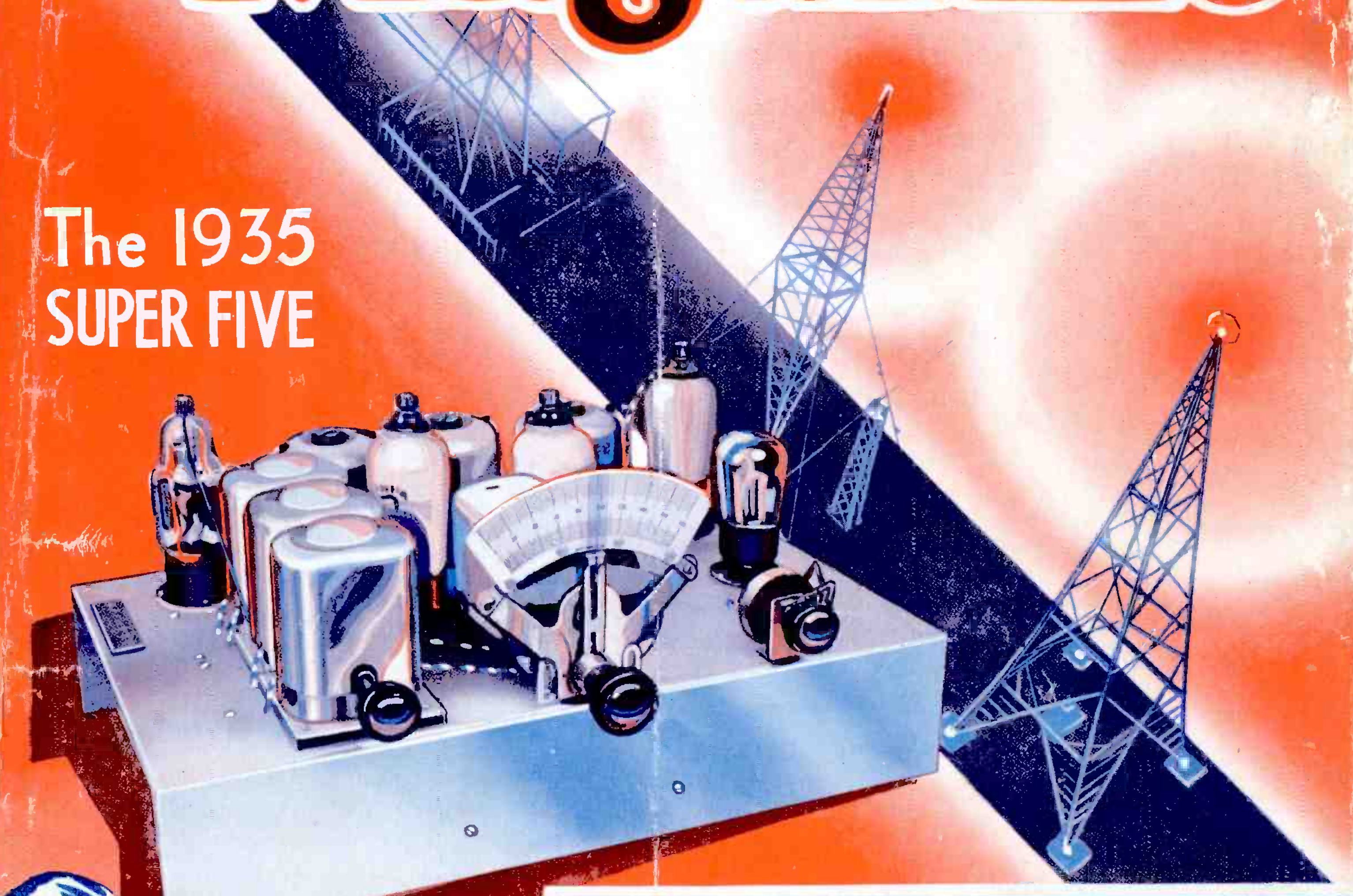
"QUALITY" ANALYSED by PAUL TYERS

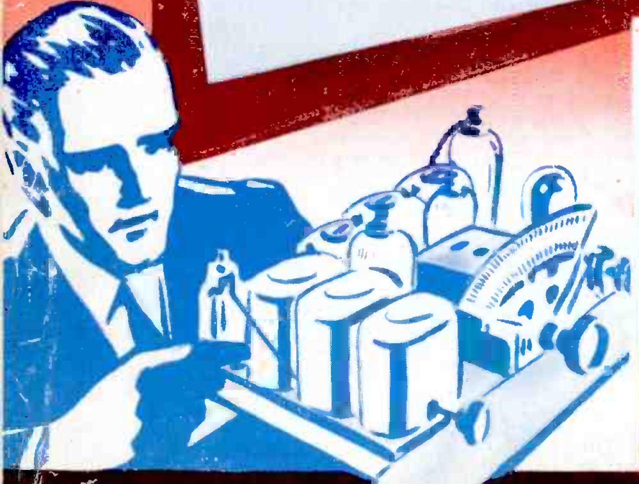
Wireless Magazine

1/-

JANUARY 19..

The 1935
SUPER FIVE





WHO SHOULD PAY FOR ANTI-STATIC DEVICES? AERIAL DESIGN :: HOW TO GET SMOOTH REACTION :: IS DROITWICH A FAILURE? THE RADIO AIRWAY :: TO-MORROW'S VALVES NOISELESS PICK-UP SWITCHING :: IT IS EASY TO MAKE A TELEVISION RECEIVER

Editor-in-Chief: BERNARD E. JONES
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Wireless Magazine

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Legal Rights of Listeners

"WHO should pay for anti-static devices?" is a very live question to-day and reminds me of still another difficult question with which I have periodically to deal—that of the man who has equipped himself with mains apparatus only to find a few months later that the nature of the local supply has been changed.

Readers assume that the local electrical supply authority will, at its own cost, make all the necessary alterations, but that is far too rough and general an assumption.

A man may treat himself to an expensive set and then some public service may cause such terrible interference with reception as to render the set almost useless. In such a case, will the public service authority pay for the installation of an anti-static device? Well, read the article by a barrister-at-law on page 537, and you will see some of the difficulties.

"What definite legal rights," asks the author, "has the broadcast listener to insist upon a static-free ether? As the law stands at present, the answer is NONE."

Morton Barr's fine article, "The Radio Airway," is both informative and readable. It shows the path taken by radio waves through the ether after leaving the transmitting aerial and includes a fine illustration indicating the various atmospheres and layers above the earth's surface up to a height of some 200 miles.

I wonder whether you will agree with J. H. Reyner in his plea, in "To-morrow's Valves," that the manufacturer should produce valves of lower efficiency but, at the same time, less likely to go "up the loop" after they have been in use for a few weeks? He makes some surprising statements which I think you will read with interest and profit.

For the technical enthusiast we have this month an article on short-wave aerial design, containing seventeen circuit diagrams; some further information by Noel Bonavia-Hunt on his diode-detector circuit, which he now modifies for A.C. sets and to battery and mains superhets; P. Wilson's article on pick-up curves; and a number of other items, each of value in its own way.

Possibly the most controversial of all aspects of modern radio engineering is quality of reproduction. Paul D. Tyers describes his article "What is this Quality?" as a simple basic analysis. He has strong views on the subject, but briefly he feels that whereas "freak" circuits do work sometimes, it is advisable to stick to methods which theory and practice prove to work the most satisfactorily.

We have another "super" in this issue. You will find that the "1935 Super Five" incorporates every possible modern development. It has a heptode frequency-changer—to ensure constant oscillation over both wavebands—used in conjunction with a special oscillator coil and a condenser with shaped vanes. Two intermediate-frequency stages give adequate sensitivity; there is a double-diode-triode second detector.

In the output stage is a pentode complete with economiser unit to save battery current when soft signals are being received, and there is a whistle-filter to ensure that no second-channel whistles spoil reproduction. All very fine and up-to-the-minute!

The home constructor will also be interested in our article showing how to add an extra amplifying stage to the £4 battery two-valver described last month, and in our gadget—the Long-wave Converter—for adding to A.C. or D.C. sets of the American and short-wave variety so that the user can receive stations on the 1,000-2,000-metre band.

Finally—not really finally—because there are many features which I simply have not room to refer to—Alan Hunter, in an article on Droitwich, makes a statement that this new station is not proving the success that the B.B.C. and listeners had hoped. In Birmingham and district, Droitwich blots out every foreign station on the long waves, while in districts 150 to 200 miles away from the transmitter distortion and fading at night are so bad that listeners have no alternative but to find a programme from elsewhere or switch off. He suggests an anti-fading aerial as a cure and suggests that the B.B.C. should have erected such an aerial in the first place. Cost? £30,000. A pretty tall order!

B. E. J.

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World's Broadcast Wavelengths

Stations best received in the British Isles are indicated in bold type. List is corrected up to the time of going to press

Note: Names in brackets are those of the main stations from which the greater part of the programmes are relayed

Wave-length	Name of Station	Dial Readings	Country
13.93	Pittshurgh W8XK		United States
14.00	Deal W2XDJ		United States
14.49	**Buenos Aires LSY**		Argentine
14.58	Bandoeng PMB		Java
15.92	Bandoeng PLE		Java
16.36	Lawrenceville (N.J.) WLA ..		United States
16.38	**Rugby GAS**		Great Britain
16.5	Drummondville (CFA8) ..		Canada
16.56	Bandoeng PMC		Java
16.56	Buenos Aires LSY3		Argentine
16.81	Bandoeng PLF		Java
16.85	Kootwijk PCV		Holland
16.86	Daventry Empire GSG ..		Great Britain
16.878	**Boundbrook W3XAL (WJZ)** ..		United States
16.88	**Eindhoven PHI**		Holland
16.89	Königswusterhausen DJE ..		Germany
19.47	Riobamba PRADO		Ecuador
19.56	**Schenectady W2XAD (WGY)**		United States
19.61	La Paz CP4		Bolivia
19.63	**New York W2XE (WABC)** ..		United States
19.67	Coytesville N.J. W1XAL (WEEI)		United States
19.67	Tashkent (Rim)		U.S.S.R.
19.68	**Radio Colonial FYA**		France
19.72	**Saxonburg W8XK (KDKA)** ..		United States
19.8	**Zeesen DJB**		Germany
19.815	Daventry (Empire) GSF ..		Great Britain
19.84	Rome (Vatican) HVJ		Italy
19.88	Moscow (RKI)		U.S.S.R.
19.93	W8XK, Saxonburg (KDKA) ..		United States
20.27	Rocky Point WQV		United States
20.31	Rocky Point N.Y. (WEB) ..		United States
21.43	Cairo SUV		Egypt
21.53	Rocky Point WIK		United States
21.58	Rocky Point WQP		United States
21.605	Rocky Point WQT		United States
21.83	Drummondville CJA8		Canada
22.26	Rocky Point WAJ		United States
22.48	Santa Rita YVQ		Venezuela
22.684	**Zeesen (DHB)**		Germany
23.39	**Radio Maroc (Rabat) CNR** ..		Morocco
24.41	Rugby GBU		Great Britain
24.9	Kootwijk PDV		Holland
25	Moscow RNE		U.S.S.R.
25.25	Radio Colonial, Paris (FYA) ..		France
25.25	**Saxonburg (Pa.) W8XK (KDKA)**		United States
25.28	**Daventry (Empire) GSE** ..		Great Britain
25.34	Wayne W2XE (WABC) ..		United States
25.4	**Rome 2RO**		Italy
25.45	Poston WIXAL (WEEI) ..		United States
25.51	**Zeesen DJD**		Germany
25.532	**Daventry (Empire) GSD** ..		Great Britain
25.63	Radio Coloniale FYA		France
26.83	Funchal CT3AQ		Madeira
27.65	Nauen DFL		Germany
27.86	Rugby GBP		Great Britain
27.88	Marapicu PSG		Brazil
28.28	Rocky Point (N.J.) WEA ..		United States
28.5	Sydney VLK		N.S. Wales
28.98	Buenos Aires LSX		Brazil
29.03	Bermuda ZFD		West Indies
29.04	Ruysselede (ORK)		Belgium
29.16	**Zeesen (DIQ)**		Germany
29.35	Marapicu PSH		Brazil
29.59	Leopoldville OPM		Belgian Congo
29.64	Marapicu PSI		Brazil
29.84	Abu Zabel, Cairo SUV		Egypt
30	Radio Excelsior LR5		Argentine
30.1	Rome IRS		Italy
30.4	Lawrenceville WON		United States
30.4	Tokio JIAA		Japan
30.00	Madrid EAQ		Spain
30.77	Lawrenceville WOF		United States
30.9	**Rugby GCA**		Great Britain
31.3	**Daventry (Empire) GSC** ..		Great Britain
31.23	Mexico City XETE		Mexico
31.26	Radio Nations HBL		Switzerland
31.28	**Philadelphia W3XAU (WCAU)**		United States
31.28	**Sydney VK2ME**		N.S. Wales
31.35	**Millis W1XAZ (WBZ)** ..		United States
31.38	**Zeesen DJA**		Germany
31.40	Lisbon CTIAA		Portugal
31.41	Jelöy LCL		Norway
31.48	**Schenectady W2XAF (WGY)**		United States
31.545	**Daventry (Empire) GSB** ..		Great Britain
31.55	Melbourne VK3ME		Victoria
31.55	Caracas YV3BC		Venezuela
31.58	Rio de Janeiro PSA		Brazil
31.71	New Brunswick WKJ		United States
31.9	Bandoeng PLV		Java
32.71	**Lawrenceville WNA**		United States
32.79	Maracay YVQ		Venezuela
32.88	Szekesfehervar HAT4		Hungary
33.26	Rugby GCS		Great Britain
33.59	Rocky Point (N.J.) WEC ..		United States
34.68	London VE9BY		Canada
36.65	Rio de Janeiro PSK (PRA3) ..		Brazil
37.04	Quito HCJB		Ecuador
37.33	Rabat (CNR)		Morocco
37.41	Suva VPD		Fiji Isles
38.07	Tokio JIAA		Japan
38.47	**Radio Nations HBP**		Switzerland
38.65	Kootwijk PDM		Holland
39.34	Tashkent RIM		U.S.S.R.
39.76	Moscow RKI		U.S.S.R.
39.82	Riobamba PRADO		Ecuador
40.3	Radio Nations HBQ		Switzerland
40.5	Bogota HJ3ABB		Colombia
40.54	Rocky Point WEN		U.S.A.
41.55	Bogota HKE		Colombia
41.6	Las Palmas EA8AB		Canary Isles
41.67	Singapore VSIAB		Sts. Settl'mts.
41.84	Grenada YN6RD		Nicaragua
41.9	Manizales HJ4ABB		Colombia
43	Madrid EA4AQ		Spain
43.86	Budapest HAT2		Hungary
44.61	Rocky Point WQO		United States
44.96	Maracay YVQ		Venezuela
45	Constantine FM8KR		Tunis
45	Gua en a a City		S. America
45.02	Guayaquil HC2RL		Ecuador
45.38	Moscow RW72		U.S.S.R.
46.53	Barranquilla (HJ1ABB) ..		Colombia
46.69	Boundbrook W3XL (WJZ) ..		United States
46.7	Boston W1XAL		United States
47	Cali HJ5ABB		Colombia
47.5	S. Domingo H1Z		Dominican R.
47.8	Domingo H1AA		Dominican R.
48.75	Winnipeg CJRO		Canada
48.78	Caracas YV3BC		Venezuela
48.86	**Saxonburg (Pa.) W8XK (KDKA)**		United States
	Moscow (RKK)		U.S.S.R.
49	Johannesburg ZTJ		South Africa
49.02	Wayne W2XE (WABC) ..		United States
49.08	**Caracas YVIBC**		Venezuela
49.1	Halifax VE9HX (CHNS) ..		Canada
49.18	**Boundbrook W3XAL (WJZ)**		United States
	Chicago W9XF (WENR) ..		United States
49.22	Bowmanville VE9GW (CRCT)		Canada
49.26	St. John VE9BJ (CFBL) ..		N. Brunswick
49.3	La Paz CP5		Bolivia
49.34	Chicago W9XAA (WCFL) ..		United States
49.39	Maracaibo V5BMO		Venezuela
49.4	Vienna OER2		Austria
49.43	Vancouver VE9CS (CKFC) ..		Brit. Columbia
49.47	Nairobi VQ7LO		Kenya Colony
49.5	**Philadelphia W4XAU (WCAU)**		United States
49.5	Cincinnati W8XAL (WLW) ..		United States
49.586	**Daventry (Empire) GSA** ..		Great Britain
49.6	Bogota HJ3ABI		Colombia
49.67	Boston W1XAL (WEED) ..		United States
49.83	**Zeesen DJC**		Germany
49.9	Singapore ZHI		F.M. States
49.92	Havana COC		Cuba
49.96	**Drummondville VE9DN (CFCF)**		Canada
50	Moscow RNE		U.S.S.R.
50.8	Barcelona EA3AB		Spain
50.26	**Rome (Vatican) HVJ**		Italy
50.42	Domingo HIX		Dominican R.
50.6	Medellin HJ4ABE		Colombia

