been to the microphone since, nerves get me. I have difficulty in opening my talk; stuttering and stammering hinder.

That Awful Moment

For a moment which seems ages in the presence of unseen hosts it is awful. To one who is used to public speaking it may appear an overstatement in saying that the only occasion when nerves become active is before the microphone, but that is true personally.

Solomon, the pianist, stated that he was never more nervous than he was at the National Orchestra of Wales concert broadcast recently. He is nervous at other concerts, but broadcast concerts cost him not a little before and after.

Telling the Same Tale

Most artists who broadcast tell the same tale. They can stand before thousands of people in a hall and have nerves like steel; they can sing to a select party at an "At Home" with utmost self possession. Before they come to the "mike" and for the first few minutes they are there, they are very conscious that they are a bundle of nerves. Even announcers are not hardened.

There must be a reason for these nerves. It may be that the absence of an audience causes it; it may be the deadening sound of the studio. Perhaps this is a matter for medical advice.

E. B. R.

The I.P.R.F.

OUT of consideration for those people who call themselves wireless fans, and are, and to spite those who think they are, and are not, I suggest that an examination, on the following lines, be set by some responsible body.

Successful candidates to be entitled to the degree of M.I.P.R.F. (Member of the Institute of Perfect Radio Fans).

The candidate must :—

(1) Prove the reception, on at least three occasions, of China, Jamaica, and Daventry.

(2) Show that he has constructed over twenty-three wireless sets, five of which must have functioned.

(3) Take oath that he has never oscillated.

(4) Have written not less than fifteen letters to the B.B.C. complaining of the programmes.

(5) Know the difference between an aerial and a clothes-line.

(6) Produce his wireless licence or, alternatively, a summons for not taking one out.

Then, perhaps, we should find out which of those bumptious know-alls in the train and at the club knew what they were talking about!

W. M. G.

Every listener interested in moving-coil loud-speakers should have in his possession a new 36-page booklet just issued by Baker's of Selhurst. A copy can be obtained post free by mentioning the *Wireless Magazine*.

KITS OF PARTS
at the Right Price

THE INCEPTOR 3
WIRELESS MAGAZINE, OCT. 1928

.0005 Cyldon Twin Thumb Control Condenser 47/-. .0001 Bulgin, 5/6. 7 ohm Lissen, 2/6. 3 W.B. Valve Holders, 4/6. 3 Coil Stands, 3/-. 1 M.F.D., 2/6. .0003 Dubilier. 2/6. Grid Leak, 2/6. Series Clip, 6d. H.F. Choke, Lissen, 5/6. L.F., R.I. & Varley, S.L.F., 22/6.

FREE
WITH KIT OF PARTS
Screen Assembly Grid Bias Clips, Pair Panel Brackets, 9 Engraved Terminals and Strip, Wire, Tags. Flex, Plugs, Dial Indicator.

Total £4 : 18 : 0

Good Quality American Type Cabinet, 14/11
Best Grade "A" Panel Drilled, 6/-
(The two if purchased with kit for 16/6. Carriage 2/-)

VALVES: Screened Grid, 22/6 Detector, 10/6; Pentode, 25/-
LEWCOS COILS CENTRE TAPPED
25, 3/6; 2 60 @ 3/6; 1 150, 5/3

MASTER THREE *STAR*
(MULLARD)

This new and wonderful set must appeal to young and old, amateur or experimenter, in fact, EVERYBODY!

YOU CAN PURCHASE
ANY ITEM SEPARATELY (OR A KIT OF PARTS). Every component is available at short notice. This list is strictly to Mullard specification. 3 Valve Holders, Lotus, at 1/3. Colvern Combined Wave Coil, 17/6. Permacore Transformer, 25/-. Climax "LFA" Transformer, 25/-. Climax H.F. Choke, 7/6. Benjamin Battery Switch, 1/3. J.B. .0005 Log, 11/6; .00035, 10/6. Mullard .0003 and 2 meg. 5/-. Magnum Panel Brackets, 2/6. Mullard .0001 Fixed, 2/6.

Total £5 : 12 : 6 Carriage paid

VALVES 2 at 10/6
Power, 12/6

OAK CABINET hinged lid, 12/6. Carriage, 2/-

NOTE GENEROUS OFFER

K. RAYMOND

Please add 3/6 to above price (total £5 16 0) and I will include: 2 Handsome S.M. Dials, Set of connecting Links, 8 plugs, 2 Spades, 4 Engraved Terminals, 2 Ebonite Strips, Twin Flex, Splendid Aluminium Panel, 18 × 7, drilled ready for use. 9-volt Grid Bias, Baseboard. Carriage Paid.

RADIANO THREE
COMPONENTS ORIGINAL

"Wireless Constructor," March, 1927.

2 Ormond S.L. Variables, with Friction Gear; 3 Coil Sockets; T.C.C. .0003 and Clips and 2-meg. Leak; 3 Benjamin Valve Holders; 3 Fixed Resistors and Bases; On-and-Off Switch; Gecophone 1st Stage L.F.; Igranic 2nd Stage L.F.; Engraved Strip, with Terminals and Nuts; 2 Terminals for Front Panel; ½ Gross Pinch-on Spades; Rubber Flex; All with Terminals.

79/6 Post Free

BLUEPRINT FREE WITH PARTS

YOU MAY NEED SOME OF THESE

FOR A POPULAR SET Post Extra
Ormond Log .0005 new type 6/- each. Peerless Rheostats, 2/-. Ormond P.P. switch, 1/3. Valve Holders, 1/3 each. Wearite Choke, 6/6. T.C.C. .0001 S.P., 2/4. Do. 1, 1/10. Do. 2 mfd, 3/10. 3 Meg. Dubilier Leak, 2/6. 9-v Grid Bias, 1/6. All makes of L.F. Transformers. Slow Motion Dials.
2 Terminal Blocks and 9 Terminals for 2/-.

CABINETS

LARGE STOCKS of really nice CABINETS, American type, hinged lid, baseboard. Oak (3 qualities).

12x8	9/11	11/9	13/6
14x7	12/11	13/11	16/6
16x8	12/11	15/6	17/11
18x7	15/-	18/6	21/-
21x7	15/-	18/-	21/-

Carriage and Packing Free. Extra Irish Free State.

RADIANO FOUR
"WIRELESS CONSTRUCTOR" OCTOBER

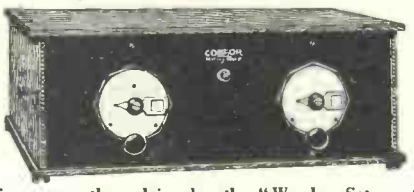
2 Indigraph Dials @ 7/6; 2 Lissen .0005 Variable @ 6/6; P.S. .0001, 5/6; Benj. O/O Switch, 1/3; 2 Lotus No. 9 D.P.D.T. @ 4/-; M.W. Screening Box, 12/6; 4 Lotus V.H. @ 1/3; T.C.C. Condensers, 2 .0001, @ 1/10, .0003 @ 1/10, .0003 S/P, 2/4; Lissen 30-ohm Panel, 2/6; 2 meg. Dubilier, 2/6; Formodenser, .00003 max., 2/6; 2 Dubilier 1 mfd. @ 2/6, 2 mfd., 3/6; R.I. & Varley H.F. Choke, 9/6; Mullard R.C. Unit, 17/6; Philips L.F., 25/-; Igranic Output Choke, Type F., 15/-.

TOTAL OF ABOVE **£7.12.0** CARR., 1/-

For 2/6 Extra you can buy at the *same time* only with above kit **For Radiano Four**

Best quality 21 by 7 Drilled Panel, 2 Brass Rods, 1 pair Panel Brackets, 2 Terminal Strips, 12 Engraved Terminals, 25 yards Rubber Flex, Wood Blocks, and Metal Screws. Lissen Coils, 60 C.T. and 60 X, 6/4 each; 250 C.T. and 250 X, 9/9 each. Screened Grid Valves, 22/6; R.C., 10/6; H.F., 10/6; Power, 12/6; Super Power, 15/-. Very nice Cabinet, 21 by 7 by 10, for 15/-, carr. 2/-.

The Original COSSOR MELODY MAKER



This was recently acclaimed as the "Wonder Set o the Season." It still remains so

SPECIAL PRICE **£4 : 4 : 0**

SPECIFIED COMPONENTS:

2 Ormond .0005, 2 Do. S.M. Dials, 6 T.C.C. Condensers, 2 B.B. Clips, 1 B.B. Rheostat, 3 Dubilier Leaks, 3 Lotus V.H., Ferranti A.F.3, 2 Switches, 9 named Terminals, Glazite, 9-v. Grid Bias, splendid D.S.C. wound Coil on Pirite former.

Handsome Oak Cabinet, 12/6 with parts, Baseboard Free. Also Cabinets at 15/11, 18/11, and Mahogany Polished, at 20/-. Carriage 2/-.

FREE
WITH PARTS
Drilled High-grade 21 x 7 Polished Panel and Strip, Wood Screws. Carriage 1/-

COSSOR VALVES 2, 4, or 6-Volt for above.
L.F., D., R.C., or H.F., 10/6 each. Power, 12/6 each.

ASTOUNDING BARGAIN IN THREE-VALVE LOUD-SPEAKER SETS

Receives London, 5GB, 5XX, and many Continental stations.

D. & 2L.F.

Call and hear one demonstrated.

NO OBLIGATION TO Purchase

AS SHOWN **£5-12-6**

SPECIFICATION Tax Paid. Carr. & packg. 5s.

Beautifully finished cabinet with hinged lid, all parts enclosed—3 British Dull Emitter Valves (1 Power). Latest Type Condenser. S.M. Dial, distant stations are easily obtainable with standard aerial. High Tension Battery 100 volts. L.T 2 volt Exide or Oldham. All Aerial Equipment, Earth Switch and wire. Tuning Coils 250 to 2000 metres. A REAL set, at a price within anyone's reach. TRY ONE.

2 VALVE SETS exact to above complete Carr. and Pack. 5s. **£4 17s. 6d.**

FIVE-POUNDER FOUR

("W.M.," August, 1928.) SPECIFIED COMPONENTS

Two Raymond Special L.L. Condensers, .0005 (with 4-in. dials) (used in set), at 6/11 each. Bulgin .0001, 5/6. Lissen Pan. Rheo., 2/6. Coil Stand, 1/-. Bulgin Neutralising, 5/-. Four Anti-micro. V.H. at 1/3. Six-pin Base, 2/-. Lissen .0003 and 2-meg., 2/-. Lissen H.F. Choke, 5/6. Do., R.C.C. Unit, 4/-. L.F. Transformer, Igranic, 16/- (or R.I. & Varley, 15/-). Ten Engraved Terminals at 6d. each. Drilled Strip, 1/3. Two Indicators, 4d. Ebonite Panel, 16 x 8, drilled, 6/-. Connecting Wire, Screws, and Baseboard, 2/6. Blueprint.

The above Lot **£3 6s. 6d.** U.K.

SEND NO MONEY. PAY THE POSTMAN C.O.D.

Coils for above, Lewcos 60 C.T., 3/6; 150 C.T., 5/3. Binocular Coils 6-pin S.P.H.F.T. BSP5, 15/-. BSP20, 20/-. Handsome American-type Cabinet, 16 x 8 x 9, 12/6. Carriage 1/6.

CABINETS 7/6 If you buy components and 4 coils (Carriage, 1/6)

K. RAYMOND
27 & 28a, LISLE ST., LONDON, W.C.2

Come to LEICESTER SQUARE TUBE.
This address is at the back of Daly's Theatre. Phones: Gerrard 4637 and 2821

C.O.D. Orders despatched same day as received where possible. Send ORDER with instructions and pay Postman.
C.O.D. APPLIES TO UNITED KINGDOM ONLY.

WE ARE OPEN
ALL DAY SATURDAY
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Hours 9 a.m. to 8p.m
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Ebonite cut while you wait at ½d. square inch, also ¼ in. at ½d. Only the best supplied. Drilled Panels for all Circuits.

EELEX Terminals, Plugs, and Spades Stocked.

We stock Igranic, Climax, Ever-Ready, Hellesen, Siemens, Formo, Ferranti, Wearite, Ormond, J.B., Benjamin, Lotus, Mullard, Dubilier, Lissen, Lewcos, Utility, Magnum, Peto-Scott, Peerless, Burndept, Pye, Marconi, McMichael, Cosmos, Carborundum. R.I. & Varley, Gambrell, Brown's, Sterling, Amplions—in fact, everything it is possible to stock.

KITS of parts for all CIRCUITS. Make out LIST for keen quotation. DON'T worry, if it's Wireless WE HAVE IT.

COSSOR VALVES
MULLARD VALVES
SIX-SIXTY VALVES
B.T.H. VALVES
EDISWAN VALVES
MARCONI VALVES

H.F., L.F., R.C., 10/6. Power, 12/6. Super Power, 15/-. 2-v., 4-v., 6-v. Screen-Grid, 22/6. Pentodes, 25/-.

LISSEN

Valve-holders, 1/-; Fixed Con., 1/-, 1/6; Leaks, 1/-; Switches, 1/6, 2/6; Latest 2-way Cam Vernier, 4/6; Rheostats, 2/6; B.B., 1/6; Lissenola, 13/6; L.F. Transformers, 8/6; Coils, 60X, 6/4; 250X, 9/9; 60-v.H.T., 7/11; 100-v. 12/11; Super 60-v., 13/6; Grid Bias, 1/6; 4.5, 5d.; Super L.F. 19/-; Variable .0003, 6/-; .0005, 6/6.

LEWCOS PRODUCTS

C.T. Coils, 40, 50, 60, 75, 3/6 each, 100, 150, 200, 5/3 each. Glazite, 10d. 10 ft. Litz Wire, 9/38, 4/- 50 yds.; 9/38 all silk, 5/6 50 yds. Also in 20-yard reels, Litz, 27/42, 11/6 50 yds. Frame Aerial Wire, 3/6 100 ft. Battery Leads. 4-way, 5/6; 5-way, 5/6; 6-way, 7/6; 7-way, 8/6. All Binocular Coils.
"Q" Coils, 21/. Aerial, 15/. In stock.

Authorised Dealer for

BRANDES

L.F. 3-1, 12/-; 5-1, 12/6. Matched Headphones, 8/- pair. .0005 Variable, 12/6. .0003, 12/-

BRANDES TABLE TALKER, 30/-
BRANDOLA HORN TYPE, 50/-
THE ELLIPTICON CONE SPEAKER, 77/-

"DARIO" VALVES
(Genuine Radio Micro)
Best in the World.

BIVOLT 2-v. .05, 5/6; Loud-speaker Valve 7/6; R.C. .05 1.8, 5/6; 3.5, .05, 5/6; Loud-speaker Valve, 7/6; 3.5 R.C. .07, 5/6. Post 6d. each.

ADVERT. OF K. RAYMOND

ORMOND

No. 3 CONDENSERS. .00025, 5/6. .00035, 5/9. .0005, 6/-. (With 4-in. Dial). Friction Geared, .0005, 15/-. .0003, 14/6. .00025, 13/6. Straight Line Frequency Friction Geared, .0005, 20/-. .00035, 19/6. S.L.F. .0005, 12/-, .00035, 11/-. Log .0005, 13/-, .00035, 12/6. .00025, 12/-, S.M. Dial, 5/-.
All Components Stocked.

J.B. CONDENSERS
T.T. Friction Ver.

.0005, 16/6; .00035, 16/-; .00015, 15/9.