(Continued on page 484

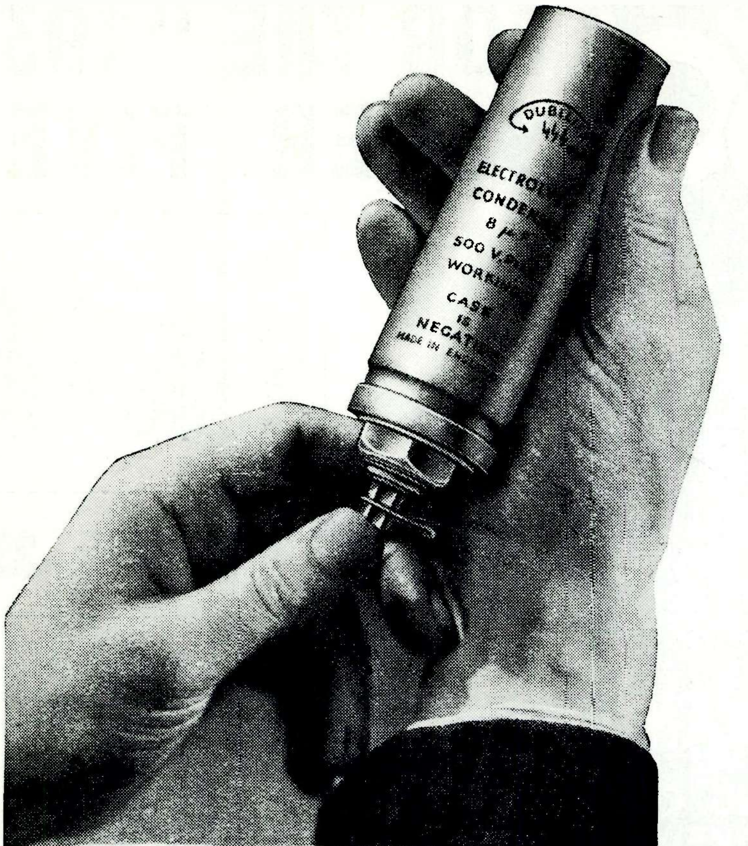
WORLD'S BROADCAST WAVELENGTHS

Continued from page 482

Wave-length	*Name of Station*	*Dial Readings*	*Country*
56.9	Königswusterhausen (DTG)		Germany
57.03	**Rocky Point WQN**		United States
58.03	Bandoeng PMY		Java
58.31	**Prague**		Czechoslovakia
60.3	Rugby GBC		Great Britain
62.5	**Long Island (N.J.) W2X**		United States
62.56	London		Ontario
65.93	Rocky Point WAD		United States
68.18	Moscow (RFCK)		U.S.S.R.
69.44	Rugby GDB		Great Britain
70.2	Khabarovsk RV15		U.S.S.R.
73	Quito (HCJB)		Ecuador
76	Maracay (YV11AM)		Venezuela
80	Lisbon CT1CT		Portugal
84.5	Berlin D4AGE		Germany
84.67	Mozambique CR7AA		East Africa
85.9	Boston W1XAL		United States
203.5	Plymouth		Great Britain
	Bournemouth		Great Britain
204.8	Pecs		Hungary
206	**Fécamp**		France
207.3	Miskolcz		Hungary
209.9	Beziers		France
	Newcastle		Great Britain
211.3	Tampere		Finland
214	Sofia		Bulgaria
215.4	Radio Lyon		France
216.8	Warsaw No. 2		Poland
218.2	Basle, Berne		Switzerland
219.6	Lorun		Poland
221.1	**Turin (2)**		Italy
222.5	**Milan (2)**		Italy
222.6	**Dublin**		Irish F. State
	Bordeaux S.O.		France
	Königsberg		Germany
224	Montpellier		France
	Lodz		Poland
225.6	Hanover		Germany
	Bremen		Germany
	Flensburg		Germany
	Stettin		Germany
	Magdeburg		Germany
230.2	Danzig		Germany
231.8	Linz		Austria
	Salzburg		Austria
	Dornbirn		Austria
233.5	**Aberdeen**		Great Britain
	Dresden		Germany
235.1	Stavanger		Norway
236.8	**Nurnberg**		Germany
238.5	San Sebastian		Spain
	Rome (3)		Italy
240.2	Juan-les-Pins		France
242	**Cork**		Irish F. State
243.7	**Gleiwitz**		Germany
245.5	**Trieste**		Italy
247.5	**Lille PTT**		France
249.2	Prague Strasnice (2)		Czechoslovakia
251	Frankfurt-am-Main		Germany
	Trier		Germany
	Freiburg-im-Breisgau		Germany
	Cassel		Germany
	Kaiserlautern		Germany
253.2	Kharkov (2)		U.S.S.R.
255.1	**Copenhagen**		Denmark
257.1	**Monte Ceneri**		Switzerland
261.1	**London National**		Great Britain
	West National		Great Britain
263.2	**Turin (1)**		Italy
265.3	Horby		Sweden
267.4	**Belfast**		N. Ireland
	Nyiregyhaza		Hungary
259	Kosice		Czechoslovakia
269.5	Radio Vitus (Paris)		France
270	**Moravska-Ostrava**		Czechoslovakia
271.7	Naples		Italy
274	Madrid EAJ7		Spain
276.2	Falun		Sweden
	Zagreb		Yugoslavia
278.6	Bordeaux PTT		France
280.9	Tiraspol		U.S.S.R.
283.3	**Bari**		Italy
285.7	**Scottish National**		Great Britain
288.5	Leningrad (2)		U.S.S.R.
	Rennes PTT		France
291	**Königsberg**		Germany
	Parede		Portugal
293.5	Barcelona (EAJ15)		Spain
296.2	**North National**		Great Britain
298.8	**Bratislava**		Czechoslovakia
301.5	Hilversum		Holland
304.3	**Genoa**		Italy
	Cracow		Poland

Wave-length	*Name of Station*	*Dial Readings*	*Country*
307.1	**West Regional**		Great Britain
309.9	**Grenoble PTT**		France
312.8	**Poste Parisien, Paris**		France
315.8	**Breslau**		Germany
318.8	Goteborg		Sweden
	Algiers		North Africa
321.9	**Brussels (2)**		Belgium
325.4	Brno		Czechoslovakia
328.6	Radio Toulouse		France
331.9	**Hamburg**		Germany
335.2	Limoges PTT		France
335.2	Helsinki		Finland
338.6	Graz		Austria
342.1	**London Regional**		Great Britain
345.6	Poznan		Poland
349.2	**Strasbourg**		France
352.9	Bergen		Norway
	Valencia		Spain
356.7	**Berlin**		Germany
360.6	Moscow (4)		U.S.S.R.
362.8	**Radio LL Paris**		France
364.5	**Bucharest**		Roumania
368.6	**Milan**		Italy
373.1	**Scottish Regional**		Great Britain
	Salonika		Greece
377.4	**Lvov**		Poland
	Barcelona (EAJ1)		Spain
382.2	**Leipzig**		Germany
386.6	**Toulouse PTT**		France
391.1	**Midland Regional**		Great Britain
395.8	**Katowice**		Poland
400.5	Marseilles PTT		France
405.4	**Munich**		Germany
410.4	Seville		Spain
	Tallinn		Estonia
	Madrid (Espana)		Spain
415.5	Kiev		U.S.S.R.
420.8	**Rome**		Italy
426.1	**Stockholm**		Sweden
431.7	**Paris PTT**		France
437.3	**Belgrade**		Yugoslavia
443.1	**Sottens**		Switzerland
449.1	**North Regional**		Great Britain
455.9	**Langenberg**		Germany
463	**Lyons PTT**		France
470.2	**Prague (1)**		Czechoslovakia
476.9	Trondheim		Norway
483.9	**Brussels (1)**		Belgium
491.8	**Florence**		Italy
499.2	**Sundsvall**		Sweden
	Rabat		Morocco
506.8	**Vienna**		Austria
514.6	Agen		France
	Riga		Latvia
522.6	**Mühlacker**		Germany
531	**Athlone**		Irish F. State
539.6	**Beromünster**		Switzerland
549.5	**Budapest**		Hungary
559.7	Wilno		Poland
	Bolzano		Italy
569.3	Viipuri		Finland
	Ljubljana		Yugoslavia
578	Innsbruck		Austria
	Hamar		Norway
696	Oulu		Finland
748	Moscow		U.S.S.R.
	Geneva		Switzerland
765	Boden		Sweden
765	Ostersund		Sweden
824	Smolensk		U.S.S.R.
845	Fuimark		Norway
1.107	Moscow (2)		U.S.S.R.
1.144.2	Madona		Latvia
1,154	**Oslo**		Norway
1,224	Leningrad		U.S.S.R.
1.261	**Kalundborg**		Denmark
1,304	**Luxembourg**		Luxembourg
1,345	Warsaw		Poland
1,354	**Motala**		Sweden
1,389	**Eiffel Tower**		France
1.442	Minsk		U.S.S.R.
1.500	**Droitwich National**		Great Britain
1,312.9	Ankara		Turkey
1,571	**Deutschlandsender**		Germany
1,612.3	Istanbul		Turkey
1,648	**Radio Paris**		France
1,724	**Moscow No. 1**		U.S.S.R.
1,807	Lahti		Finland
1,875	**Kootwijk**		Holland
	Huizen		Holland
	Brasov		Roumania
1,935	**Kaunas**		Lithuania

It helps us if you mention "Wireless Magazine"



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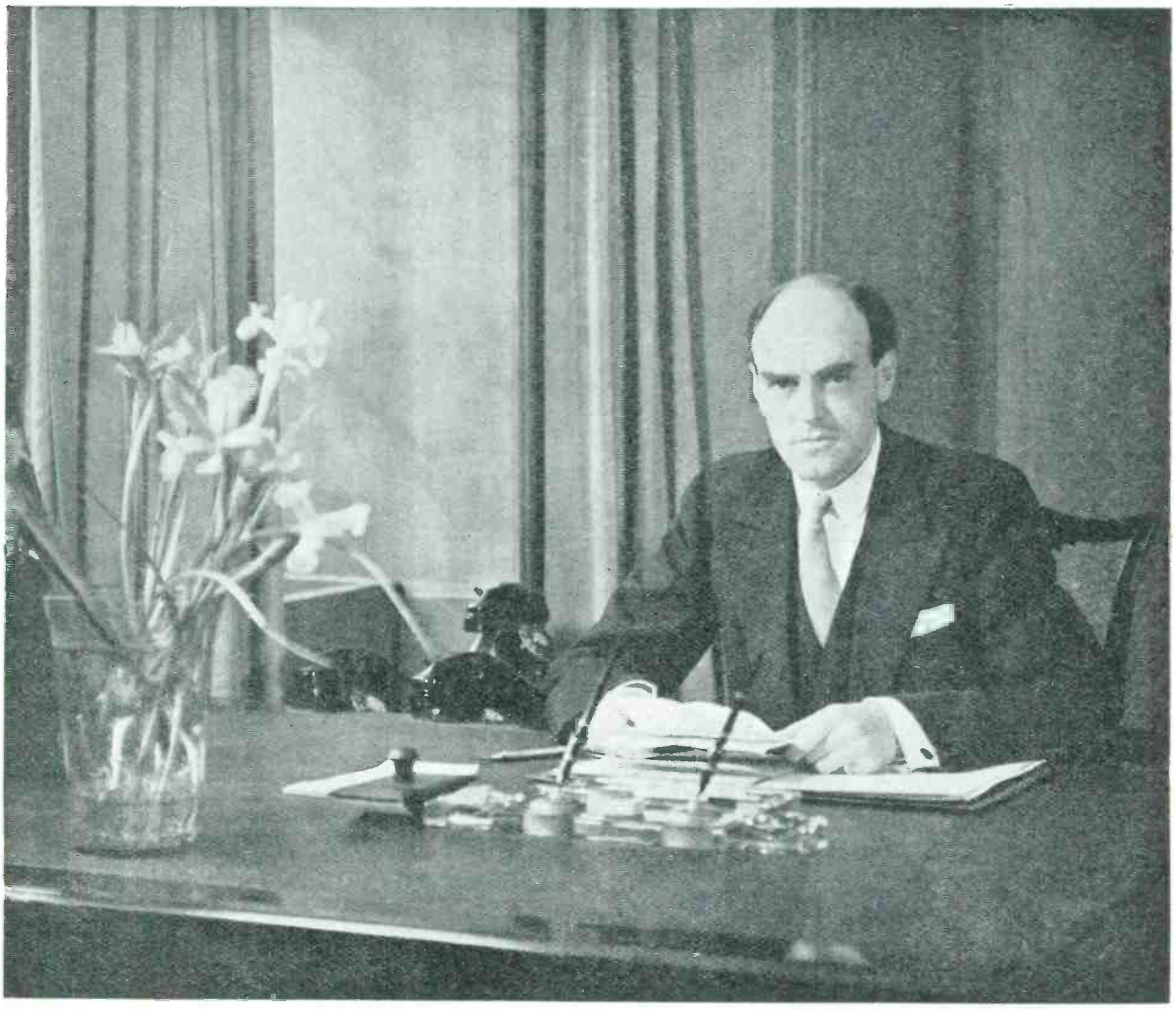
New Year Message from the Director-General



To the Editor-in-Chief, "Wireless Magazine"

I am glad to be able to wish you and your readers a very happy New Year. There is no halting or hesitation in the progress of broadcasting or the wireless industry generally. In the New Year, for example, we shall hope to know a little more about what to expect with regard to television.

BIG NOISES

Recent improvements in speaker and circuit technique now enable us to use increased outputs to real advantage, since peak resonances are eliminated and the ear can properly appreciate the fine detail and balance of full bodied reproduction. Marconi output valves should be familiar to all who demand 'punch' unmarred by the effects of excessive characteristic 'tail' or insufficient emission reserve.

LARGE-OUTPUT VALVES

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PX 25	25 watt triode	25/-
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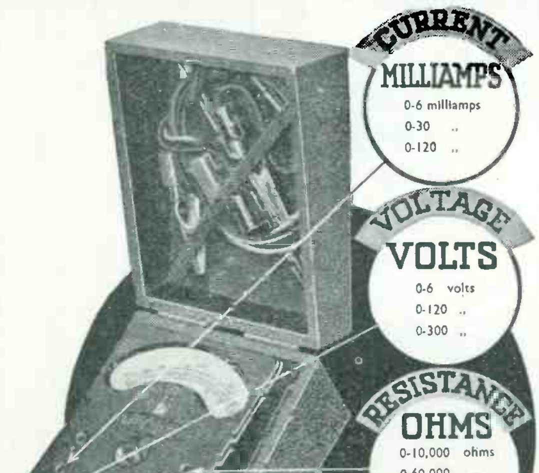

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BRITISH manufacturers have made the standard super-het for the 1934/5 season a four-valver—a combined first detector/oscillator, a single intermediate-frequency stage, second detector, and an output valve, usually a pentode. This is a combination which will give all that most listeners require in the way of programmes.

Average Listener's Ideal

Indeed, the four-valve combination is probably the average listener's ideal when it comes to the best all-round set for mains operation. But does this hold true when we want to produce a battery set ?

A moment's reflection shows that it does not; and for the very simple reason that, although they are nowadays extraordinarily efficient, standard battery valves are not *quite* so good as their equivalent mains types.

Extra Valve Needed

To get a battery set that will give a performance as good as that obtained from a mains " four " it is normally necessary to use at least one more valve, making a total of five. But where shall the fifth valve be added ?

There are two parts of a super-het circuit where it is possible to add a fifth stage—in the intermediate-frequency amplifier or in the low-frequency amplifier. The best place is, of course, in the intermediate-frequency stage: an extra valve here will give us two extra tuned circuits, which will improve the overall selectivity, and also increase the pre-second detector amplification, which will enable us to add self-adjusting (or automatic) volume control.

Although it would be cheaper to add an extra low-frequency valve, there is no great advantage in so doing. All the stations that are really worth hearing will have sufficient strength at the second-detector stage to load fully a normal pentode, which means that full loud-speaker volume will be obtained.

In other words, an extra low-frequency stage will not give us any better selectivity and will not materially increase the *entertainment* value of the set.

All this leads up to the fact that in designing a new battery-operated super-het for " Wireless Magazine " readers to use in 1935 we have compromised on a five-valver with a combined first detector/oscillator, two intermediate-frequency stages, second detector, and a pentode output valve.

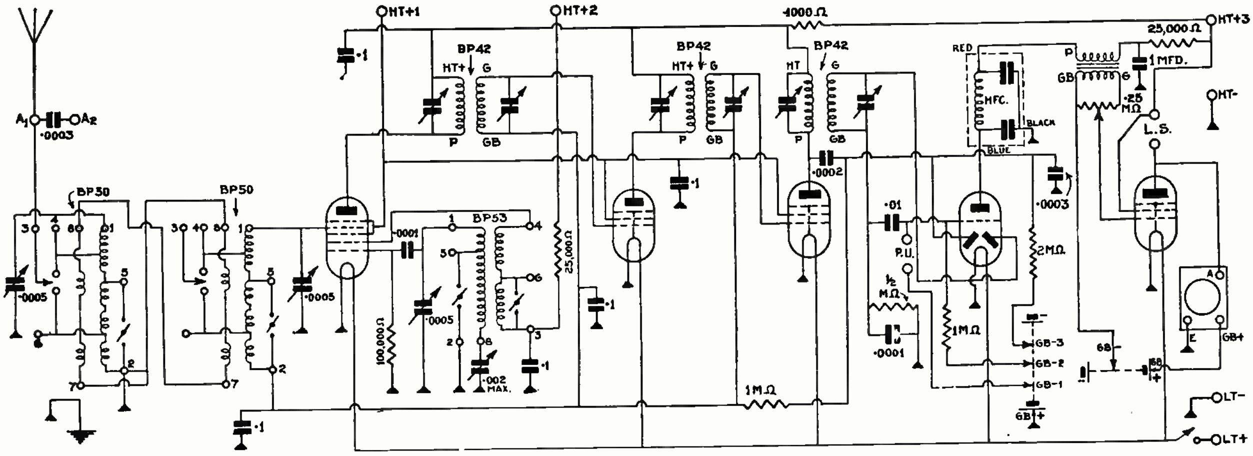
The Five Features

The set has five distinctive features that will appeal to all technicians, namely, (1) all the coils, including the oscillator and the intermediates, have iron cores; (2) the intermediate frequency is 110 kilocycles (every " Wireless Magazine " super-het up to now has had 126-kilocycle intermediates); (3) self-adjusting volume control is incorporated; (4) a battery economiser is used to keep the high-tension consumption down to the absolute minimum consistent with good quality; and (5) selectivity can be varied between about 6 and 12 kilocycles. These points will be discussed in detail during the course of the article.

Our Reputation

But from these preliminary details it will be appreciated that " Wireless Magazine " once again lives up to

A Super-het with Five Distinctive Features



THE CIRCUIT OF THE 1935 SUPER FIVE

The circuit of this fine new " W.M." battery super-het contains all the refinements necessary to ensure super-efficient results. The valve combination consists of combined first detector-oscillator, two intermediate-frequency amplifiers, second detector double-diode-triode and a pentode output stage

its reputation of producing only the highest class sets of their type—a reputation that increases steadily with the passing of the years.

Let us now analyse the various points of interest about the circuit of the 1935 Super Five and comment on the special features as we come to them.

Aerial Circuit

First of all we see that the aerial circuit is tuned on the band-pass principle. Provided that it is ganged up properly a band-pass circuit is obviously more selective than a single tuned circuit; and the extra selectivity thus obtained does not mean any sacrifice of quality, thanks to the " flat-top " characteristic of the response curve.

Moreover, as both the band-pass coils are of the latest iron-core variety the selectivity is of a very high order and as great a signal strength as possible is obtained right at the beginning—where it is wanted and where the greatest advantage can be taken of it.

Aerial Tappings

Moreover, to get the best results from any particular aerial system two aerial connections are provided, one direct to the coils and the other through a .0003-microfarad condenser for increased selectivity.

The band-pass coils form part of a three-coil unit, of which the third component is the iron-core oscillator. This is of the 110-kilocycle type. We have used it, not because there is any great advantage in 110-kilocycle intermediates as compared with the 126-kilocycle types previously used for " Wireless Magazine " sets, but because the coils themselves are a definite advance.

We have looked into the desirability of getting manufacturers to make 126-kilocycle intermediates on the latest lines for " Wireless Magazine " sets, but as 110 kilocycles has been adopted as the standard by most coil manufacturers and, as already remarked, there is no great difference in practice between 110 and 126 kilocycles, we have not pressed the point.

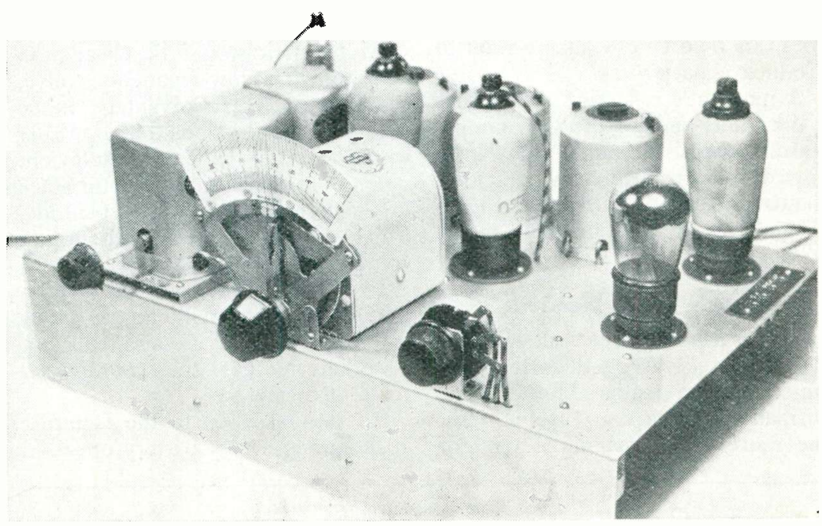
The result is that only standard production parts are needed for this set and there should not be the slightest difficulty in getting supplies from any good dealer.

Much of the efficiency of the set is due to the fact that the intermediate-frequency coils are adjustable for selectivity. This is attained by making the coupling between the primary and secondary windings variable, the degree of coupling being controlled by means of a large screw-head on the tops of the cans.

Selectivity Control

The positions of maximum and minimum selectivity are clearly marked at the ends of a graduated scale engraved on each coil.

Apart from this there are also two trimmers on each intermediate coil, one each for the primary and secondary. No matter how the actual wiring of individual sets may vary,



EFFICIENCY IS THE KEYNOTE OF THIS 1935 SUPER

Only a glance is needed at the layout and appearance of the 1935 Super Five to see that the set is super in every way. Note the loud-speaker and pick-up sockets on the right therefore, it is always possible to adjust the intermediate-frequency stages to give the maximum signal strength, a point of considerable importance when it comes to getting the weaker of the more distant transmissions.

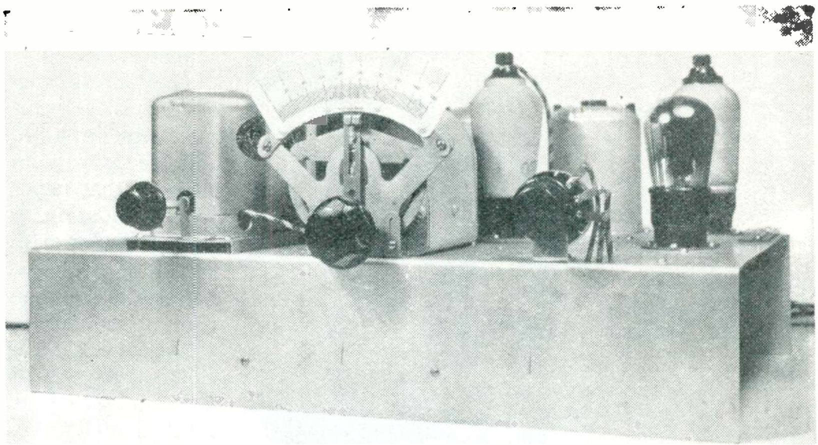
The detector / oscillator, it will be seen, is of the pentagrid variety; in other words, a valve combining a screen-grid assembly and a triode assembly is used.

Pentagrid Efficiency

This one valve can be used for two distinct functions with the maximum of efficiency. The screen-grid portion is coupled to the first band-pass intermediate coil and the triode portion acts as the oscillator, a form of electron coupling being utilised to give more or less constant strength of oscillation.

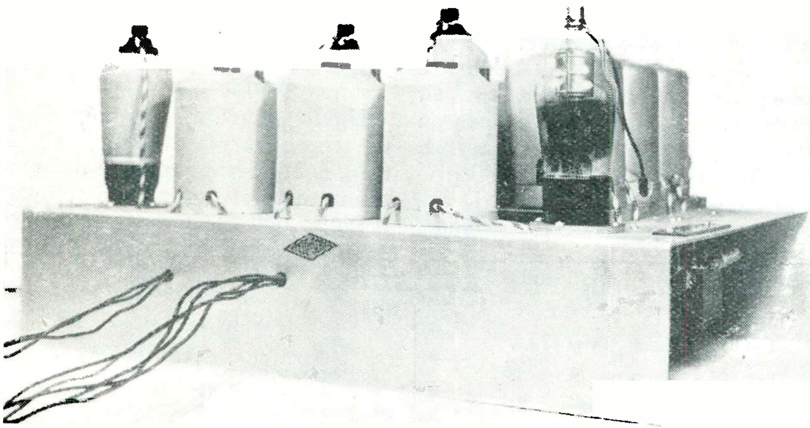
The triode part of the circuit is decoupled by means of a 25,000-ohm resistor and a 1-microfarad condenser.

Both the intermediate-frequency amplifiers are the latest type of variable-mu high-frequency pentode. They are biased automatically by



CONTROLS ARE AS SIMPLE AS THE ALPHABET

There are just three controls on the front. On the left is the wave-change switch, in the centre the sole tuning control, and on the right is the combined on-off switch and volume control. This is about the limit of simplicity



FLEXIBLE LEADS FOR BATTERY CONNECTIONS

As you can see the battery leads are brought out through a small hole in the metal chassis. The aerial and earth sockets can be seen on the extreme right of the set

the second detector so that full self-adjusting volume control is obtained. It is for this reason, of course, that no pre-second detector manual control of volume is provided.

Both anode circuits are decoupled by means of a 1,000-ohm resistance and .1-microfarad condenser.

The next point of interest in the circuit is the second detector, which is another multiple valve—a double-diode-triode, that is, two diodes and a triode in one bulb. This valve is used in the following way:

The first diode is used as a signal detector and is resistance-capacity coupled to the triode portion, which acts in effect as a first-stage low-frequency amplifier. It is well known that a diode gives much better quality than a triode because in practice it never overloads; it is somewhat unusual to use one in a battery set, but the 1935 Super Five has such tremendous overall amplification that the use of a diode is fully justified.

The second diode is used for self-adjusting volume control, the voltage developed in the detector circuit being fed back as grid bias to the two intermediate-frequency valves, thus controlling the volume. It is obvious that as the signal strength increases so is the bias increased, with the result that the amplification factors of the valves is decreased and the volume therefore falls.

The practical effect of this control is that very loud stations are kept down to a reasonable volume, while weak signals are unaffected. It is not true that all stations come in at exactly the same volume, as some claims made for self-adjusting volume control lead one to expect, but the difference in strength between any particular weak and strong stations is evened out.

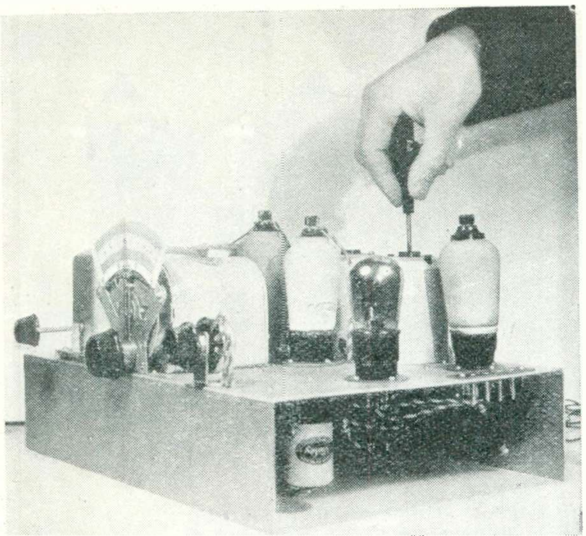
Output Arrangement

The triode portion of the valve acts as a low-frequency amplifier and is transformer coupled to the output pentode. The gramophone pick-up, when one is used, is connected into the grid circuit of this part of the double-diode-triode.

The use of a pick-up means that some form of volume control that can be manually controlled is needed. We have killed two birds with one stone by using a potentiometer of 250,000 ohms across the secondary of the intervalve transformer. This control therefore functions both for radio and gramophone working.

Whistle Filter

Another interesting point to note is that a whistle filter is included in the second-detector circuit. This can be used to minimise the effects of bad heterodyne whistles and will also cut out a lot of high-pitched background noises—including needle scratch when a pick-up is used. This whistle is adjustable, and the top cut-off can be varied between about 3,000 and 5,500 cycles.



The three intermediate-frequency coils are each provided with selectivity adjustors so that the selectivity can be varied roughly between 6 and 12 kilocycles

It will be noted that the screening grid of the pentode valve is taken direct to the high-tension supply, no dropping resistance being utilised. This is in conformity with the makers' recommendations.

Battery Economiser

At the end of the circuit we also come in contact with the battery economiser. This is a simple device that makes use of a metal rectifier in such a way that when no signals are actually being received the anode current is reduced to an absolute minimum. As soon as signals come in the anode current rises to its normal amount.

In practice the set is more or less "dead," therefore, until signals are actually received.

This battery economiser is a complete unit in itself, and the only point about it that needs special mention is the fact that an extra 9-volt grid-bias battery is used in conjunction with it.

Three high-tension supply points are provided, marked H.T.+1, H.T.+2, and H.T.+3. The first supplies about 60 volts to the screens of the first three valves; the second supplies 35 to 60 volts to the triode anode of the double-diode-triode; and the last supplies the full voltage of the battery to all the anodes. A 120-volt battery will be suitable, but if it is possible to use 150 volts all the better.

All the details needed for constructing the 1935 Super Five are included in these pages. There is a good selection of photographs and a layout and wiring guide.

If desired, of course, a full-size blueprint can be obtained for half price, that is 9d., if the coupon on the last page is used by January 31.

Address your application to "Wireless Magazine" Blueprint Dept., 58-61 Fetter Lane, London, E.C.4, and ask for No. WM379.

As we have already mentioned, all the parts used in this design are standard, and there should be no difficulty about obtaining supplies. If any delay should arise readers are advised to get into touch with the makers of the components direct and say that such-and-such a part is needed for the "Wireless Magazine" 1935 Super Five.

Getting the Parts

If, in any exceptional circumstance, that should fail to produce satisfaction, then a full report of the case should be sent to "Wireless Magazine." In many cases delay in getting parts is due to the local dealer passing on the order to the factor or maker only after considerable delay.

As far as the operation of the set is concerned the only points that really need stressing are the methods of ganging. There is rather more ganging than usual in this set, but there is nothing complicated about the process. In the first place the three-gang tuning condenser will need trimming up; this is done in the usual way, of course, on one or two moderate signals somewhere towards the middle and bottom of the medium waveband.