S.L.F.
.0005, 11/6; .00035, 10/6; .00025, 10/-; .00015, 10/-;
Neutralising 3/6

FOR MASTER 3 STAR
Log .0005, 11/6. .0003, 10/6.

R.I. & Varley H.F. Choke, 9/6. R.C.C. Unit, 20/-; Type B, 22/6; Tuners Model A, 47/6; Model B, 37/6; Standard, 39/6. Straight Line Super L.F., 25/-; with 4 terminals, 22/6. General Purpose L.F., 15/-. Push Pull Output Transformer, 22/6. Filter choke, 21/-. Wire-wound resistances, all capacities.
ALL PARTS STOCKED

You need not send any cash to us first—We Send Goods CASH ON DELIVERY (United Kingdom only).

LOUD-SPEAKERS

Ediswan One-Der	50/-
M.P.A. Plaque ...	29/6
Phillips Seven-Corner ...	50/-
Amplion Cabinet	60/-
Do., Mahogany...	63/-
Ferranti ...	63/-
Orphean Gem ...	30/-
C12 Celestion ...	145/-
Amplion Cone ...	37/6
Sterling Mellovox	50/-
Marconi Moving Coil Assembly, £6 6s.; in Cabinet, 210/- for D.C. Mains, etc.	

HYDRA CONDENSERS
Tested on 500 volts D.C. (working voltage 240 d.c.)
1 mfd., 2/6; 2 mfd., 3/6; 4 mfd., 5/3.

CONE SPEAKER CABINETS take 12 in. cone (will take Blue Spot unit), handsome design, all enclosed, 9/11, 10/11, 12/11 each.
OAK FINISH.
2/- each more by post.

"A.W.", "P.W.", & "M.W." LOADING COILS, 7/6

Mica Microscopics!

Used as a dielectric in nearly all small-capacity fixed condensers, mica is a substance of great importance to the radio industry and every amateur should know something about it.

MICA is of the greatest utility in the preparation of the condensers and other portions of wireless sets, owing to its valuable insulating properties and general characteristics.

Split Into Sheets

It is well known that the substance can be split into exceptionally thin plates or sheets which, in the case of condenser manufacture, need to be carefully measured in thickness—or shall I say thinness?—and sorted after having been cleaved and cut.

Research men have learnt that by coating a sheet of mica with shellac on both surfaces where it comes into contact with metallic discs on each side of it, the capacity of the condenser is increased. The same result follows if the sides of the mica are simply wetted with water.

When naked mica only is affixed between two metallic discs the resultant capacity is relatively poor.

Reasons for Variations

The reasons for these striking variations in service are that when dry, or uncoated, mica is thus situated, thin layers of air occupy the spaces between it and the metal; and since the dielectric constant of air has a value of 1, whereas mica itself has a dielectric constant of the value of 8, it is obvious that when the air between it and the metal is forced out, *by any means*, the capacity is increased in corresponding proportions.

Fig. 3.—Greatly magnified sheet of amber mica showing plentiful cracks, and irregular semi-crystalline and discorded patterns. Actual size $\frac{1}{24}$ inch

It is believed that shellac has a dielectric constant even higher than mica. At any rate, its presence enables the mica to exert its inherent powers.

From these highly technical, yet fundamentally important, features I will pass to the material itself.

Mica, chemically viewed, is a basic aluminium silicate of alkaline nature, in its clearer, colourless, or pale-tinted kinds, and an aluminium silicate of iron-magnesium style in its darkly mottled or coloured varieties.

The transparent sorts (also called muscovite) and translucent ones

Fig. 2.—Greatly magnified iron spot in speckled Indian mica (used for condensers) showing its crystal line formation. Actual size $\frac{1}{24}$ inch

come into the first category—all others into the second.

Mica is fundamentally crystalline, its primary base being formed of microscopical rhomboidal prisms. This can be proved by placing a pin's point or similar thing against a sheet of it and then sharply striking the head or top.

Six-rayed Stars

Six-rayed stars are always produced, and if a number of such depressions are made all over the mica, and then the rays of the figures are extended in their own directions, a host of rhomboidal figures, or finely divided flakes, will become visible, these representing, as it were, the "bricks," or basic particles of the material.

My statements must be regarded as merely guiding ones—I have not enough space for perfect scientific expression.

Fig. 1.—Greatly magnified sheet of clear transparent mica (muscovite) showing one of its perfect crystals embedded in it. Actual size $\frac{1}{24}$ inch

Magnified mica reveals many remarkable structures. In Fig. 1 is shown a portion of the transparent kind, with internal crystals, optical configurations, fractures, etc.

In Fig. 2 is a view of Indian mica spotted with iron and its oxide, which to the naked eye appears as mere dots.

In Fig. 3 is shown the formation of amber mica which, when handled, reminds one of thick gold-beater's skin, as it is membranous-like and oily-looking.

Scratching Glass

Not many people know that although mica is easily cut with a knife, it will itself scratch glass.

Now it must be plain that so curious a mineral must have influences of an obscure character, for good or evil respectively, in connection with the less conspicuous portions of our wireless sets, some faults being traceable thereto, or, contrarily, benefits being conferred upon them by its presence and quality. J. S.

Wireless Magazine, November 1928

Fair Play for the Crystal

Such simple hints as the following article embodies may encourage and help many to the satisfactory enjoyment that a crystal set can afford. The article deals with real facts.

MY brother Jim was not at home when our crystal set began to function efficiently, but when he got on half-term *exeat* he was soon at the phones, and what he heard was revealed directly.

"Ah, there's dear old Wallflower Davis with his sweet voice and delightful strumming on the piano. His name is no wonder, I can almost sniff the fragrance when he is at the other end."

Poetical Perversion

I did not think it worth while to correct the boy's poetical perversion. It seemed promising for his future, and Sir Walford will not mind.

We soon had trouble with Jim at home, for he will tinker with the set and occasionally brings it to the floor by tripping in the flexes (not yet slung up on Uncle Bob's plan); but no lasting trouble occurred till one day the sounds became intermittent, seeming at times to *twitter* and sometimes to stop altogether.

We went through the humiliating experience of calling in our village expert, who had been superseded by Uncle Bob. He could find nothing to cause the trouble and spoke depreciatingly of crystals, and hinted at reduced prices for valves and loud-speakers.

Happily, our uncle does not want much inducement to visit us, and an SOS postcard was sent off.

"Will Uncle Bob (UNCLE BOB), last heard of at Crankham Rectory, visit his niece (NIECE), who is in trouble?"

We had seen our uncle in time of triumphant success; now we were to see him fairly puzzled. At first he fizzled over: "Helpless—Mere children—Soon have you going again!"

Then to work. He hitched on his own phones and set, which he carries for casual tests and demonstrations, but the twittering and silences continued. Of the aerial and earth he made no examination; for had not they been set up under his own eyes, and so were beyond suspicion!

Wandering in the garden, he encountered Tim, who heard of the trouble without any signs of sympathetic distress. He had apparently mistrusted the spread of wireless and hinted that there were those who attributed the wet seasons to the new development, and he quoted in support the words of a local wiseacre.

"Says he, 'They tell us as how these 'ere voices and music comes by waves. Well,' says he, 'how can you have waves without water? It stands to reason,' says he; 'and I saw waves myself once at the sea side.'" Tim further hinted that the weather had "held up" better the last few days—curiously coinciding with our local failure!

We might draw a moral from the fact that Uncle Bob gained no clue to the cause of the trouble till he condescended to examine his own particular work.

When he did so it was soon discovered that the earth wire had been severed and *twisted together* again just under the window. Now it was all plain. Our house front is covered with ivy. Tim had been cutting it and cut through the wire by mistake and twisted it together again in hope of covering his carelessness.