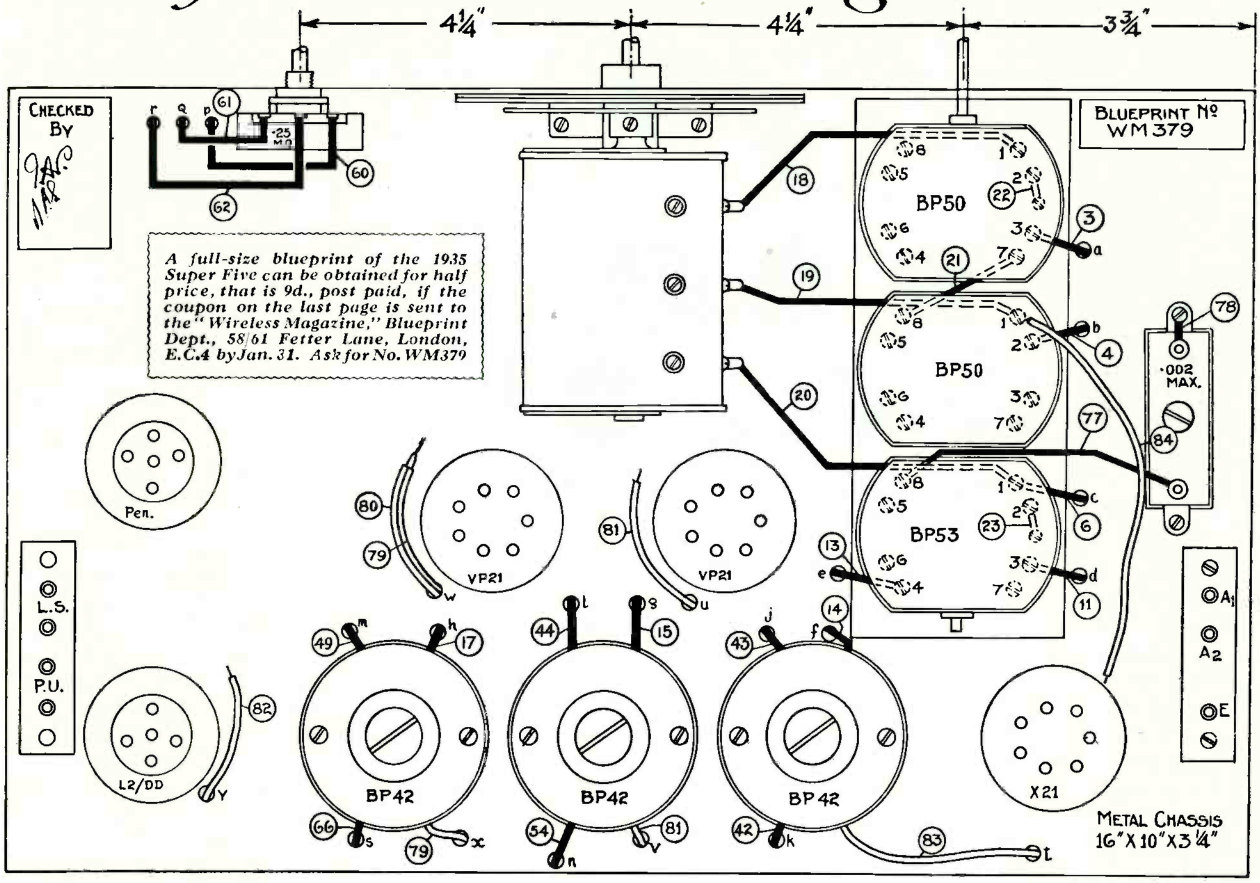
Ganging the Set

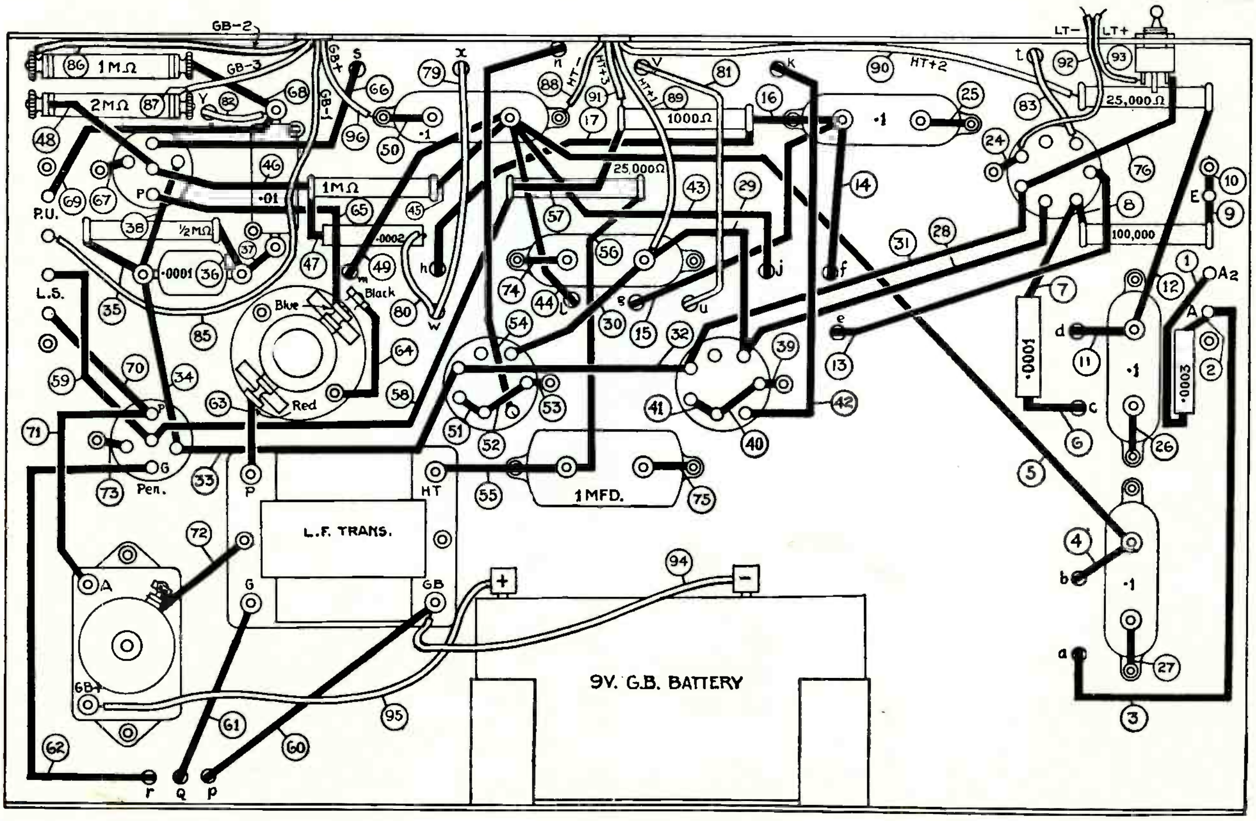
Having tuned-in a station, adjust the trimmers on the condenser in turn, not forgetting to move the main tuning control around the resonant point so that the effect of adjusting

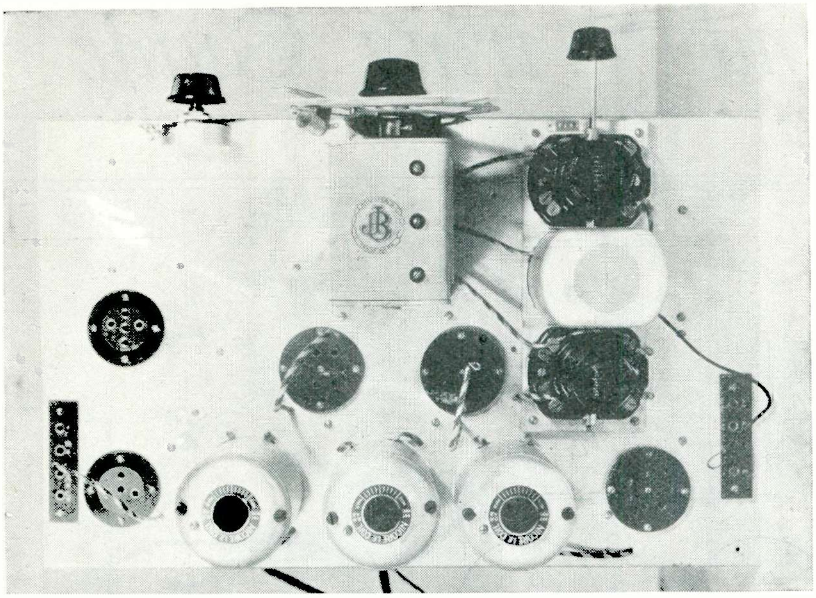
COMPONENTS NEEDED FOR THE 1935 SUPER FIVE

	£	s.	d.
CHASSIS			
1—Peto-Scott, aluminium, 16 in. by 10 in. by 3¼ in.		8	6
COILS			
1—Varley coil unit, type BP62 ...	1	13	0
CONDENSERS, FIXED:			
1—T.C.C. .0001-microfarad, type tubular (or T.M.C. Hydra) ...		1	0
1—Dubilier .0001-microfarad, type 665			6
1—Dubilier .0002-microfarad, type tubular (or T.M.C.)		1	0
1—Dubilier .0003-microfarad type tubular (or T.M.C.)		1	0
1—Dubilier .01-microfarad, type 670		2	0
5—Dubilier .1-microfarad, type BB (or T.C.C.)		9	2
1—Dubilier 1-microfarad, type BB (or T.C.C.)		2	6
CONDENSERS, VARIABLE			
1—J.B. three-gang .0005-microfarad with shaped-plate oscillator section, type Baby Superhet Gang		16	0
1—Goltone .002-microfarad pre-set		1	0
DIAL, SLOW-MOTION			
1—J.B. full vision, arcuate ...		5	9
HOLDERS, VALVE			
2—Clix 5-pin, chassis mounting		1	0
3—Clix 7-pin, chassis mounting		2	3
PLUGS, TERMINALS, ETC.			
10—Clix wander plugs, marked: G.B.—1, G.B.—2, G.B.—3, G.B.—4, G.B.+ (two), H.T.+1, H.T.+2, H.T.+3, H.T.— (or Goltone)		1	3
1—Clix socket strip, marked: A1, A2, E.			7
1—Clix socket strip, marked: Pick-up, L.S., L.S.			8
1—Clix metal cap connector ...		...	2
RESISTANCES, FIXED			
1—Erie 1,000-ohm, 1-watt (or (Dubilier)		1	0
1—Erie 20,000-ohm, 1-watt (or Dubilier)		1	0
2—Erie 25,000-ohm, 1-watt (or Dubilier)		2	0
1—Erie 100,000-ohm, 1-watt (or Dubilier)		1	0
1—Erie .5-megohm, 1-watt (or Dubilier)		1	0
2—Erie 1-megohm, 1-watt (or Dubilier)		2	0
1—2-megohm (Erie)		1	0
RESISTANCE, VARIABLE			
1—Erie .25-megohm (or Claude Lyons)		3	6
SUNDRIES:			
Round-tinned copper wire, No. 20 gauge, for connecting (Goltone), say		...	9
Oiled sleeving (Goltone), say ...		1	0
5 yds. thin flex (Goltone), say ...			5
1—Aluminium 1½-in. mounting bracket, say		...	2
1—pair grid-bias battery clips (Bulgin No. 1)			6
5—doz. 6 B.A. ½ in. round head bolts and nuts (Peto Scott) ...		1	8
SWITCH			
1—Bulgin three-point shorting, type S87		1	9
TRANSFORMERS, INTERMEDIATE-FREQUENCY			
3—Varley iron-core, type BP42 .	1	14	6
TRANSFORMER, LOW-FREQUENCY			
1—Ferranti ratio 1 to 3, type AF10		8	6
UNITS			
1—Kinva heterodyne whistle, filter, type		7	6
1—Varley battery enconomiser, type DP45		15	6
ACCESSORIES			
BATTERIES			
1—120-volt high-tension (Drydex), type H1012		16	9
2—Drydex 9-volt grid bias, type H1001		1	0
1—Smiths 2-volt accumulator, type 2RGN7		10	6
LOUD-SPEAKER			
1—Ferranti cabinet, type MT5 ...	3	10	0
VALVES			
1—Osram X21		18	6
2—Osram VP21 (met.)	1	7	0
1—Mazda L2DD (met.)		9	0
1—Cossor 220PT		13	6
MAINS UNIT (in place of 120-volt battery)			
1—Atlas, type T10/30 for A.C. mains	3	9	6

Layout and Wiring Guide







LAYOUT ON THE UPPER SIDE OF THE CHASSIS
Nothing difficult about this layout! The three intermediate-frequency coils are seen in a row at the bottom. Note the selectivity adjustors on these coils by means of which the selectivity of the set can be varied to suit the conditions under which it is used

the trimming condensers can be appreciated.

Remember, also, that if the set is ganged with the aerial-series condenser in circuit the aerial trimmer, at least, will need readjusting when this condenser is out of circuit.

Trimming the Intermediates

As soon as the three-gang condenser has been trimmed up, the trimming of the intermediate-frequency coils (three of them) should be undertaken. There are two trimmers on each coil, one for the primary and one for the secondary. These are adjusted for maximum signal strength by screwing them up and down in the way adopted for trimming a gang condenser.

Do not confuse this trimming with the adjustment of the selectivity. The latter is done by setting the large screw-head in the centres of the coil cans, but the primary and secondary trimmers are smaller screw-heads at either side of the selectivity adjuster.

Selectivity Adjustment

Selectivity can be adjusted to meet the needs of the moment and will not affect the trimming of the rest of the circuits in any way. For instance, if you live very close to a high-power station you will probably want to have the maximum selectivity; in that case you turn the screw-heads to the point marked "Max."

If, on the other hand, you live miles away from a transmitter then you may get better quality reproduction by adjusting to the "Min." point. It should be realised that as the selectivity is increased so will the reproduction of top notes suffer to some extent.

Lastly, there is the adjustment of the whistle filter, which again will vary in individual circumstances. This unit is adjusted by pulling the core in and out; the maximum cut-off is obtained when the core is pushed in as far as possible.

You will notice from the list of parts that we have specified a mains high-tension unit as an alternative to the 120-volt dry battery. The 1935 Super Five has been thoroughly tested by the Technical Staff with this unit, an Atlas model T10/30, and the set behaved satisfactorily.

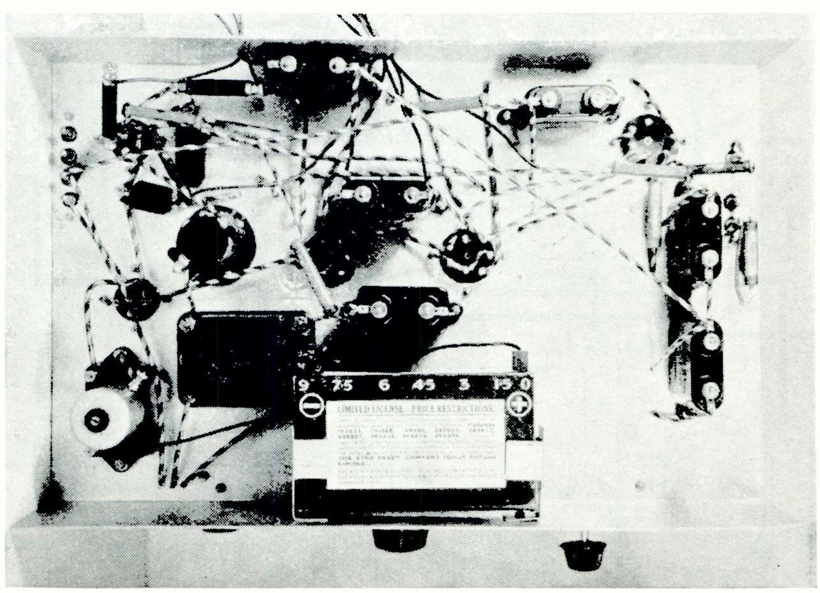
Unique Output

We specially chose this mains unit because it happens to a model eminently suitable for a set of this type. The unit in question has two power tappings, one of 120 volts and the other 150 volts. By means of a rather ingenious three-point switch on the front, the unit can be made to give either of these voltages with currents of 10, 20 or 30 milliamperes.

In addition to this feature, the unit incorporates a trickle charger, which will charge an ordinary 2-volt accumulator at the rate of .5 ampere.

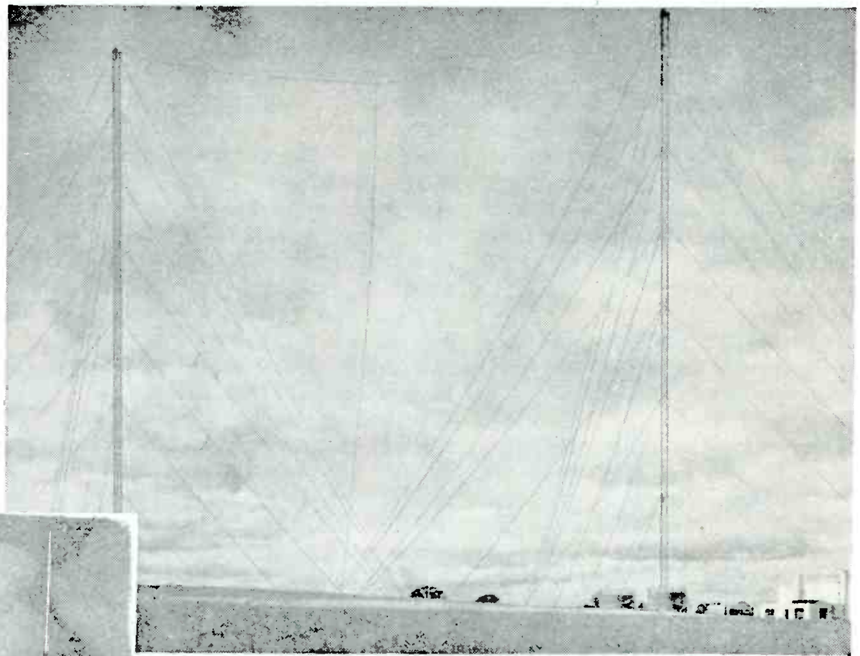
From this description it will be seen that the 1935 Super Five does represent the last word in battery-set technique. We have no hesitation in presenting it to "Wireless Magazine" readers as the best that can be offered in its class for use during the New Year—and for many years after!

Just one final word. We do want to know of the results you get with the 1935 Super Five. Reports from any part of the country will be welcomed by our Technical Staff.

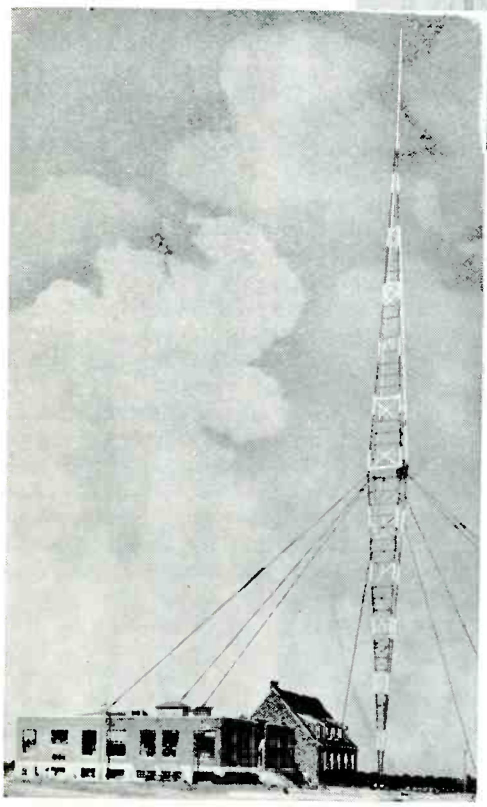


LAYOUT OF THE UNDERSIDE
Again there is little work to be done. Constructors will find work much easier if they study this plan view in conjunction with the layout on page 493

In this special article Alan Hunter reveals that there is a growing discontent by many listeners with their reception of Droitwich. He says that people in the Birmingham area are complaining bitterly of swamping and those situated between 150 and 250 miles away get "night distortion" so badly that they cannot listen at all. It is suggested that the "T" aerial system of Droitwich may be to blame



B.B.C. Photo



This fine anti-fading aerial is the proud possession of WLW, a 500-kilowatt transmitter in the United States. The mast is supported by huge steel stays and rests on two porcelain insulators. At the top of the page is seen the "T" aerial of Droitwich

Is Droitwich a Failure?

Asks ALAN HUNTER

WITH the coming of the Droitwich high-power long-wave station most of us, with some justice, imagined that the National programme had been made safe for democracy.

Taking the place of obsolescent Daventry 5XX, the 150-kilowatt Droitwich transmitter was heralded as the last cry in super-efficient broadcasters.

The public is having the last cry, though. In fact it is rather more than a cry. A positive howl—in afflicted districts.

What, then, is wrong with this paragon of stations? In what way has it fallen from the grace of its 700-ft. masts?

In two ways, though the first is nobody's fault except Old Man Progress. And the second is so unexpected that the B.B.C. itself is tongue-tied.

Firstly, then, Droitwich has caused a rumpus within its fairly considerable swamp area. People in nearby Birmingham are complaining bitterly that it is Droitwich, Droitwich all the time. That the long waveband, once their happy hunting ground for sponsored programmes, has become a sea of troubles, which, even when opposed by all selectivity devices, ends not.

Many a set dubbed a go-getter in the Daventry days is now relegated to the has-beens. Simply because of Droitwich swamping. Sets that could cut out Daventry soon enough to bring in Radio Paris and Luxembourg free from the National programme are now paralysed. I know this is so because quite a lot of vituperation has fallen upon the heads of luckless set designers, some of whom have come to me for solace.

Swamping by Droitwich was among the expected things, all the same. Everyone realised that ideas on long-wave selectivity would have to be revised when the giant took the air. It was no use holding up designs until that time, though. Besides, I am not sure that any simple set will solve the problem—and simple sets are still in demand, and will still be built.

Against a partial admission of swamping in certain Midland areas the B.B.C. has pointed out that vast numbers of people at greater distances have benefited by Droitwich. People who could only just hear Daventry, said the B.B.C., now received a wonderfully strong signal from Droitwich.

This sort of sermonising did little to appease the disgruntled Midlanders—naturally. They are only human, after all.

Then came the really shattering discovery. To the effect that the very listeners Droitwich was supposed mostly to benefit were crying out at " night distortion."

In many parts of the West Country, particularly in West Devon and Cornwall, in North Wales, and the North-east of England, this night distortion was so bad that listeners gave up trying to hear the long-wave National programme. And they are still disgusted, these distant listeners.

What does it all mean ? Night distortion sounds a perfectly ghastly state of affairs. It is, indeed. The signal, without the slightest warning, becomes an utter mangle of meaningless sound, with or without severe fading.

It is no new thing, this night distortion. Daventry was prone to it at critical distances. I mention this only for the benefit of those who have never experienced the trouble. At 50 to 100 miles I doubt if any one has ever heard Daventry distort at night—or at any other time.

No, it is a function of wavelength and distance. On a 1,500-metre wavelength—the wavelength of Droitwich, that is—night distortion seems likely to happen between 150 and 250 miles radius.

Now, ever since the first cry from the heart was uttered about Droitwich's night distortion the B.B.C. has sought to allay fears by the use of the magic word " seasonal." They have tried to prove this night distortion is something that comes on each year, starting roughly when Summertime ends and going on for several weeks.

After that, the records of Daventry's behaviour show, complaints dwindle away, so that long before Christmas the technical correspondence department can breathe freely once again—because no one is writing in about night distortion.

With a certain amount of justification, these engineers have suggested that much the same seasonal effect was being observed by Droitwich. And, such is the sanguine nature of engineers, they indicated that there was nothing much to worry about—a few weeks and all would be well.

Those few weeks are passing into months. I am still receiving bitter complaints about Droitwich's night fading and distortion.

Perhaps even more worrying is the fact that these complaining listeners definitely assert that the trouble is very much more pronounced than they can ever remember with Daventry.

Quite sensibly it is being suggested that Droitwich, with its 150 kilowatts, is radiating such a powerful upward ray that when it comes down at the distant point, out of phase with the ground ray, there is a complete wipe-out. This state of affairs is compared with the Daventry transmissions, with a weaker upward ray and therefore less proneness to fade and distort.

So runs the lay contention of quite a body of listening opinion. I might here interpolate the not entirely irrelevant point that Daventry's ground ray was also weaker—and that therefore the relative effect of the downward ray presumably would be much the same.

We cannot be too sure, though, that Droitwich's aerial is, like Cæsar's wife, above suspicion. Perhaps this particular T-type aerial tends to send out a larger proportion of upward ray than Daventry's 500-ft. aerial did. I say perhaps because the only people who can possibly know these things are the research engineers. It is tricky work, this.

What we do all know is the effect at the critical distances—awful. Yet, in spite of a widespread knowledge of the Droitwich night distortion, the B.B.C. does not officially admit that the trouble is serious.

If I may say so, this sort of " poker-face " attitude does nothing but infuriate the poor victims, who, suffering from a ghastly signal, are not even given the benefit of an acknowledged martyrdom.

Bland assurances by B.B.C. officials that all is well on the Droitwich front are just part of a set policy *never to admit that the Corporation is wrong.*

As a rule all comments and criticisms are duly noted by the " brass-hats " at head office, who plan out suitable action accordingly. Inside the " Big House " they know perfectly well that they are not infallible. When something does go wrong chits and " memos for internal circulation only " fly about—gathering the momentum of illegible signatures.

So don't imagine that all this fuss and bother about Droitwich has fallen on deaf ears. Far from it. The ears of the B.B.C. are peculiarly sensitive to criticism. Only remember that those ears have been trained not to twitch in public.

And while ears burn behind the comfortable facade of the " Big House," things are moving in the engineering department. When the tumult and the shouting has died down they will be able to act—not before.

If they admitted right away that something was being done about Droitwich's distortion they would be committing the unforgivable sin of " pandering to the ignorant masses." So, like Brer Rabbit, they just lie low and say " nuffin'."

Meanwhile experiments with that Droitwich aerial are being mooted. So it has come back to the aerial, anyway. Of course, it is easy to be wise after the event. Really, though, would it not have been a good plan to have experimented with anti-fading aerials when Daventry was still going ? It might have saved the Corporation a lot of money.

I understand that a complete anti-fading aerial system for Droitwich would cost something in the neighbourhood of £30,000. If Droitwich continues to distort the B.B.C. may be forced into this expenditure—especially if they go forward with plans to scrap the medium-wave Nationals.

How the official mind works is admirably illustrated by the statement made to me that nothing will be done about anti-fading aerials yet, because such aerials might earn unjust credit owing to the possible waning of the seasonal effect.

In other words, the engineers still hope that the trouble will right itself. I think they are too sanguine. That 700-ft. Droitwich aerial is a deal too simple for the job, we shall probably find.

More About the New Detector

Last month NOEL BONAVIA-HUNT, M.A., explained a new method of diode detection which could be used in battery sets. Here he explains a modification for the A.C. set user and also gives suitable methods for incorporation in both A.C. and battery super-hets

A DISTORTIONLESS detector capable of receiving weak as well as strong signals was offered to readers last month, but the offer was made to battery users only. Not that all A.C. set users are debarred from making the necessary exception in their outfit in the shape of a 2-volt accumulator

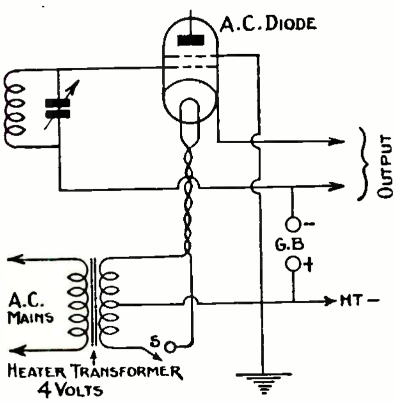


Fig. 1.—An A.C.-heated screen-grid valve used as a diode detector. Note the switch S

and a grid-bias battery; nor that D.C. mains sets need be so terribly proud of their supply that the suggestion of batteries as a separate source should evoke scathing criticism and instant rejection !

However, since there may exist a large number of quality enthusiasts who resolutely refuse to accept any sort of battery in their receivers—though I would gravely question the wisdom of such an uncompromising attitude if *quality* is the real objective —I am able to tell them that it is possible to work an A.C. or D.C. indirectly-heated valve in the special capacity described in my December article.

But it is *not* possible, so far as I am aware, to apply to such a valve a graduated heater control corresponding to the direct filament control advocated in connection with the 2-volt valve.

One obvious way of making this point clear is to ask any reader, who cares, to make the following experiment with an A.C.-heated valve, connected in circuit as shown in Fig. 1.

Try the effect of disconnecting the heater from the heater transformer by means of the switch S. The cathode will start cooling, and if the receiver happens to be tuned in to a moderately weak signal, this signal will come in at optimum strength at some point in the cooling process.

Then as the cathode grows still cooler the signal will be found to die away till all is silence. Switch on the heater again, and wait for the signal to reappear. It will come on with a fairly rapid crescendo, and then will fade as the cathode becomes too hot, either to disappear altogether or to settle down to a weak edition of its best self.

Now if only one could trap the cathode temperature at the desired point, all would be well ! But I do not know how it can be done.

The trouble is caused by the fact that the cathode is *indirectly* heated and therefore cannot be sufficiently controlled. We are consequently restricted to the use of our special diode for detecting the more powerful

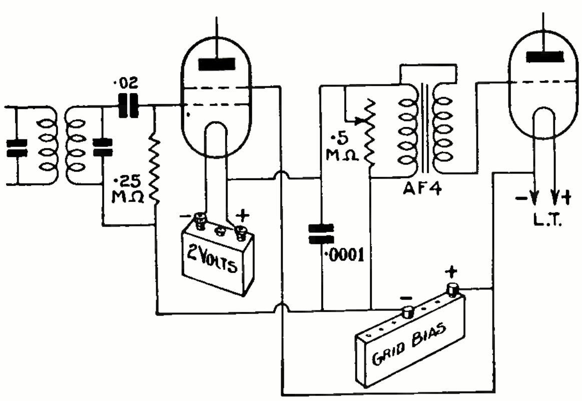


Fig. 3.—The complete circuit for adapting a battery super-het to use the author's novel method of diode detection in the second detector stage

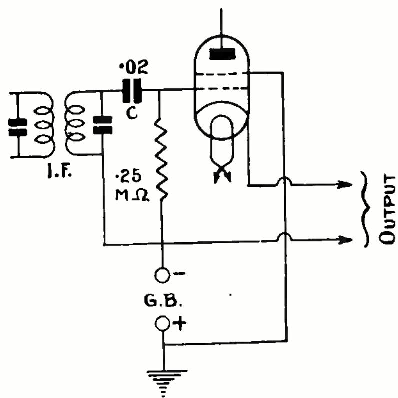


Fig. 2.—How to arrange the diode for an A.C. superhet. Note the blocking condenser and grid leak

signals such as those transmitted from our local B.B.C. stations or Droitwich, and possibly the big Continentals.

We cannot resort to the filament rheostat to coax in the weaker brethren, unless we scrap the A.C. valve in favour of the directly-heated battery valve, as recommended in my article of last month.

Superlative Quality

However, the A.C. valve of Fig. 1 gives superlative quality. Viewed simply and solely as a diode detector I do not know its equal, given adequate input voltage to its grid. And providing this input is not less than 1 volt we may safely entrust a signal to it.

The thrill of logging stations with the adjustable rheostat described last month will, I regret to say, be denied the experimenter, unless he consents to adopt the 2-volt valve. That is a matter for him to decide. I can merely lay before him the advantages of a less convenient method.

But it can be safely promised that my new diode, even in A.C. form, will handle the more important signals without distortion, and that a pre-detector volume control is not precluded. I may add that any type of screen-grid valve is admissible, whether the ordinary or the variable-mu.

Continued on page 548

The Radio Airway

A few years ago most people thought vaguely of the atmosphere as an ocean of air which extended upwards for eight or ten miles from the earth's surface, and above that they thought there was empty space. In this special article MORTON BARR presents the modern view, which accounts for atmospheric zones up to a distance of over 200 miles from the earth's surface. He also tells us how wireless waves have been used to explor this region.

THE energy radiated from a transmitting aerial may travel through space either as a ground wave or as a space wave. In the first case it follows the curved surface of the earth in much the same way as an alternating current

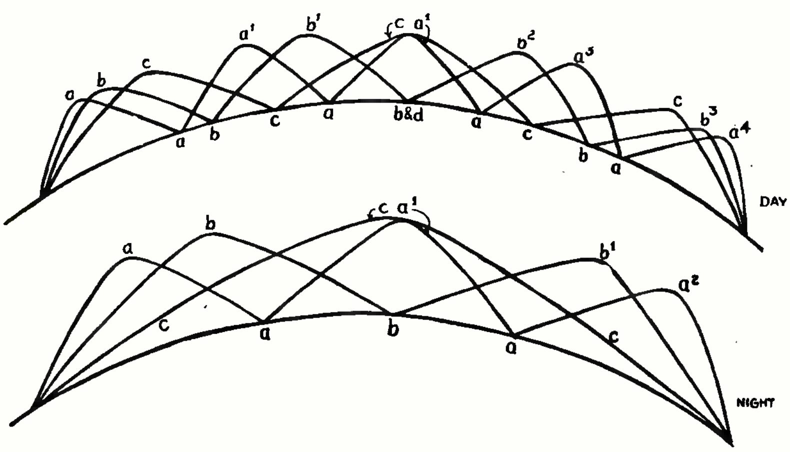


Fig. 1.—Two diagrams showing the "skip" distances of wireless waves, a, b, c. During daytime the average height of the reflecting layer is lower than at night and, therefore, the "skip" distances are shorter

follows the path of a conductor. In the second case the wave progresses in a series of skips between sky and earth.

Long waves are practically all earth-bound. In the beginning they travel for some distance with only one foot on the ground, stretching the other up until it reaches the nearest Heaviside layer. Then they straddle along in the shell-shaped area formed between the two conductors.

Short waves, on the other hand, definitely prefer to take what may be called the "airway." Those below the 100-metre mark, in particular, can only cover long distances by ricochetting between the first layer and earth, as shown in Fig. 1.

Waves of 10 metres or less plunge still deeper into the recesses of the atmosphere before they are reflected back to earth; in some cases they slip straight through into outer space.

This leads one to ask what lies above the ordinary "ceiling" of the atmosphere and how does it serve as a reflecting surface for wireless waves ?

In 1902 Professor Kennelly, of Harvard University, put forward the following explanation: "It is safe to infer," he said, "that at an elevation of some 50 miles or so the rarefaction of the atmosphere is at least some 76,000 times less than it is at sea level. We know from experiments that air at this pressure has a conductivity (to alternating currents) some twenty times greater than that of sea water. This being so, the curvature of the earth is no bar to the transmission of wireless waves since they are confined within a spherical shell formed between the conducting sea or ground and an upper conducting layer."

Professor Heaviside, writing about the same time in the "Encyclopaedia Britannica," came to practically the same conclusion. "We know," he said, "that sea water has quite enough conductivity to make it behave as a conductor for Hertzian waves, and the same is true, though to a less extent, of the solid ground. There may, in addition, be a similar conductive layer in the upper air and, if so, the waves will, so to speak, catch on to it."

Here is the first conception of what we now call the Heaviside, or more fairly, the Kennelly-Heaviside layer.

Effects of Ultra-violet Rays

A few years later Professor Eccles showed how the impact of ultra-violet rays from the sun affects the state of ionisation of the upper atmosphere, increasing it during the daylight hours and pushing the level of the ionization layer downwards towards a denser part of the atmosphere.

Under these conditions the space waves suffer heavy absorption and signal strength accordingly falls off. Once the sun has gone down, the layer shrinks back again into the more rarefied regions, higher up, and reception improves. The widening of the layer during the daylight hours is shown in Fig. 2.

Ether Waves

Ether waves will pass freely through any kind of matter so long as it is not a conductor of electricity. Any conductor will stops or break them up in much the same way as an opaque body stops the passage of a ray of light.

There are, of course, degrees of conductivity—just as there are of opaqueness. Sea water, for instance, is a very poor conductor as compared with any metal, but a 500-metre wave cannot penetrate the sea for for more than a few yards. For the same reason such waves cannot pass through the Heaviside layer in the atmosphere.

Waves less than 10 metres long seem, however, to possess greater penetrative powers, and so are able to pass clean through the Heaviside layer instead of being reflected back to earth. In this respect they may be compared to X-rays, which force

By MORTON BARR

their way through substances not transparent to ordinary light.

When waves strike against a conductor they induce currents in it which are re-radiated or reflected particularly if the conductor is tuned or can " swing " to the proper frequency.

In considering the action of the Heaviside layer, one must assume that it is ionised, and that the electrons have a long free path so that they can vibrate to the frequency of the incoming wave. The mean free path varies inversely with the atmospheric pressure, so that it may amount to hundreds—or even thousands—of metres at extreme heights. Once set into motion, each charged electron becomes, in effect, an electric current, swinging in tune with the wave and serving to re-radiate or reflect it back to earth.