Getting Off with a Warning

I was present at the discovery and expected a furious denunciation of poor Tim, but my Uncle was so pleased at finding his objection to exposed joints so supported that Tim got off with an explanation and warning more calculated to bore than intimidate.

Uncle was soon agreeably fussing around with emery paper, etc., making one of his infallible junctions. The complacent smile came again when all was right, just in time for us to hear Big Ben boom out the hour of his triumph.

Under the soothing influence of his own restored importance, Uncle Bob expanded and revealed how recently he had been puzzled at home with his very own set.

I found afterwards he did not tell the whole distressing circumstances of his humbling; but from what he did tell, and what I afterwards heard, I can fill up the narration as follows:—

The trouble was first revealed on one of those not infrequent occasions when our good Uncle had decoyed a neighbour in to hear what a crystal, properly managed, would do. The Prime Minister was to broadcast and the time was approaching.

Uncle Bob, by way of introduction, was blandly expatiating on the pleasure and surprise of former visitors. The present visitor sits with phones on ears, hair a bit ruffled, spectacles awry, and face adjusted to the expected expression of blissful anticipation!

Confident Expectation

After a glance at the clock, Uncle Bob adjusts his own phones and motions for silent attention, with an air of confident expectation.

An interval occurs; then: "Why aren't they punctual? Ah! there it is—Confound the fellow, he's stammering. No—What the——!" And then came the mocking twitter!

I was glad I was not there. I am fond of my uncle, and don't want to see him made an illustration of the proverb about pride and a fall—at least, not before those outside the family.

But now on our own hearth, with our enjoyment of restored reception postponed, we had it all explained at great length.

If I can make plain shortly what my uncle finally discovered was the cause of his discomfiture, some other crystal users may be helped through another pitfall.

My uncle makes a great point of bringing the rubber insulated lead-in straight, all in one piece, through a hole in the window-frame.

In this it may become fixed pretty firmly. The slack part between this and the aerial end sways about in the wind, and the fine stranded wire may be bent and twisted till it actually breaks close to the fixture, though *the rubber casing may remain unbroken*, and so not betray the breakage inside.

It may even keep the wire in slight intermittent contact, hence twittering before actual stoppage occurs.

E. F. K.

"We Are Now Going Over—"

How An Outside Broadcast Is Arranged

"AND now, ladies and gentlemen, we are taking you over to the Hotel Majestic, where you will hear dance music by the Majestic bands until midnight. Good-night, every body—*good-night.*"

◆ ◆ ◆

Some three or four hours before the appointed time of broadcast, a van draws up at a back entrance to the hotel and deposits, *inter alia*, a heap of batteries, several plain-looking boxes, three or four coils of armoured cable, and two engineers. One box contains two very delicate microphones, whilst sensitive valve amplifiers are contained in two larger cabinets of teak wood.

The Paraphernalia

Into a small room, not too remote from the ballroom, is carried the paraphernalia. A narrow bench runs round three sides of the room, and just above, on the wall, are two small black circular boxes about the size of a five-shilling piece. Inside these covers terminate the Post Office telephone lines, which will eventually carry the music to Savoy Hill.

In two other little boxes, not quite the same shape, end the microphone wires from the platform where the band plays.

Fixing the Mikes

An engineer goes into the ballroom, and close to the band position he fixes the microphones—two of them—one to act as a standby in case of failure of the other.

He places them in a pre-determined position, selected to give the best balance of bass and treble, and at the same time convenient for the band leader to announce his numbers, and connects them to two sets of terminals which are joined to the lead-encased cables running to the room where the amplifiers are installed.

In the meantime the other engineer has connected up in duplicate the amplifiers and batteries, which are necessary to magnify the sounds which the microphone picks up to a

(*Continued on next page*)

"We Are Now Going Over—"

(*Continued from page* 391)

sufficiently high level to be passed over the telephone lines. Switches are interposed between the amplifiers, microphones, and telephone lines, so that should a fault develop in any section an almost instantaneous change can be made.

Incidentally the spare telephone line is used as a "control"; that is to say that any comments between the engineers in the hotel and Savoy Hill are sent from the room direct, thus avoiding the necessity of using a telephone in some distant part of the building.

A "Line" Test

A telephone of the usual type is connected to one side of the change-over switch to the phone lines, and when all is wired up and working satisfactorily, headquarters is called upon for a "line" test.

This usually consists of transmitting music over each line in turn so that the necessary corrections may be made at Savoy Hill to compensate for the muffling effect which cables have upon music. They tend to accentuate the bass and cut off the treble notes.

"All O.K.?"

"All O.K. with you?" says the engineer in the little room in the Hotel Majestic to Savoy Hill. "Right-o; we'll be back again half an hour before we're due to go over—'Bye."

It is ten-thirty and the ballroom floor is a scene of graceful disorder. The band has just finished playing a waltz, the leader has turned round and is standing in front of the two little white objects which rest on a pillar on the edge of the low platform, and "Good evening, everybody. You have just heard the Majestic Band from the Hotel Majestic, London, play a waltz, entitled——" goes out into the ether.

J. H. D. R.

Film Stars Spoil A Great Radio Chance!

WHETHER it is better to be seen and stay unheard, or to be heard and stay unseen—that is the question. It is, in fact, the problem that must be engaging the attention to-day of some thirty million radio listeners, following Hollywood's recent attempt through the sunny optimism of Dodge Brothers, who sponsored the programme, and through the medium of station WJZ, to reverse the generally accepted order of things out California way.

Six Idols of the Screen

Six idols of the silent screen, heroes, every one of them in the United Artistes' odyssey, cleared their million-dollar throats and sought to woo their public through another channel.

And, without wishing to detract from Dodge Brothers' well-meant efforts to give the public what it wants, this effort appears to be one of the strongest arguments against the talking movie that has yet been made.

A Leviathan opportunity, unprecedented in the chronicles of jubilant publicity.

With their names hung like a golden bell in the hearts of millions, six towering pillars of the profession let their hopes for enhancement slip like an old lady on a banana peel.

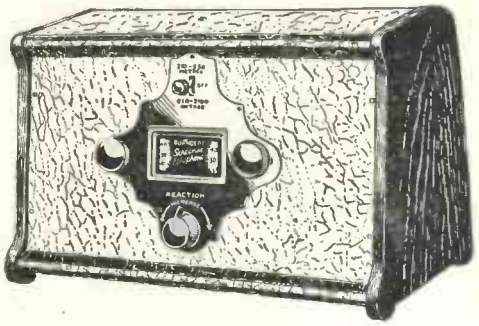
Not insensible to the dreadful charm of the occasion, we imagine the vesper hour discovered Charlie Chaplin, Douglas Fairbanks, Norma Talmadge, D. W. Griffith, John Barrymore, and Dolores Del Rio assembled before the microphone in the Fairbanks' homestead.

Insured Against Breakdown

Indeed, Dodge Brothers had gone so far as to have themselves insured against a possible breakdown for the tidy little sum of £1,000.

Then the calm, clear voice of Edward G. Wilmer, speaking for Dodge Brothers in Detroit, directed the strained attention of thirty

(*Continued on page* 394)



The Screened Ethophone

PRICE :
(including valves and royalty)

£12 : 7 : 0

A THREE-VALVE RECEIVER WHICH GIVES FIVE-VALVE RESULTS . . .

—the new BURNDEPT Screened Ethophone. If, say, you don't want the trouble or cannot afford the time to build your own receiver, the Screened Ethophone is the very set for you ! Employing the screened grid valve (a departure in radio manufacture in which BURNDEPT were the pioneers), a detector and pentode valves, the Screened Ethophone gives results equal to a five-valve receiver. 20 to 25 stations can easily be received on the loud-speaker. Wave-change switch gives a range of 210–550 and 650–2,100 metres, without plug-in coils. Astonishing selectivity. Pure, clear tone—faultless reproduction—adequate loud-speaker volume. Just ask your local radio dealer to let you hear this Screened Ethophone : you will then be convinced of its wonderful value.