200 Miles Up

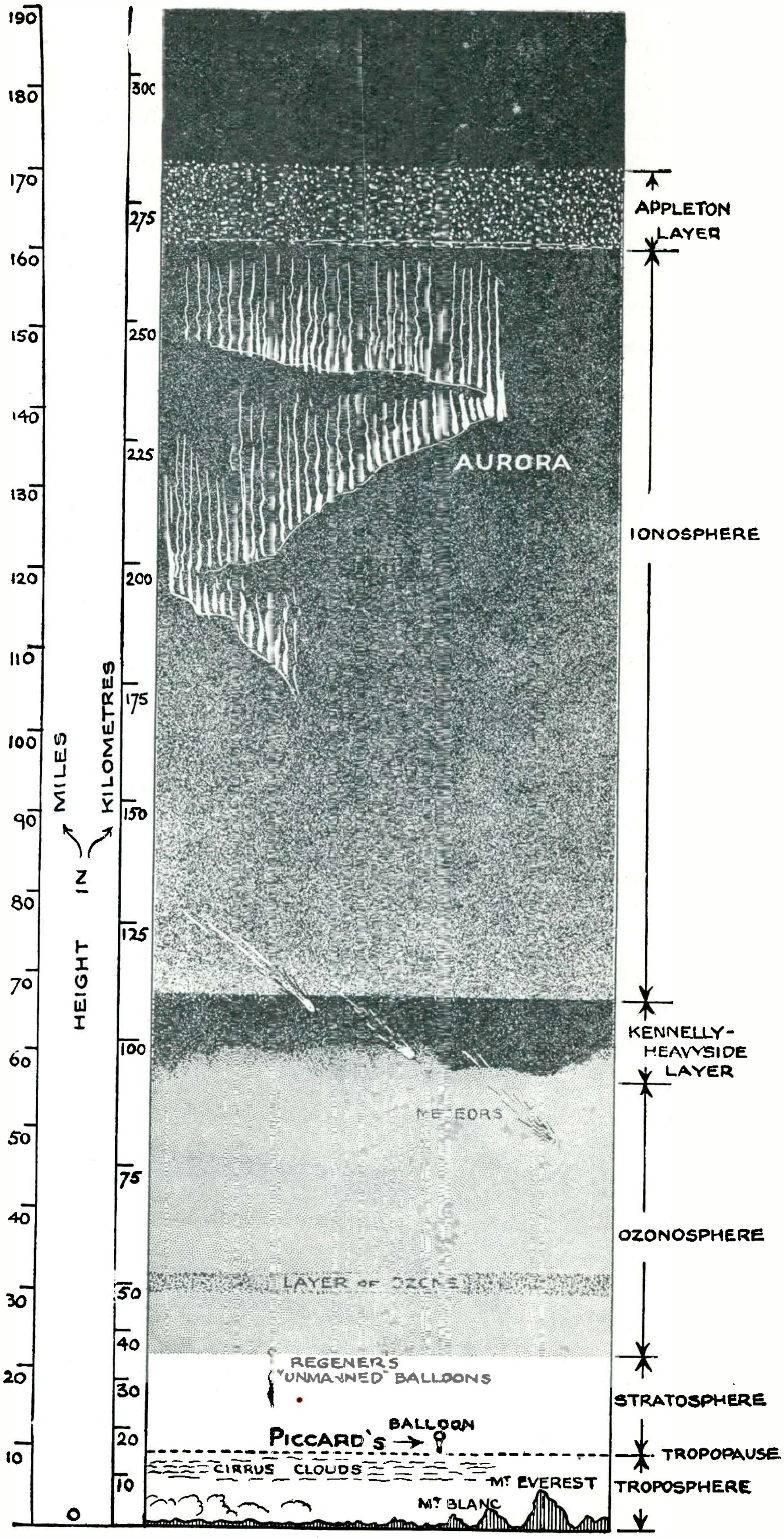
Not so very long ago one thought vaguely of the atmosphere as an ocean of air which extended upwards for eight or ten miles and then gradually petered out into empty space.

Nowadays we have a far clearer conception of the true state of affairs, and can give at least some account of high-up regions such as the Stratosphere, Ozonosphere and Ionosphere, which extend for a distance of roughly 200 miles above sea level.

Our knowledge is due, in large measure, to the pioneer work of radio engineers in exploring the path taken by short waves over long distances. The more we learn of conditions in the radio " airway," the better are we able to design Beam and other stations to give maximum efficiency.

Cosmic Rays

The mysterious cosmic rays have given a further stimulus to atmospheric exploration. The physicist wants to know where they come from, and how they are distributed through space, and he has pushed his inquiries



VERTICAL SECTION THROUGH THE RADIO AIRWAY

This drawing speaks for itself. The heights of the various zones are contrasted with that of Mount Everest, which appears as a mere speck at the bottom right-hand corner of the drawing.

far beyond what was once thought to be the uppermost limits of the atmosphere. Although the picture is still far from being complete, we are daily adding to the details, and in course of time shall know more about the upper ocean of air than we do of the lower depths of the sea.

"Sounding" the Sky

Professor Appleton, in particular, has devised an ingenious method of "sounding" the upper limits of the sky by shooting out pulses of short radio waves and catching the reflected echoes. By measuring the time taken for the echo to return he has located new layers—high above the original Kennelly-Heaviside layer—and has made records of their rise and fall.

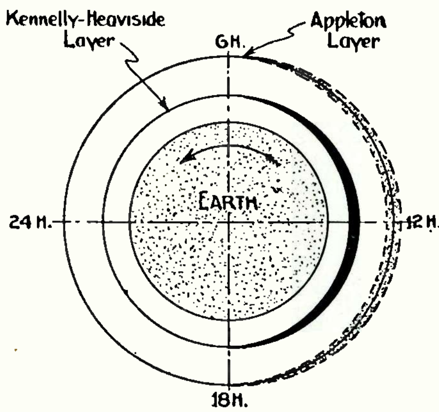


Fig. 2.—Showing how the ionised layers are spread by the action of the sunlight

By using short-wave pulses of varying frequency, and catching the echoes on a cathode-ray indicator, an accurate estimate can be made of the relative conductivity—or state of ionisation of the different layers. This, in turn, allows their probable composition to be determined.

More direct methods are, of course, available for the lower regions. The Stratosphere, for instance, has been penetrated by Piccard up to a height of nearly 12½ miles above sea-level, as well as by other passenger-carrying balloons.

Previous to that unmanned balloons fitted with self-recording instruments have been sent as high as 22 miles before they have burst and dropped their instruments to earth by parachutes.

Higher still lies the Ozonosphere, so called because of its rich content of free ozone. Here one method of exploration is that of audible sound ranging, in which the time taken by the reflected echo serves to measure the height of the denser layers of ozone. Other valuable information is given by the spectroscope and the polariscope.

The Ozonosphere extends from a height of roughly 22 miles up to the first Heaviside layer, which on an average lies twice as high. The ozone content of this region is largely concentrated in a layer which is situated about midway between its upper and lower limits.

The actual quantity is so small that if it were collected into a uniform layer at ordinary atmospheric pressure and temperature, it would be barely 3 millimetres thick. Yet it serves the useful purpose of screening-off the fiercer short-wave radiation from the sun, which if not so blanketed might possibly prove dangerous to human life.

Ozone is a gas which "dissociates"—or produces free ions and electrons—even in the dark, and this is consistent with the known fact that the Heaviside reflecting layer maintains its ionisation long after the sun has gone down.

The uppermost region, the Ionosphere, reaches a height of at least 275 kilometres (170 miles). It is composed chiefly of ionised oxygen and nitrogen, and is separated from outer space by a final ionised layer, which is now known by the name of its discoverer, Professor Appleton.

This is the highest point of the radio "airway," and serves to reflect all but the shortest wireless waves.

Temperature Variations

Some interesting variations in temperature take place from point to point through the various zones. Starting from sea level, the temperature falls, more or less uniformly, at an average rate of 6 degrees Centigrade per kilometre up to a height of 12 kilometres, where it registers about −55 degrees Centigrade. This is the upper limit of the so-called Troposphere, which includes the region of violent air movements and thunderstorms.

The Tropopause

Separating the Troposphere from the Stratosphere is a narrow belt called the Tropopause, where the temperature is constant, and remains so throughout practically the whole of the Stratosphere proper. Beyond that it gradually rises, owing to increased absorption of short-wave solar radiation, throughout the Ozonosphere, estimated to have an average temperature of 40 degrees Centigrade.

Professor Stormer puts the average temperature of the Ionosphere at 300 degrees Centigrade during the night time. During the day, when the sun is pouring in its radiated energy at full blast, it rises to the amazing figure of 1,000 degrees Centigrade. Beyond the Appleton layer is a region containing practically no gaseous matter, and here the temperature falls to "absolute zero.

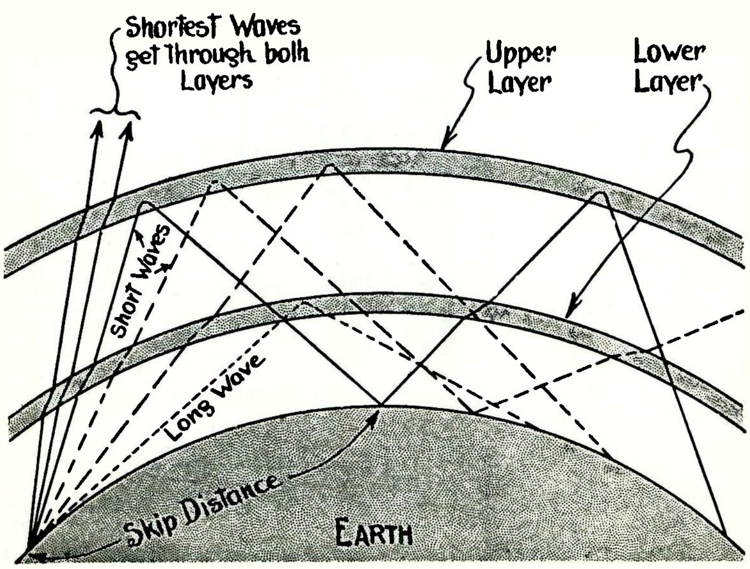


Fig. 3.—Showing how wireless waves are reflected back to earth by the two main layers. Long waves are reflected back by the first layer, medium waves go through the first and are reflected by the second, while the very short waves penetrate both layers

What Is This Quality?

There is quality in both senses of the word here. The fine-looking radio gramophone is one of the latest Marconiphone models with only the volume control on the front

A Simple Basic Analysis of Quality Reproduction—a Subject which is perhaps the most Controversial of all Aspects of Modern Radio Engineering

By PAUL D. TYERS

EVEN before the head telephone was relegated to the lumber room and was replaced by the horn loud-speaker with a thick steel diaphragm, one began to hear of special " quality circuits." As the loud-speaker developed and the technique of the microphone was improved so the number of " quality circuits " multiplied at an alarming rate. In fact, even at the time of writing they appear to be just as much alive.

What I mean by " quality circuit " is some special non-standard completely unorthodox arrangement. I am not going to suggest that all these special circuits are not capable of giving good quality, but it really does seem necessary to carry out a little dispassionate analysis and to see exactly what " inventors " are really doing.

Blissful Ignorance

Probably in nine cases out of ten these freak quality circuits are produced in blissful ignorance of the manner in which they really work. A number may be produced by a technical man who certainly should know all about them, but even then in many cases I wonder if these investigators have really thought about their problem basically.

First of all, it is absolutely essential to realise that the primary function of what we call a good quality wireless receiver is that of creating an illusion. We endeavour to make our loud-speaker give the impression that at one moment it is a person actually speaking in the room, and at the next a symphony orchestra playing to us in a concert hall.

The whole thing is just as much an aural illusion as a vanishing lady in a glass case on the music-hall stage is an optical illusion. It is just as well to get this fundamental thought well at the back of one's mind before laying down the law on the subject of quality reproduction.

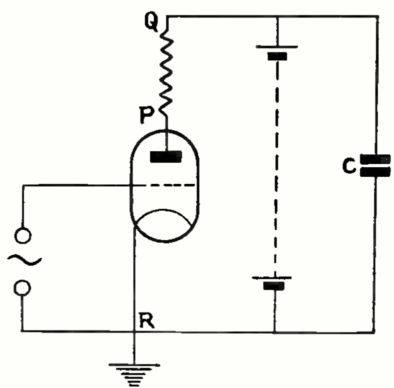


Fig. 1.—A simple form of resistance amplifier has a high impedance in the form of a resistance in the anode circuit

The more perfect our illusion the better shall we say is the reproduction.

Next let us think what happens when we listen to a sound, be it the voice of a man, the barking of a dog, or, in fact, anything we like to choose. In every case we appreciate the existence of this sound, which is a more or less complicated vibration in the air.

Appreciating Sound

We are conscious of this because the air vibration impinges on a certain part of the ear affecting certain sensory nerves, and it is because the nerves are affected in this way that we appreciate what we call a sound.

But nature has endowed us with a pair of ears, and we, therefore, appreciate all sounds by a process known as binaural hearing. It is quite possible that many readers are not aware of this fact.

The use of two ears helps us very definitely to locate a sound, and particularly those of higher frequency. This process is analogous with that of sight, by means of which we definitely position a point with the aid of two eyes.

This can be proved by shutting one eye for some time and rapidly

Ferranti photo
Jack Hylton, in the company of Eve Becke, makes his choice a Ferranti Arcadia Consolette receiver. And a good choice it is!

trying to touch a point with a finger.

Most normal people miss the point by a very considerable distance, simply because no bi-focal process is employed.

If one is possessed of a fine difference in mental appreciation it is exceptionally easy to determine the difference in any sound as heard by one ear instead of two.

First Departure

Our first departure from the orthodox in any sound reproducing system is immediately to use a single microphone and a single amplifying and reproducing system terminating in a loud-speaker. It is very reasonable, therefore, to suppose that immediately we must tend to introduce conditions which are definitely not representative of reality.

There are several other obvious shortcomings in our aural illusion or sound-reproducing system. A symphony orchestra occupies very considerable space and the sound which reaches us is distributed from various parts of a large area.

Slight Difference!

In our wireless set the sound generally emerges from a 7-in. hole. It is not surprising, then, that there is, at the best, a slight difference in the actual reproduction when compared with that of the original.

It is very interesting to note that human nature is so easily tricked and many people are so unaccustomed to clear reasoning that I have met literally scores of people who confidently believe that there is not the slightest difference between the real thing and the reproduction from their particular set.

This is probably helped by the fact that the ear and its associated complex nervous system is a most accommodating portion of our anatomy and we very quickly lose any appreciation of the shortcomings of our receivers partly, probably, because we know what the original should really sound like. To the world at large this is a most delightful gift of nature, but it is very trying for the research worker.

It is quite impossible to form any accurate ideas of reproduction unless one introduces considerable rest periods at frequent intervals during the observations and makes comparisons with the original.

Think of a holiday with a portable set.

After a few days one begins to imagine that the reproduction is really quite good, but it is only on returning to an ordinary mains receiver that the difference is immediately noticeable.

Perhaps the most striking experiment one can make is to listen to a gramophone record of an orchestra or an organ and immediately go to a concert or a church or cinema and listen to the real thing.

What I have just written should, I think, place readers on a fairly firm basis of what one is really considering when discussing quality of reproduction. We are, in short, employing an illusionary system, and in order to bring this to the greatest stage of perfection all one is really concerned with is a small number of fairly simple electrical, mechanical and acoustic problems.

Perhaps the most obvious of these is the frequency range. Everyone by now knows that sounds consist of nothing other than air vibrations at various frequencies. We call these audio frequencies because the ear can appreciate air vibrations between certain limits.

Normally we work somewhere between 30 or 50 cycles per second up to somewhere in the region of 5,000 or 6,000 cycles. So-called quality reproduction is frequently taken up to 8,000, 9,000 or even 10,000-cycles per second.

Limits of Hearing

Some people can hear very much higher notes than others, and in my own particular case my limit of hearing extends far beyond 10,000 cycles per second, which is not altogether an unmixed blessing. A high limit of audibility tends to make one more dissatisfied with loud-speaker reproduction, and it may even introduce considerable annoyances in life.

Deafening Note

An interesting example of this fact is that of a certain bunsen burner I had in my laboratory which at a certain gas pressure emitted what to me was a terrible deafening note. About half my assistants could hear it and the other half cold not. Peace was only restored by changing the burner.

Now it is very obvious that in any

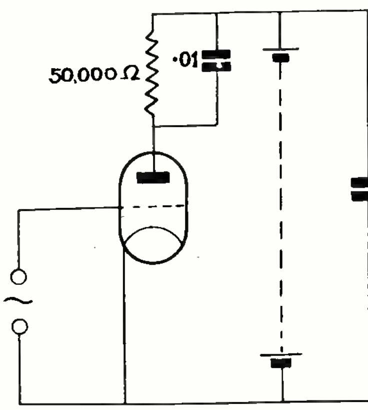


Fig. 2.—Similar to Fig. 1, except that there is a capacity shunted across the anode resistance

sound-reproducing system one must start with the microphone which either alone or with a correcting circuit will give an even response over the desired frequency range. If it does not do this, then the high, middle or low notes, as the case may be, will not be reproduced in their correct order.

It is best to assume, for the sake of argument, that the transmission side is beyond criticism, so that we need only confine our attention to problems as they affect the listener, that is in reception.

One aspect of frequency response over which most controversy seems to have raged is that of the type of response which we require for the so-called perfect reproduction. It is at this point, perhaps, that one really enters upon controversial ground.

Level or Tilted

One school of thought demands a level frequency response throughout the receiver. Another school states that as the efficiency of a loud-speaker tends to fall at both ends of the scale the amplifier should obviously be tilted at each end so

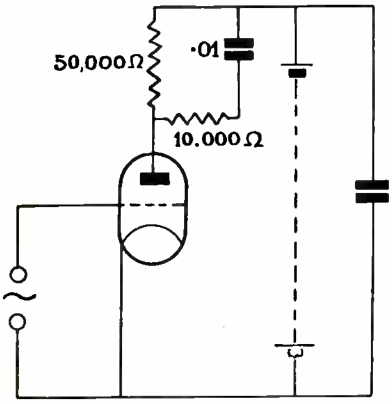


Fig. 3.—Similar to Fig. 2, but with a resistance in series with the condenser across the anode resistance

that the response at the beginning and end of the range is materially increased.

Finally, another school of thought, which embraces a large diversity of opinion, demands frequency characteristics of a totally uneven nature, accentuating some bands of frequencies and removing others.

Variety of Reasons

Adherents of this class, in order to justify their opinions, advance a variety of reasons why this should be so. For the most part, however, they all seem to think that our ears when listening to a loud-speaker require a totally different proportion amongst the frequencies from the combination which exists in the original.

If I were to consider all the different views and analyse them from A to Z it would take several complete issues of "Wireless Magazine" to carry through the analysis.

It is not my intention to enter this field of controversy. What I propose to do is merely to explain the absurd simplicity of frequency response in amplifiers or in networks in general.

If I succeed in doing this without introducing complicated theory or mathematics, even the most non-technical reader should be able to analyse various freak quality circuits, which one so often encounters, and see exactly how they work and exactly what they do.