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LONDON, S.E.3

BURNDEPT

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A.J.W.

HYDRA
Serves you well

There *must* be something unusual in this condenser to win and hold the confidence of the most important Eliminator manufacturers, not only in Britain but the world over.

ALL CAPACITIES OBTAINABLE

To work on 240, 450 volts D.C., 240, 450 volts A.C., and upwards to 5,000 volts D.C. working voltage.

Tested 500 volts, 240 volts D.C. working voltage, **2 Mfd. 3/6 ; 1 mfd. 1/9**

Specified for the "Super Power Unit" in this issue
Visit our Stand No. 60, Manchester Radio Exhibition

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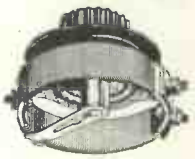
JUNIOR

In six types—
2, 6, 10, 15, 30 and 60 ohms.

For all types of valves.

2/- each



DUAL RHEOSTAT

JUNIOR DE LUXE

Will carry current of two valves. One hole fixing. In six types—2, 6, 10 15, 30 and 60 ohms.

2/3 each.

For bright and dull emitter valves. Two windings—6 ohms and continuation on to 30 ohms. 3/- each

Read the description of the Touchstone Set in this issue, and fit "Peerless" every time.

BEDFORD ELECTRICAL & RADIO CO., Ltd.,
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PAREX

UNTARNISHABLE COPPER SCREENS FOR ALL CIRCUITS

"INCEPTOR 3" SCREEN as specified **4/6**
FOIL for same ... **1/-**

"TOUCHSTONE" SCREEN as specified **4/6**
complete with terminals and drilled
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"SUPER CHUMMY 4" SCREENS as specified **16/6**

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Film Stars Spoil A Great Chance *(Cont.)*

million listeners over to Douglas Fairbanks in Hollywood.

And Doug, the fearless, peerless D'Artagnan of Filmland, was suddenly before his listening public.

A flat, nasal, strident voice, a speech duller than an income-tax return, delivered with all the calm coherence of a man about to catch a train—Doug, the articulate vapour!

A Delphic Utterance

In the course of his oration, which Fairbanks explained hastily was aimed at "The Youth of America," he delivered himself of the following Delphic utterance: "The worst that happens to you may be the best that happens to you if you don't let it get the better of you." The thought seemed to divert him, for he repeated it twice, and begged his radio audience to repeat it after him. Perhaps some of them did. For others it doubtless was too early in the evening.

The remainder of his priceless minutes "Our Doug" devoted to some brief and well-nigh sublimely meaningless references to spirit, hardening of the arteries, hardening of ideas, multiplication tables, Beethoven, life's handicaps, and the heritage of young America.

Roguish and Engaging Theme

Fairbanks then made way for Miss Talmadge. With all the enchanting subjects in the world to choose from, the star hit upon the roguish and engaging theme of "Fashions for Women." In a thin, tiny, colourless voice, Miss Talmadge acquainted her public at an incredible speed with the following epoch-making facts: (*a*) That Paris rules the world where fashions are concerned, (*b*) that Hollywood is the style centre of the United States, (*c*) that simplicity has a distinct charm of its own, (*d*) that a woman's own little contribution to her ensemble effects will help to create a new era of economic prosperity, and (*e*) that "chic" might just as well be pronounced "sheek."

"We'd love to see you," wound up Miss Talmadge with all the emotion of an address to a double-tailed tree toad. "Come out to Hollywood and see for yourselves if it isn't the style centre of the United States."

Whereupon the microphone became the property temporarily of the bewitching and beautiful Dolores Del Rio. Miss Del Rio has a pronounced accent, but that was evidently not to interfere with her fluency. She beat Miss Talmadge's time record by several syllables to the split-second. In short, she was utterly incoherent. By degrees, however, she burst into song, disclosing a pretty little drawing-room voice which, while unsensational, was at least melodious.

D. W. Griffith

D. W. Griffith was the next to face the ordeal. The noted director spoke slowly and distinctly, even when overcome by his own emotions and the stirring significance of his theme. He spoke about "Love."

"Just imagine," said D. W., rolling out the *vox humana*, "just imagine the rough, uncouth creature who goes into the movie-house and sees there the sweet, tender story of romance unfold before him. Will he not come out with a better knowledge of what love and romance really are? He will be glorified with the glow of love. He will see the woman with him through more tender eyes. She will be beautiful before him. What is the little home but a feeble monument of love that burns in the heart of every man for every woman.

"All this flapper talk is nonsense. Never were girls so straight and clean and interesting as the girls of to-day, never more beautiful! Why, they want nothing more than to win the dearest thing in the world; love of mankind, love of an honest man, birds singing, moon shining, girls and boys going hand-in-hand.

A Measure of Love

"Through the medium of the motion-picture and its measure of love we can wipe out the most absurd and hideous crimes of our times—war. All through love—love."

A short breathing space was introduced at this moment when Paul Whiteman and his merry men chimed in from New York, while D. W.'s message of love was sinking into the consciousness of the public.

Then came the big moment when

(*Continued on next page*)

Their Broadcasting Failure

Chaplin took the air. On the whole, he was perhaps the most successful of the six. He has a clear, cultured voice, with a definite English intonation, and, although markedly nervous, at least he did not give the impression of citing his lines *à la parroquet*. He told three or four humorous stories.

Finally, he said: "I shall now retire behind that curtain of silence, the screen, where I think, perhaps, I can be more eloquent than here." Whereupon the insurance company, we imagine, heaved a sigh of infinite relief and agreed to call it a night.

Advised to Speak Slowly

Lastly came John Barrymore—gay Lothario. Barrymore had evidently been advised to speak slowly, for the love of Shakespeare. He obliged. One word every ten seconds, alternating with a well-timed "er," was pretty good going, as he launched into an explanation of one of Hamlet's soliloquies, prior to his recitation.

Meatless Day at the Zoo

Then he began to declaim. Probably meatless day at the Zoo would best describe the extraordinary sounds that screeched and croaked and grated their way through the loud-speaker while America's Hamlet addressed the biggest audience that ever harkened to the words of Willie. We had a feeling that Barrymore was saying it with gestures, and a horrid apprehension that our aural apparatus would never be the same again.

Of such, then, was the Dodge Brothers' second "Victory" programme. At best, we fear it must go down to history as Dodge's "Pyrrhic Victory." F. P.

[Owing to pressure on our space this month we are obliged to hold over until the next issue an article on "Moving-coil Loud-speaker Development" and a "John Simple" feature.]

The Touchstone (Continued from page 301)

when the volume-control resistance is turned off. Now adjust the small condenser mounted on the panel until the signals have their maximum strength. This tunes both circuits.

Neutralising the Set

Now very slowly turn the neutralising condenser fitted in the set. Start by turning it as far as it will go in an anti-clockwise direction, but do not force it. Then turn it very slowly in a clockwise direction, when you will notice the signals gradually falling off. A point will be reached where they will not be heard at all, or perhaps only very faintly.

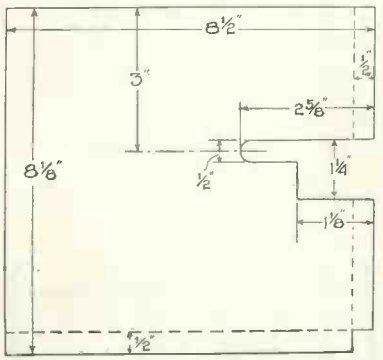
You should carefully adjust the tuning condensers and the fine tuning control in order to make certain that the circuits are in tune. The circuit is now balanced, and you will find, after turning on the volume control rheostat, that a number of stations will be received as the tuning knob is turned.

Ensuring Stability

Make sure the circuit is quite stable at the top and bottom of the tuning range and, if necessary, slightly readjust the neutralising condenser, although this should not be necessary if it was properly set as described above.

When an ordinary outdoor aerial is used, the volume from many stations will probably be too great. The aerial may then be connected to the terminal marked Aerial 1. This will have the effect of slightly reducing volume, but improving selectivity.

I have found that ample volume can be obtained from nine or ten stations by connecting the aerial to a terminal fastened to the cabinet just above the terminal marked Aerial 1. A piece of copper foil about 2 in. in diameter is bolted to the inside surface of the cabinet by the terminal nuts. The terminal is not connected in any way to the receiver, but when the aerial wire is joined to it there is sufficient capacity between the terminal and the small piece of foil to the aerial coil to provide signals of adequate strength.



Details of metal screen needed for the Touchstone

This is equivalent to connecting the aerial through an exceedingly small condenser.

It is most important that the set be so placed with regard to the aerial lead-in that the aerial wire does not pass near the high-frequency inter-valve coupling. The aerial wire should run from the left-hand side to one of the aerial terminals, and not be allowed to lie near the cabinet, as signals will pass direct to the coils.

Magnification of 2,000,000!

Readers may be interested to know that **the magnification to be obtained from the receiver is at least 2,000,000 even with two-volt valves.** This amount of magnification means that distant stations can be received at full loud-speaker strength, even when a small aerial is employed.

A reader need not purchase new valves for each stage in the receiver, but he is very strongly recommended to obtain a good valve for the high frequency position.

Superior Valves This Season.

The new valves are much superior to last season's, and for a given impedance the magnification obtained will vary in direct proportion to the magnification factor of the valve used. Ample magnification will be obtained from a set of 2-volt or 6-volt valves, but I prefer 6-volt types

(Continued on next page)

The Touchstone
(Continued)

because a 6-volt power valve will usually handle more volume than a 2-volter.

The total high-tension current consumption of the set is 12 milliamperes, of which 9 milliamperes passes through the power valve with 150 volts high-tension. This current consumption is well within the capacity of high-tension batteries and, further, will not harm the average make of loud-speaker.

Results with Moving-Coil

Excellent results are obtained with a moving-coil loud-speaker and with cone types. A choke-filter output was not included in the receiver because different loud-speakers need different output circuits. Some of them have to be used with a step-down transformer, and others may be employed with a choke-filter output or a one-to-one ratio transformer.

A choke-filter output is recommended in preference to a one-to-one ratio transformer, but the condenser of the filter must be so connected that one side of the loud-speaker is joined to the low-tension negative.

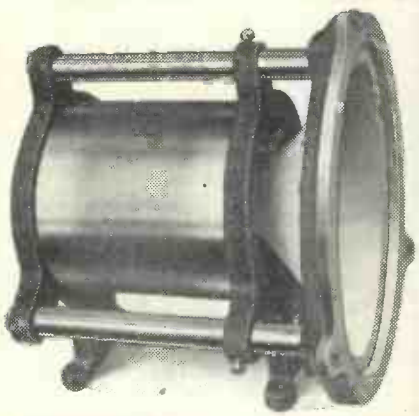
The 16-volt grid battery used will provide ample bias for most valves. It is fitted to the lid of the cabinet in order that the grid-bias wires shall not pass over the amplifying apparatus. The battery may, however, be fastened to the inside of the back of the cabinet with a pair of clips if that is thought to be more convenient.

Switching Off the Set

Do not forget to switch the set off by means of the filament switch provided on the terminal strip. The volume-control rheostat is joined to the first valve only. Further, if you should try various valves in the detector position, do not forget to adjust the variable anode resistance, as different valves require different anode voltages.

The receiver is such a simple one that there is nothing to go wrong and it should give the constructor many hours of pleasant reception from all parts of the world.

[Look out next month for a further article on the Touchstone by W. James]



"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. 91*

Tuned-anode Circuits, Resistance of

THE ratio between the external impedance in the anode circuit of a valve and the internal resistance of the valve itself has an important bearing upon the functioning of the circuit in question. This applies not only to receiving, but also to transmitting apparatus.

In the case of receiving apparatus, the valve circuits are usually tuned in order to present a high impedance at the particular frequency being employed. The tuned-anode circuit is the simplest form of tuning and the effective resistance of the inductance with the condenser in parallel is given by the expression: L/CR.
Where L = inductance in microhenries,
C = capacity in microfarads,
R = H.F. resistance of circuit in ohms.

If this impedance, which has the properties of a pure resistance when the circuit is tuned, is large compared with the valve, then practically the full amplification factor will be obtained from the valve itself. On the other hand, the valve resistance will be low compared with that of the tuned circuit, so that it will set up a heavy damping effect and the circuit will be flatly tuned. If, on the other hand, we make the external impedance low, the damping effect of the valve is quite small, but the amplification is reduced very seriously.

As a compromise we can make the external impedance approximately equal to that of the valve, when the effective resistance of the circuit is doubled. Thus, if a circuit has an actual high-frequency resistance of 5 ohms, and it is employed with a valve having an internal resistance equal to the effective resistance of the circuit, L/CR, then the circuit will behave as if it had a high-frequency resistance of 10 ohms.

A much-used solution of the problem is to employ a tapped arrangement or a transformer coupling which is electrically equivalent, so that the actual anode impedance may be made low, but a step-up effect is obtained to counteract the drop in amplification. (See Sheet No. 92.)

In a transmitter, it is essential, in order to obtain the maximum output, to balance the internal resistance of the valve to get the effective resistance of a tuned circuit which is determined by the ratio L/CR. It may not be convenient to adjust the constants of the circuit to give this particular value of resistance owing to the fact that the circuit has tuned to some particular wavelength.

It is customary, therefore, to tap the anode across a portion of the tuned-anode circuit only.

WIRELESS MAGAZINE Reference Sheet — *No. 92*

H.F. Transformers, Ratio of

THE condition for obtaining high amplification from a valve is that the external anode impedance shall be high compared with the internal resistance of the valve itself. Such a condition, however, is incompatible with that of selectivity, for the valve resistance introduces serious damping into the tuned circuit and may cause the H.F. resistance to be increased many times. (See Sheet No. 91.)

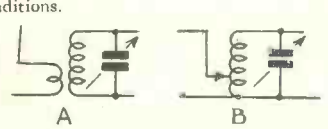
It is possible to overcome the difficulty to some extent by the use of a tapped circuit or by a transformer coupling. The two circuits shown in the diagram are electrically equivalent and we can confine our attention to the second circuit, indicating a tapped tuned-anode arrangement.

Now, as we tap the anode farther and farther down the coil we reduce the effective impedance in the anode circuit, in consequence of which the amplification obtained from the valve steadily decreases. At the same time, however, there is a step-up effect to be considered. The voltage is only introduced across a portion of the circuit and the voltage across the full circuit will therefore be greater, due to a transformer action taking place.

In the case of a simple tapped circuit such as we have considered, the step-up ratio will be directly proportional to the ratio of the number of turns in the full portion to the number of turns in the tapped portion. With a transformer there is a loss due to leakage, but if the coupling between primary and secondary is kept tight, the same relationship holds good.

From the point of view of selectivity, this tapping introduces a marked improvement. It is found that if the anode is connected across one-half of the coil, instead of the whole coil, the damping introduced is reduced to one-quarter, the effect being proportional to the square of the tapping.

Thus, as the tapping down the coil is reduced, the selectivity increases very rapidly and it is a comparatively simple matter to ascertain the best tapping point for any particular set of conditions.



Two Electrically Equivalent Circuits

WIRELESS MAGAZINE Reference Sheet *No. 93*

Frequency Spectrum

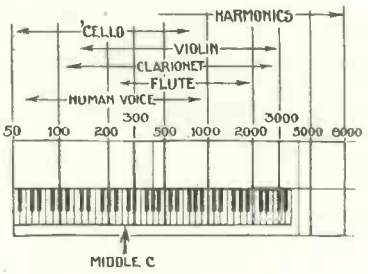
IT is often useful to know the exact range of frequency covered by any particular instrument. For speech a small band of frequencies is usually permissible, while certain instruments operate principally in the lower registers and others in the upper registers.