In any amplifier or electrical network we are concerned with three quantities—resistance, inductance, and capacity. The behaviour of electrical currents and voltages with any combination of resistance, inductance and capacity is as well defined as any other so-called law of nature and is, in fact, more permanent than the laws of the Medes and Persians.

A resistance offers the same impedance to currents of any frequency, an inductance offers a greater impedance as the frequency rises, while a capacity offers a *lower* impedance as the frequency rises. These are three exceedingly simple notions and are the basis of everything appertaining to quality amplifiers.

In an elementary resistance amplifier we simply place a high impedance in the form of a pure ohmic resistance in the anode circuit of the valve. Voltages applied to the grid circuit are magnified by the valve and an amplified voltage is, therefore, obtained across the anode resistance PQ in Fig. 1. It is important to realise, however, that the point Q, from an A.C. point of view, is at the same potential as R, which is earth, because the high-tension supply and the shunt condenser C have a negligible impedance.

If voltages of equal magnitude and varying frequency are applied to the grid, the amplified voltage across P and R will be the same irrespective of frequency, for the simple reason that the resistance in the anode circuit offers exactly the same impedance at all frequencies.

It is for this reason a resistance amplifier is used for high-quality work where a wide frequency band has to be amplified.

The conditions in Fig. 2 are entirely different, because here the anode resistance is shown shunted by a capacity.

I have already pointed out that as the frequency rises so the impedance of the capacity falls. In other words, with increased frequency the anode resistance tends to become short-circuited.

Illuminating Figures

A few actual figures are most illuminating. Let us suppose the anode resistance has a value of 50,000 ohms, and suppose that the condenser has a capacity of .01 microfarad. At 50 cycles this condenser represents the very high impedance of 300,000 ohms.

Now, the amount of amplified voltage which appears at the anode is dependent upon the relative impedance of the valve and the value of the anode resistance. A 300,000-ohm resistance in shunt with a 50,000-ohm resistance obviously has practically no effect.

Little Magnified Voltage

When the frequency rises to 1,000 cycles the impedance of this condenser has dropped to the extraordinary low value of 15,000 ohms. When 5,000 cycles is reached the condenser is acting exactly like a very low resistance of 3,000 ohms, and accordingly there will be very

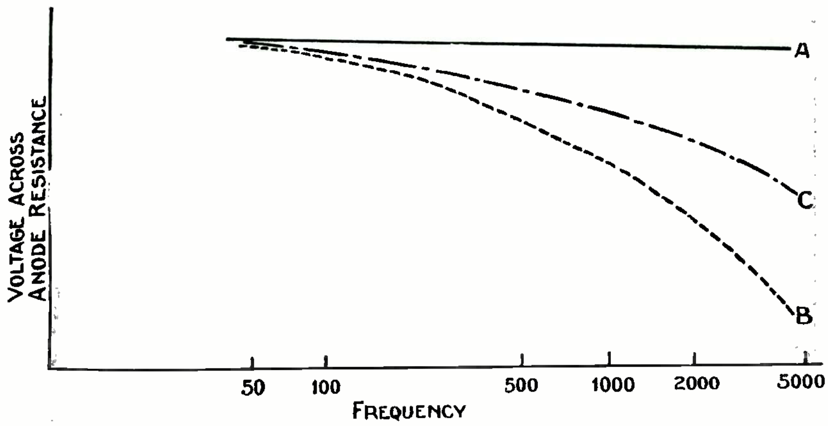


Fig. 4.—Showing the type of response curves one might obtain with the circuits shown in Figs. 1, 2, and 3. Curve A, voltage with pure anode resistance; curve B, with anode resistance shunted by a capacity; and C, with the anode resistance shunted by a capacity in series with a resistance

little magnified voltage appearing at the anode.

One very important point emerges from this consideration, and that is this. The effect of a capacity in shunt with an impedance is to cut down the effective voltage according to a simple law which increases with frequency.

Pentode Correction

The simplest practical application of this law is the use of correction circuits on pentode valves where a capacity is connected between the anode of the pentode and earth for the very purpose of minimising the top response.

Another important point can be understood by examining Fig. 3. Here we have a 50,000-ohm resistance shunted by a .01-microfarad condenser, which is in series with a fixed resistance of 10,000 ohms. We found that a .01-microfarad condenser at 50 cycles has an impedance of 300,000 ohms. This impedance is now in series with a fixed 10,000 ohms, and once again its presence across the anode resistance will make little difference.

Less Effect

As the frequency rises so will the impedance of the condenser fall, but its effect on the anode resistance will obviously now be less because of the fixed 10,000-ohm resistance.

It is possible by simple mathematics to work out what will be the effective impedance at various frequencies. In fact, any network, however complicated, can be worked out by what is known as vector analysis, which involves a little elementary mathematics, but the actual fact, however, in plain English is simply that when the impedance of the condenser becomes very low at a high frequency it obviously will not cut so much top if it happens to be connected in series with a fairly high resistance.

Fig. 4 shows the type of response one might obtain with circuits of the type shown in Figs. 1, 2, and 3. It is to be understood that these are not actual curves worked out with any particular value, but are merely representative.

Before dealing with the subject of inductances and combinations of inductances, capacities and resistances, there is one further point which I must mention without going into any detail as it borders on advanced theory.

No doubt many readers will have already guessed what this is. In addition to acting as an impedance a valve has quite appreciable capacities due to the geometric shape of the electrodes, and it is very obvious that all these capacities are actually in shunt with our coupling network.

There is a capacity between the anode and the cathode and this must, therefore, represent a shunt capacity on the output. It is for this reason that extremely high-fidelity amplification requiring an even response up to 10,000 cycles necessitates the use of a low-impedance valve or one of very low capacity.

If the impedance of the valve is very high, or the impedance of the anode load is very high, the impedance of the electrode capacity tends to become of the same order and may cause anything from 10 to 30 per cent. loss at high frequencies.

Similarly, of course, a high input capacity can act as an input load. Further, there is what is known as reflected capacity, but this is too complicated to discuss here and is really a matter which concerns designers.

Effect of Inductance

It should be realised that when we are dealing purely with combinations of resistance and capacity, the capacity can only have one effect, and this effect I have already explained in detail.

The case of an inductance, however, is quite different. It is different chiefly because an inductance, or rather an electric coil possessing the property of inductance, invariably possesses the property of resistance and distributed capacity. Further, the combination of a pure inductance and a capacity produces a totally different effect from those already discussed.

The simplest case of the combination of inductance and capacity is that of an ordinary tuned circuit which is used in a radio receiver. In fact, a set functions entirely by virtue of this property. The combination of an inductance and a capacity when connected in parallel produce what is known as a resonant circuit.

It follows, therefore, that any coil possessing inductance, whether it has an air core or an iron core, in conjunction with any capacity will always tend to form a resonant circuit. The frequency of this circuit may be beyond the audible range, but when it lies in the audible range then its effect in an amplifier will obviously be very marked.

THE "W.M." STENODES

Designed by Paul Tyers.

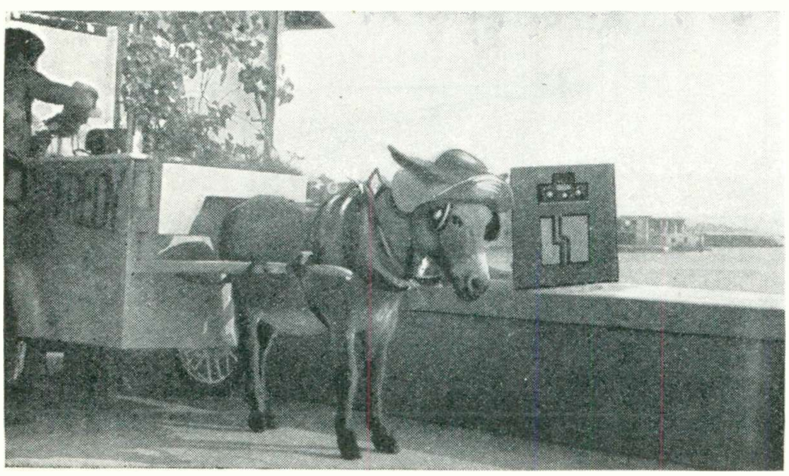
There are only a few copies left of recent issues of "W.M." containing articles describing the Stenode principles and sets incorporating this major feature. Readers wishing to obtain back copies are advised to make their applications early. The articles and sets are:—

September, 1934
The "W.M." A.C. Stenode.
Where the Stenode Scores (Part 1).

October, 1934
The "W.M." Battery Stenode.
More about the "W.M." A.C. Stenode.
Where the Stenode Scores (Part 2).

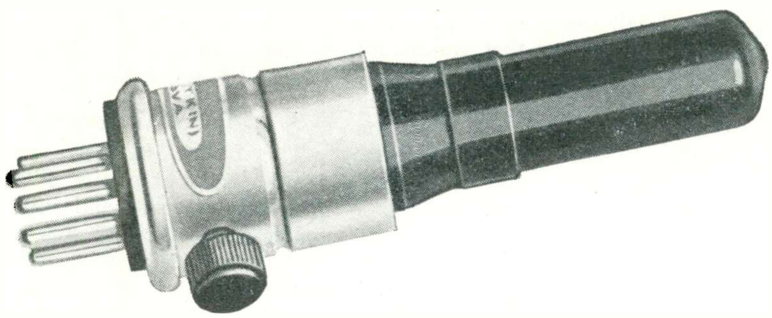
November, 1934
Getting the Best from the "W.M." Stenodes.

December, 1934
Is a Transportable Stenode Possible?



H.M.V. photo

So this is that thing called quality! The donkey—complete with sun hat—of an ice-cream vendor at Monte Carlo spends his spare moments listening to an up-to-date portable



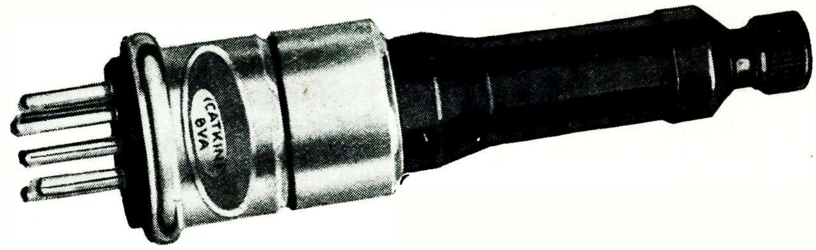
By J. H. REYNER,
B.Sc., A.M.I.E.E.

To-morrow's Valves

THERE was once a Set Manufacturer who said unto Himself, I do not like these High-efficiency Valves. Behold I will design Me a Set with Low-efficiency Toobs, which are more Reliable. And he went to the Valve Magicians and made his Request that they should supply him with less Pretentious Bottles.

But the Magicians said among themselves: "Lo, we cannot Do this Thing, for are Not our Thermionic Emitters made according to the Laws of the great God Beeveaye." And They told the Manufacturer to Depart and Raise his Head to a High Temperature.

But He Persisted and in Due Time did find a Magician to supply him with the Valves he Required, and behold his Sets were Successful for the Public did not Know the Difference, while the Manufacturer saved much Money.



THIS little fable has the merit of being true, and the manufacturer in question is one of our largest set-makers, yet so accustomed have we become to high slopes that the bare idea of being content with anything less seems retrograde in the extreme.

Most of the valves introduced within the past year or eighteen months have been characterised by a marked improvement in slope, so much so that we view a slope of the order of 8 or 9 with comparative equanimity, whereas only a few years ago a valve with a slope of 2 or 3 was something rather remarkable.

The manufacturer in question did have some difficulty in obtaining the necessary low-slope valves, and they are actually being specially made for him. Yet the results obtained with the set incorporating these "old-fashioned" valves are every bit as good as from comparable sets using high-slope types.

There is one country which has for many years maintained a policy of low slope and has refrained from utilising very high mutual conductances. "Such a pig-headed country can, of course, be dismissed from serious consideration as the sets which it manufactures will obviously be inferior to our own," says the high-slope fiend. The fact, however, is perhaps worth mentioning, for the country in question is the United States of America.

Not so long ago I was talking to an importer who brings over every year a number of sets from this "pig-headed and unprogressive" country.

Most of the sets travel the 3,000 or 4,000 miles and arrive at their destination in *working order* with the valves (which are shipped in their sockets and not separately packed) all intact and ready to perform. I wonder how many sets made in this country arrive at their destination in working order?

Lest any reader should think I am being captious, let me say that I have heard from three separate sources recently of complaints that no single set which has passed through their hands has been correct in every particular, and a great deal of the trouble is in the valves.

One is tempted, therefore, to wonder whether this progressiveness of ours—this constant seeking after more slope and higher efficiencies—is altogether as wise as we think it is.

Low-valve Complex

One of our difficulties, of course, is that we have the low-valve complex. We are quite satisfied with a set having three valves, and we think that one with four or five valves is rather good. If we find a set with six or eight valves we begin to mistrust it, shaking our heads about the possibilities of valve failure, and so on.

The irony of the situation is that we are quite right because with our present methods of production every one of the eight valves is liable to give trouble quite early in its life.

Early Licensing

This complex arose from the early days of radio when the licensing arrangements involved payment of 12s. 6d. a valveholder royalty. Consequently every effort was made to keep down the number of valves. This situation is not so acute today because the royalty is now calculated on stages and is in any case very much less than it was formerly, so that there is less force in the argument.

American technique, on the other hand, has developed on entirely different lines for there the manufacturer was not concerned with the number of stages so much as the ultimate performance of the set, bearing in mind, of course, the cost.

This has led to the development of valves having smaller mutual conductances which are cheaper and more robust.

Technical Aspect

Let us examine the technical aspect of the question. Consider a typical not-too-good circuit having a dynamic resistance of, say, 100,000 ohms. If the valve is a high-slope one, say $r = 300{,}000$ ohms, $g = 4$, and $m = 1{,}200$, the stage gain would be

$$\frac{100{,}000}{300{,}000 + 100{,}000} \times 1{,}200 = 300.$$

With a less efficient valve having a slope of, say, 2 we should keep $m = 1{,}200$ and allow r to increase to 600,000 ohms. (This assumption is quite fair for increased slope is usually applied to reduce r.) Then the gain would be

$$\frac{100{,}000}{600{,}000 + 100{,}000} \times 1{,}200 = 183,$$

which is appreciably more than half the former value.

Better Selectivity

Moreover, the selectivity will be better because the valve damping will be less (owing to the higher value of r), and for a true comparison we should tap the anode part way down the coil in the first case, which would reduce the gain to about 250.

Thus there is a drop of little more than 25 per cent in the gain and we could recover this quite easily by a small improvement in the tuning circuit, leaving us with the same gain and an improved selectivity (due to the better coil).

True, we could increase the coil efficiency with the high-slope valve, but a gain of 250 is about all we can stand in a factory-built set, so that we should be unable to make use of any more, and we have in fact to throw away amplification—for what? For the pleasure of using high-slope valves, which are hard to make, variable in production, and unreliable in use.

A low-slope valve is admittedly easier to make. The tolerances in manufacture are larger, and the valve can therefore be made more robust and more uniform. This latter point is probably one of the most important in the question.

If you went into a shop and asked for a pound of sugar and you were given a packet which when you got home was found to contain only 10 oz., you would be rather aggrieved If you went back to the shop and complained and the dealer said: "Oh, that is quite all right; that is the permissible tolerance of the Sugar Makers' Association," I tremble to think what would happen.

Yet this is what happens every day in the valve industry, and is apparently accepted.

B.V.A. Tolerance

The B.V.A. tolerance on mains valves is plus or minus 50 per cent on anode current, and minus 33.3 per cent on slope, so that you can have a valve rated to take 10 milliamperes and it may take either 5 or 15 and still be considered acceptable. You may order a valve with a nominal slope of 3 and the one you get may have an actual slope of 2.

I do not say that you have no redress. You have, because if you find that a valve is not reasonably in line with the figures quoted by the maker you are entitled to return it. And, to give the valve makers their due, they will always replace it, but the fact remains that most people are quite unaware of the enormous tolerances which exist.

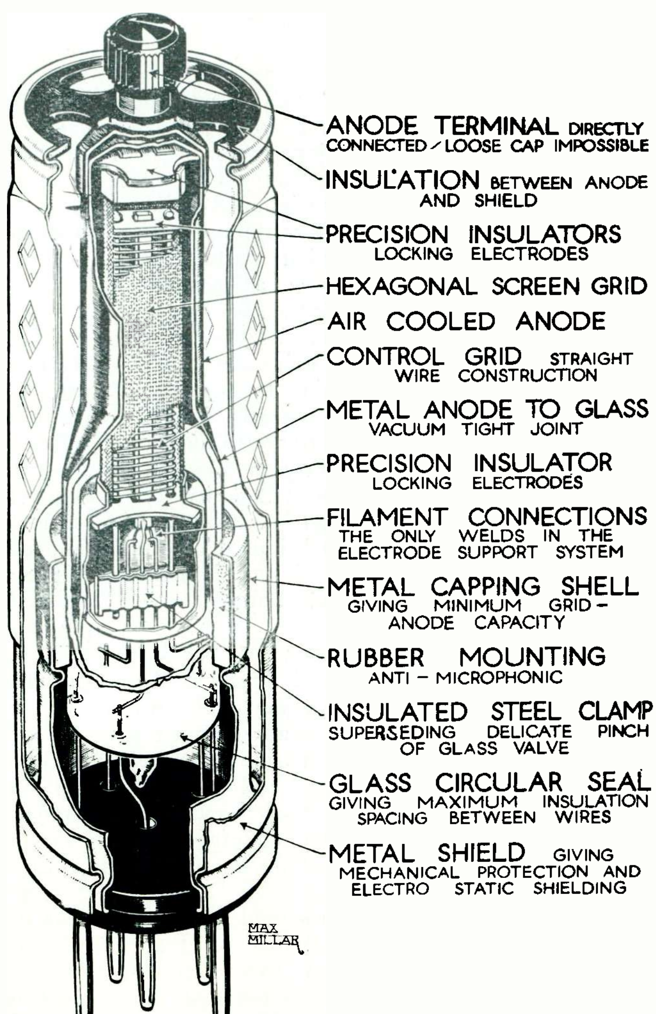
Battery valves are a little closer than this, the tolerances being plus or minus 33.3 per cent on anode current and minus 20 per cent on slope. Even these figures are quite bad enough.