The total audio frequency band extends from 20 cycles up to 10,000 cycles per second, although the frequency band of a practical amplifier is usually considerably less than this. Frequencies up to 20,000 cycles per second can be heard by young people, but with advancing age the upper limit falls to 10,000–15,000 cycles per second.

The diagram acccompanying this sheet shows the approximate range of frequency of a number of instruments. Generally speaking, an amplifier which will go down to 50 cycles is satisfactory for practically every instrument and speech, as it is only in exceptional cases that a lower frequency than this is required.

It is important to note, however, that on the upper frequency band, higher harmonics are prevalent and in order to obtain naturalness of tone, it is essential that the upper frequencies shall be reproduced in their correct strength and without distortion.

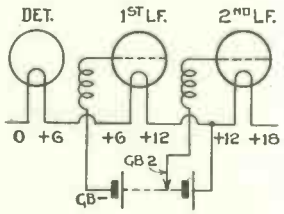
Intelligible music and speech may be transmitted with a very much narrower band than that shown on the chart. Speech, in particular, may be mutilated considerably before it becomes quite unintelligible. The designer has to decide just how much mutilation is permissible, for the reproduction of the full frequency spectrum is a very expensive matter in the case of a radio receiver.



Scale of frequencies

WIRELESS MAGAZINE Reference Sheet *No. 94*

D.C. Mains Working



D.C. mains circuit

IT is often desired to convert a receiver to operate from D.C. mains. One of the methods of achieving this is to wire the filament circuits of the valves in series and to employ valves all taking the same filament current (usually .1 ampere). The voltage to supply these valves is broken down from the mains voltage, which may be anything from 100 to 250, by means of a resistance which must be designed to carry 100 milliamperes (or whatever current the valve filament takes) and to give the necessary voltage drop when carrying such a current. The voltage drop across this resistance is utilised to supply the high-tension to the valve and suitable tappings can be taken to provide the various high-tension tappings required.

A circuit indicating how this may be done is shown in Sheet No. 95. This is a circuit of a simple three-valve receiver operating on a tuned-anode principle. Any other method of H.F. coupling may be used, nor is the method necessarily limited to three valves. The circuit shown will give good daylight loud-speaker reception on a standard 1½ kilowatts broadcast station at distances of 50 to 60 miles.

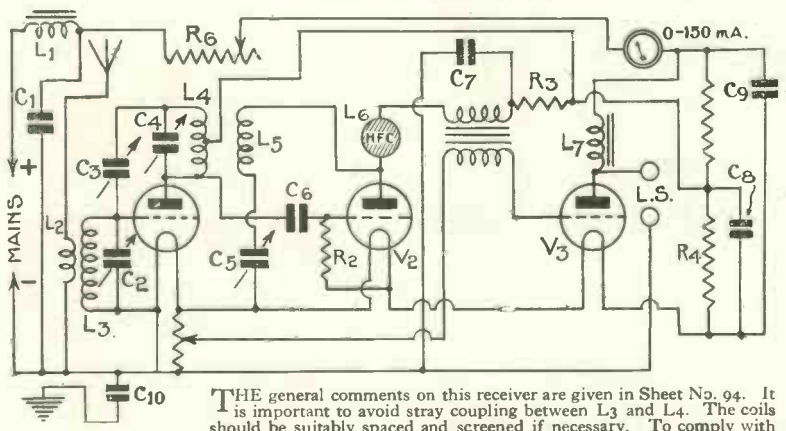
It is to be noted that the particular method adopted does not avoid coupling through the potentiometer itself and a species of motor-boating may easily be set up, particularly if more than one stage of low-frequency amplification is employed. To obviate this, a filter circuit should be employed in the detector stage and a choke-output circuit should be used. If this is done, no difficulty whatever will arise.

A particular feature to which attention must be paid is that of obtaining the correct grid bias.

The positive end of the grid-bias battery for the last valve must be connected to the negative leg of the last filament and we can arrange to put, say, 9-volts grid bias on this valve.

WIRELESS MAGAZINE Reference Sheet *No. 95*

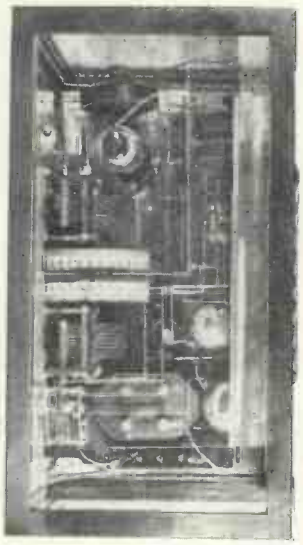
D.C. Mains Receiver



THE general comments on this receiver are given in Sheet No. 94. It is important to avoid stray coupling between L3 and L4. The coils should be suitably spaced and screened if necessary. To comply with I.E.E. regulations, a separately-coupled aerial coil must be used as shown. Six-volt valves should be used. The potentiometer R will then give a bias varying between – 6 and – 12 for the last valve.

THESE photographs show the splendid copy of the Inceptor 3 exhibited by Sydney S. Bird & Sons at the Radio Exhibition, referred to on page 314. Readers will be especially interested in the glass panel on which the controls are mounted.

We understand that Mr. Bird, who has tried the set himself, is very pleased with the results obtained.



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Loud-speaker Special	AW 78
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Super Reinartz One	AW127
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One-dial 2 (D, Trans)	WM23
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Crusader (D, Trans)	WM69
Flat-dweller's 2 (HF, D)	WM76
Two-Daventry Two (D, Trans)	WM97
Tetrode Short-wave Two (SG, D)	WM99
★Key-to-the-Ether Two (D, Pentode)	**WM107**
KL1 2-valver (D, Trans)	AW 5
One-control 2 (D, Trans)	AW 6
Wide-world Short-wave (D, Trans)	AW 11
Reinartz 2 (D, Trans)	AW 21
Empire Short-wave	AW 28
Next Step 2 (D, Trans)	AW 34
Centre-tap 2 (D, Trans)	AW 42
Three-option 2 (D, Trans)	AW 51
Rover 2 (HF, D)	AW 53
General-purpose 2 (D, Trans)	AW 55
All-wave (L Choke)	AW 57
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30/- 2 (D, Trans)	AW 61
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Home-and-Abroad 2 (D, Trans)	AW 77
Two-wave (D, Trans)	AW 83
Ultra-selective Hartley (D, Trans)	AW 90
Oceanic Short-wave (D, Trans)	AW 91
Trapped Reinartz (D, Trans)	AW 92
"Q" 2 (D, Trans)	AW 99
Long Distance Two (HF, D)	AW110
Three-waveband Two (D, Trans)	AW112
DX Headphone Two (HF, D)	AW133
Ace of Twos (D, Pentode)	AW143
Home Two (D, Trans)	AW146
All purpose Short-wave Three (D, Resistance Trans)	AW147

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Screened-grid (HF, D, RC)	WM21
Five-guinea 3 (HF, D, Trans)	WM29
Mains Three-valver (D, 2LF)	WM34
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
Pole-to-Pole Short-waver (D, RC, Trans)	WM89
Glee-singer Three (D, 2 RC)	WM92
Aladdin Three (HF, D, LF)	WM95
Inceptor Three (SG, D, Pentode) *Price* 1s. 3d. *with copy of "W.M."*	WM105
★All-wave Screened-grid Three (HF, D, Pentode)	**WM110**
M.C.3 Star (HF, D, Trans)	AW 16
Split-primary (HF, D, Trans)	AW 24
Lighthouse 3 (D, 2 Trans)	AW 29
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 DX (D, RC, Trans)	AW 63
Britain's Favourite (D, RC, Trans) *Price* 4d., *with copy of "A.W."*	AW 72
Broadcast 3 (D, RC, Trans)	AW 76
Selectus 3 (HF, D, Trans)	AW 81
Q-coil 3 (D, RC, Trans)	AW 84
Clarion 3 (D, 2 Trans)	AW 88
Miniature Hartley Three	AW101
Summer-time DX Three (HF, D, Trans)	AW106
Three-valve Mains Receiver (HF, D, Trans)	AW109
British Station Three (HF, D, Trans)	AW122
Optional Two-three (D, 2LF)	AW124
"Simpler Wireless" Mains Three (D, 2LF)	AW126
Simplicity Screen-grid Three (HF, D, Trans)	AW132
"Proms" Three (D, 2 RC)	AW137
All-wave Mains Three (HF, D, Trans, Rectifier—Price 1/6)	AW144
Adaptable Three (D, 2 Trans)	AW139
New-style Baffle Three (D, RC, Push-pull—Price 1/6)	AW141

FOUR-VALVE SETS

All these 1s. 6d. each, post free.

Revelation (HF, D, RC, Trans)	WM24
Simplicity (HF, D, 2 Trans)	WM49
Astral (HF, D, 2 RC)	WM53
Trapped 3-4 (D, 2RC Paralleled)	WM61
Station-finder (HF, D, 2RC)	WM68
Gramo-Radio 4 (D, RC, 2 Trans Push-pull)	WM70
Q-coil 4 (HF, D, Trans, RC)	WM71
Screened grid 4 (HF, D, 2RC)	WM77
All-from-the-Mains Four (HF, D, LF)	WM86
Five-pounder Four (HF, D, RC, Trans)	WM91
Frame-aerial Four (HF, D, 2RC)	WM85
Symphonic Four (HF, D, 2LF)	WM98
★Touchstone (HF, D, RC, Trans)	**WM109**
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
Special 4 (HF, D, 2LF)	AW 70
"Q" 4 (HF, D, RC)	AW 98
Near and Far Three-Four (HF, D, RC, Trans)	AW113
Pick-up Three-four (D, 2 Dual-imp.)	AW118
Explorer Four (HF, D, RC, Trans)	AW120
Summertime Searcher (2HF, D, Trans)	AW128
Overseas Shortwaver (HF, D, 2 Trans)	AW134
Ranger Four (SG, D, RC, Trans)	AW145

FIVE-VALVE SETS

All these 1s. 6d. each, post free.

1927 Five (2HF, D, 2 Trans)	WM 6
Two-volter's 5 (Trans-Parallel Power)	WM11
Exhibition 5 (2HF, D, RC, Trans)	WM33
Phoenix (2HF, D, 2LF)	WM42
1928 Five (2HF, D, 2 Trans)	WM46
All-the-world 5 (2HF, D, 2RC)	WM63
Cataract 5 (HF, D, RC, Push-pull)	WM79
Empire Five (2SG, D, RC, Trans)	WM96
Individual 5 (2HF, D, 2 Trans)	AW 25
School 5 (HF, D 2RC)	AW 85

SIX-VALVE SETS

1s. 6d. each, post free.

Nomad (2HF, D, RC, Push-Pull Trans)	WM31
Connoisseur's Six (2HF, D, RC, Push-pull)	WM88
★Eagle Six (3HF, D, RC, Trans)	**WM106**
Short-wave Super-6 (Super-het. Trans)	AW 67
Adaptor for above (see miscellaneous list)	AW67a

SEVEN-VALVE SETS

1s. 6d., post free.

Simpladyne (Super-het)	WM22

PORTABLE SETS

		Price	Post free
Springtime 2 (D, Trans)	WM12	1/-	
Countryside 4 (HF, D, 2 Trans)	WM17	1/6	
Handy 3 (D, 2 Trans)	WM27	1/-	
Sunshine 5 (2HF, D, 2 Trans)	WM74	1/6	
Chummy 4 (HF, D, RC, Trans)	WM80	1/6	
Chummy 4 (with modification for LS and HT)	WM80a	1/6	
Sidecar Portable (2 HF, D, RC, Trans)	WM83	1/6	
Pilgrim Portable (D, Trans)	WM94	1/6	
Super Chummy 4 (2HF, D, Pentode)	WM104	1/6	
Motorists 4 (HF, D, 2 Trans)	AW 14	1/6	
M.C. 3 (HF, D, Trans)	AW 22	1/-	
Holiday 3 (D, 2 Trans)	AW 32	1/-	
Easter 7 (Super-het, RC, Trans)	AW 89	1/6	
Table Grand 4 (HF, D, 2RC)	AW 93	1/6	
Attaché Portable 2 (HF, D)	AW 96	1/-	
Companion 5 (2HF, D, RC, Trans)	AW 100	1/6	
Daventry Portable (D, Trans)	AW 105	1/-	
Daventry Loud-speaker Portable (2HF, D, RC, Trans)	AW 107	1/6	
Town and Country (HF, D, RC, Trans)	AW 111	1/6	
House and Garden (screened-grid HF, D, RC, Trans)	AW 116	1/6	
Hand Portable (D)	AW 125	1/-	
"Best-yet" Portable (SG, D, 2 Trans)	AW136	1/6	

AMPLIFIERS

All these 1s. each, post free

Two-valve D.C. Mains Amplifier	WM15
Range Extender (HF Unit)	WM38
True-tone Amplifier (3 valves)	WM47
Gramo-radio Amplifier (2 v.)	WM72
★Super-power Unit (2v.)	**WM103**
One-valve DX Unit	AW 37
Utility (RC, Trans)	AW 68
Screened-grid HF Unit	AW 75
One-valve LF Unit	AW 79
Add-on HF Unit	AW 82
Super-power Push-pull	AW 86
Hook on Short-waver	AW104
Purity Amplifier	AW108
Add-on Distance-getter	AW117
Add-on 3	AW121
Screened-grid HF. 1	AW129
Screened-grid HF Amplifier	AW138

MISCELLANEOUS

		Price, Post free
Volume-control Unit	WM40	-/6
A.C. Mains Eliminator	WM41	1/-
Cone Loud-speaker	WM55	1/-
A.C. Adapter for "Simpler Wireless" Sets	WM57	1/-
Moving-coil Loud-speaker	WM58	1/-
D.C. Mains Eliminator	WM59	1/-
Wavetrap	WM64	1/-
Valve Tester and Paralleling Unit	WM65	1/-
Portable Cone Loud-speaker	WM73	1/-
Permanent-magnet Moving-coil Loud-speaker	WM75	1/-
"Junior" Moving-coil Loud-speaker	WM81	1/-
Universal Short-wave Adaptor	WM82	1/-
Linen-diaphragm Loud-speaker	WM90	1/-
Valveless A.C. Power Unit for L.T	WM100	1/-
Valveless A.C. Power Unit for H.T	WM101	1/-
Heterodyne Wavemeter	AW 7	1/-
Rectifying Unit for "Simpler Wireless" Sets	AW 62	1/-
Adaptor for Short-wave Super 6	AW 67a	-/6
H.T. from A.C. Mains	AW 73	1/-
"AW" Moving-coil Loud-speaker	AW 97	1/-
H.T. Eliminator for A.C. (200 v. output)	AW 102	1/-
Moving-coil Output Unit	AW 115	1/-
L.T. and H.T. Mains Unit (DC)	AW 123	1/-
Anti-motor-boating Unit	AW 130	1/-
Knife-edge Wavetrap	AW 131	-/6
All-metal Eliminator for H.T.	AW 135	1/-
Duplex-diaphragm Loud-speaker	AW 142	1/-

A blueprint of any one set described in the current issue of the "Wireless Magazine" can be obtained for half-price up to 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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