Rejected Valves

The more discriminating set manufacturers draw up their own specifications for valves with much closer tolerances and often reject more than half the valves they receive from the makers. These rejected valves are passed on to other set makers until finally the valve maker is left with a selection of valves which do not suit any of the set manufacturers, *but are still within the B.V.A. limits.*

These are the valves handed on to the public.

I suggest that it is time the ordinary user took notice of these things. If you purchase your valves from a reputable dealer he will be able to check the characteristics for you at the time you make the purchase. If they are not within 10 per cent of the rated figures you



This sectional drawing of an Osram mains screen-grid valve shows very clearly the large amount of work involved in the construction. These Catkin valves are available for A.C. mains only have, to my mind, a justifiable complaint, irrespective of any arbitrary ruling which the manufacturers may make among themselves.

You will find that the less ambitious valves having lower slopes are always closer to their rated values than the fancy ones to which we have been treated within the last year or two.

There is a mistaken idea in this country that unless every manufacturer produces something different from everybody else there will be no chance of competition. What happens in practice is that a manufacturer is forced to build his set round a particular type of valve and then, when he gets into production, supplies are not forthcoming because the valve maker is " run off his feet."

Different Bases

Even with alternative makes of valve having similar characteristics we find to day that the bases are different. One manufacturer only supplies his valves in 5-pin bases and another only in 7-pin.

Still another manufacturer may decide to use an entirely different form of base, while in order to make things even more cheerful some valves are made with the grid at the top and others at the bottom.

This is called organisation.

Less highly organised countries standardise their connections and their bases so that a reasonable interchangeability is obtained. They also have characteristics which are reasonably close to their rated values and the valves made by different manufacturers are practically to the same specification.

" Clearly Unprogressive "

The result is that they know that there will be a demand for these general types of valve, and they are able to make during the slacker season and stock valves ready for the demand when it comes. This, however, is clearly unprogressive and cannot be tolerated.

Still another ingenious line of development is that of putting several valves inside one envelope and calling it a new type. Recently there was an agreement among the B.V.A. members that they would cease to do this, so that we may confidently expect to see next year several new types, released by each of the valve makers, incorporating further developments in this direction.

INSIDE A MODERN VALVE FACTORY
The making of a valve involves many delicate processes. These girls in the Mullard valve works are seen at the tricky job of welding anodes

In fact, one is beginning to wonder whether non-ring firms are going to prove the salvation of the industry in this country. The only trouble is that they, too, are aiming at high efficiencies and try to compete with the B.V.A. manufacturers, whereas they have a golden opportunity to turn out less ambitious valves of which the principal asset would be robustness and uniformity.

I see I have called this article " Tomorrow's Valves." Do you think, Mr. Editor, I could change the title ? Because, having thought about the subject for half an hour or so, I find I have very few clear ideas left. I wonder if anyone else has ?

Europe's Giant Tuning Fork

HOW often have you heard musicians tuning up before a concert ? These sounds are the first picked up when we switch over to a broadcasting station relaying some outside musical performance. If the studio has switched you over to a theatre you will be given the same sounds between the acts when an opera or musical comedy is in progress.

A violin usually tunes the A string to coincide with that of the piano; an orchestra in its turn usually takes an A supplied by the oboe or from the organ, if the latter is taking part. The normal A, a frequency of 435 cycles, was adopted in France in 1859 and I believe later in other countries.

Musicians have now been able to observe when listening to broadcasting stations that the official standard is not adopted in practice. As a rule musical instruments seem to be tuned to a note higher than the normal A and vary as much from it as a quarter tone, or 447 as against 435 cycles.

In order to carry out comparisons from time to time, an arrangement was made with the Prague station by which a standard A would be broadcast several times daily in the form of a tuning note preceding the time signal. This note is also heard through other Czech transmitters. So now Europe possesses a gigantic tuning fork to which musicians can tune their instruments.

An idea on these lines seems to have struck the Director of the Berlin broadcasting station. When the Berlin broadcast is taken by other German stations, in order to make it quite clear that the programme is supplied by the capital the letter B in Morse is transmitted at short intervals.

To make these signals of general use they are, as in the case of Prague, tuned to the musical note A.

—*J. Coote*

Electrolytic Condensers

By Philip R. Coursey, B.Sc.

BIG CAPACITIES IN SMALL CANS
Electrolytic condensers are well in evidence in many "Wireless Magazine" sets

OF the many condensers included in the make-up of a modern radio receiver, a broad separation into two groups may be made—first, into those which form part of a radio-frequency circuit or are carrying primarily a radio-frequency current, and, secondly, those which are not so employed.

Generally in the first category are included all the variable tuning condensers, reaction condensers, if any, and certain of the fixed capacity by-pass and coupling condensers; while the second embraces reservoir and smoothing condensers, audio-frequency coupling and decoupling condensers, and certain by-pass condensers.

Uses of Electrolytics

Electrolytic condensers have, as yet, little utility for any of the uses included in the first group; but can and do find much useful application in many, if not all, of the locations covered by the second.

At first sight it is perhaps not completely obvious why this should be so, but although the evolution of electrolytic condensers has removed their modern form very much from their earlier ancestry and is bringing them more to resemble their cousins of other types—for example, paper-dielectric condensers—yet there still remain sufficient distinctions and differing characteristics entirely to justify the above-mentioned selection.

As compared with other condensers containing the " more conventional " dielectrics, such as air, mica, paper, wax, etc., electrolytic condensers are to be distinguished largely by being less perfect, more removed from the " ideal "condenser having no leakage and no losses. Some few years ago it might well have been said that such a difference was fundamental, but as time goes on—and even more important, commercial uses expand and so encourage development—the gulf is

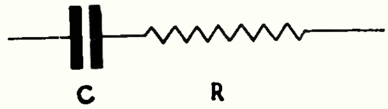


Fig. 1—Equivalent of an electrolytic condenser

lessening and, in fact, fast disappearing.

Leaving aside theoretical possibilities of other forms that could be employed, the electrolytic condenser as made today has a dielectric not of paper or of mica or of some similar thin sheet-like material, but of a film of aluminium oxide produced by electrochemical means actually on the surfaces of the aluminium sheets or foils forming the metallic electrodes of the condenser.

Basically such a layer is a porous one, being built up of very small particles or crystals packed together on the surface of the metal; and this porosity is undoubtedly the main cause of its differing electrical properties, since it is so much more pronounced and uniform than the more spasmodic porosity which occurs in; say, paper, or the occasional microscopic fault in a sheet of mica.

Main Uses

Accepting this difference, therefore, it becomes obvious that the main uses of electrolytic condensers should be in such places in the radio receiver circuit as they will be subjected to steady direct current or slowly pulsating voltages, or to low-frequency alternating voltages only. The merits of using electrolytic condensers in such places are several; the disadvantages few if proper care is taken in the design.

Why should electrolytic condensers be used at all? The answer is chiefly the dual one of smaller size and lower price. Smaller size is possible in these condensers only by sacrificing some of the factor of safety against overload that has been usual with other types of condensers, and is achieved by using in them thinner dielectric layers than are usefully or practically possible with other materials such as paper or mica.

Dielectric Strength

The dielectric strengths of these, various materials are not all identical but at least are somewhat similar so that the thinner dielectrics can naturally withstand less voltage.

For instance, a small mica condenser may have a dielectric thickness of 50u and a puncture voltage

of, say, 4,000 volts D.C.; a paper
$1u$ = 1 micron = 0.001 millimetre = $^{6}10-$ metre.
condenser with two thin wax-impregnated papers forming the dielectric may have a dielectric thickness of 18 to $20u$ and a puncture voltage of about 2,000 volts D.C.; an electrolytic condenser may have an effective dielectric film thickness of about $1u$ and a breakdown point of perhaps 200 volts D.C.

Too Difficult to Handle

Thinner dielectrics of the paper or mica type cannot be employed because in the first place they would be too difficult to handle or to prepare and, secondly, because they would generally be useless electrically on account of small natural thickness variations or other defects which would cause breakdown and short-circuit. With electrolytic condensers the insulating film is produced electrochemically on the aluminium plates, and is built up by the applied voltage only to the necessary thickness to withstand that voltage.

Fundamental Difference

Another fundamental difference separating electrolytic condensers from other types is the absence of direct contact between the active dielectric film and the metal electrodes on each side of it. On one side the contact is the closest possible—that is, to the aluminium foil on which the film is actually formed—but on the other a conducting electrolyte must be used to provide the contact between the outer surface of the oxide layer and the second metal electrode.

With wet or liquid electrolytic condensers the current path through this electrolyte is a comparatively long one, with the dry and semi-dry types it is comparatively short; but in either case it has a rather high resistance.

Electrically the condenser is equivalent to the circuit of Fig. 1 with a pure condenser C in series with the resistance R. The effective values of both R and C vary with the frequency, and R is numerically large as compared with other types of condensers. R is the equivalent series resistance of the condenser.

With a 500-volt dry electrolytic condenser it may, at a frequency of 50 cycles, have a value of about 100 ohms for a 1-microfarad condenser; a liquid type of condenser of the same capacity may have an equivalent resistance of 250 to 500 ohms; while a paper-dielectric condenser would only have 10 ohms at the same frequency, and mica a still smaller value. The power factor and losses of these condensers will therefore be in somewhat similar proportion.

Hence the need for limiting the alternating current that may with safety be passed through an electrolytic condenser—a limitation that does become of practical importance in using these condensers for smoothing the output of A.C. rectifiers, and sets an upper limit to the load that can usefully be dealt with by such a combination.

The D.C. leakage current through electrolytic condensers is much higher than even the lowest grade of paper-dielectric condensers or, expressed in other words, its insulation resistance is lower.

A good dry electrolytic condenser may have an insulation of, say, 50 megohm-microfarads; a wax-impregnated paper dielectric condenser one of, say, 2,000 megohm-microfarads, and a mica condenser one of 5,000 or more—these figures being good commercial values rather than maximum possible ones. In most applications, however, the leakage is by no means important.

Simple Receiver Circuit

In Fig. 2 is sketched a simple receiver diagram, which while not a complete one, yet contains the main elements to which it is desired here to refer. It shows three operating valves, V_1, V_2, V_3, and a double-wave rectifier V_0, the first valve being a variable-mu screen-grid valve, the second a screen-grid detector,

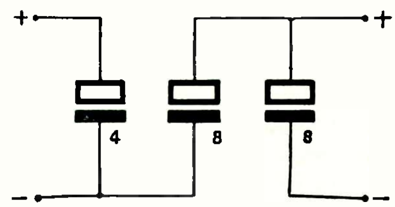


Fig. 3—Several condensers can be made up into one unit

and the third a power-pentode output valve.

The two chief uses of electrolytic condensers in such a circuit are for the reservoir condenser C_1 and main smoothing condenser C_2, with the loud-speaker field winding between them to act as a smoothing choke and being placed in the negative lead of the high-tension circuit, to provide simultaneously a grid-biasing voltage for the output valve V_3.

Both these positions are suitable ones for electrolytic condensers, since they both automatically have the necessary D.C. polarising voltage

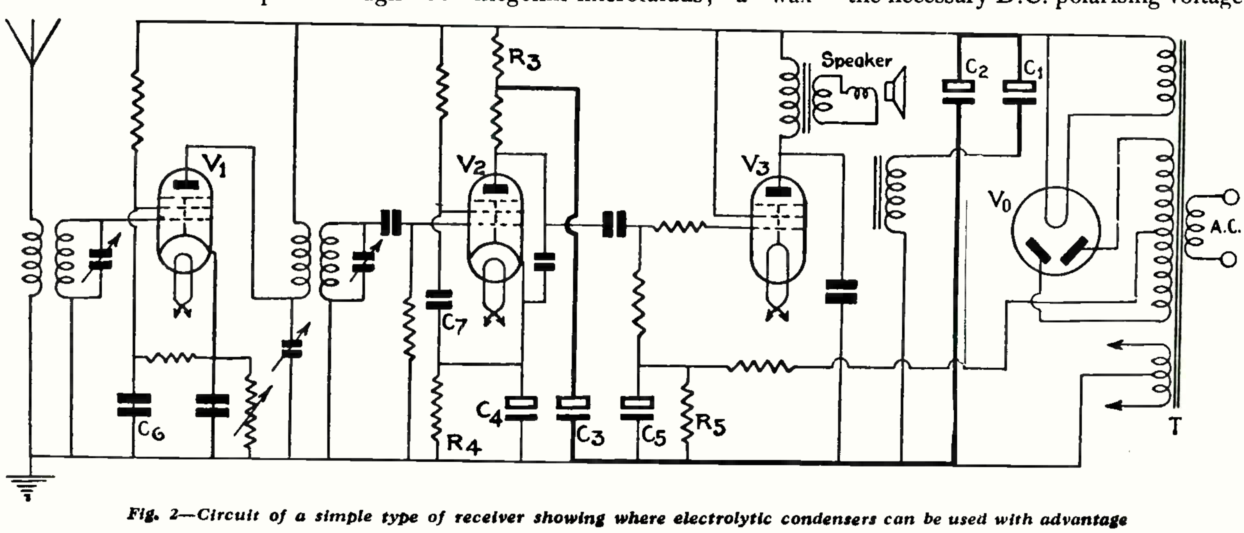


Fig. 2—Circuit of a simple type of receiver showing where electrolytic condensers can be used with advantage

for the condensers—namely, the full high-tension voltage output of the rectifier valve.

In the case of the first condenser c_1, there is superimposed upon this a ripple voltage, which may have an amplitude of 20 volts or more, resulting from the double half-wave pulses from the rectifier. This ripple is therefore fundamentally of 100-cycle frequency with the normal 50-cycle supply to the receiver. The second condenser c_2 has only a very small or negligible ripple voltage in addition to the D.C. polarising voltage, so that in this position the use of an electrolytic condenser is quite straightforward.

Condenser Power Factor

Owing to the ripple voltage applied to the reservoir condenser c_1, however, it is necessary to bear in mind the condenser power factor, since this definitely imposes a limiting load which must not be exceeded if the condenser is to give reliable service. As an example, if there is 30 volts ripple applied to an 8-microfarad condenser, the 100-cycle ripple current through it will be $8 \times 0.628 \times 30 = 150$ milliamperes and if the power factor of the condenser is 5 per cent, there will be $0.05 \times 0.1 \times 30 = 0.225$ watt dissipated in it.

This is quite a small amount and would cause no harm, but is nevertheless quite appreciable, and rapidly becomes larger as the ripple current is increased. The heating resulting from these energy losses in the condenser does provide a limit beyond which it is not economically practicable to use electrolytic condensers, so that paper condensers need to be employed for the larger rectifiers.

In the use of electrolytic condensers in both these positions, c_1 and c_2, there is a further design limitation which needs careful consideration, namely, the peak voltage which the condenser will receive, made up of the steady D.C. voltage plus the peak of the ripple voltage. This total must be less than the rated peak voltage of the electrolytic condenser chosen for the work if safe operation is to be secured.

Further, in this connection it must not be overlooked that the cathodes of the valves in the receiver take an appreciable time to heat up to full working temperature, and that during this period the rectifier (which usually heats up much earlier when, as is often the case, it is of the directly-heated type) is delivering its voltage under practically no-load conditions.

The two condensers c_1 and c_2 will during this period each charge up very nearly to the peak of the alternating voltage derived from the supply transformer T. Thus if each half of the secondary winding of this transformer delivers 350 volts R.M.S., both the condensers will during this heating-up period get close on 500 volts applied to them—and this even although when the set is working normally and the valves taking their load they may only get about 320 volts D.C. Condensers rated for the full 500 volts peak must therefore be used.

The third condenser c_3 in the diagram is a decoupling condenser for the detector valve v_2, and this again can be an electrolytic condenser, but even although it normally operates at a still lower voltage than the other two, owing to the potential drop in the resistance R_3, it must still have the same peak voltage rating of 500 volts to take care of the switching-on period.

This is a point only too often overlooked when electrolytic condensers are first used in radio receivers in place of paper condensers, since they have not the overload capacity of these latter and can therefore withstand less abuse.

These three condensers c_1, c_2 and c_3 can be entirely separate condenser units or can be arranged in a common box and connected together as sketched in Fig. 3.

Note must be taken of the polarity of the condensers when they are connected together to ensure that they can be correctly joined on to the receiver. This is indicated in Fig. 3 both by the + and — signs shown, and also by the use there as well as in Fig. 2 of the special symbol for the polarised electrolytic condensers—the outlined electrode being the positive one, on which the dielectric film has been formed in the condenser. Quite usually the third condenser is made of smaller capacity than the other two.

Typical Values

Typical values for this group of three condensers c_1, c_2 and c_3 are 8, 8 and 4 microfarads respectively.

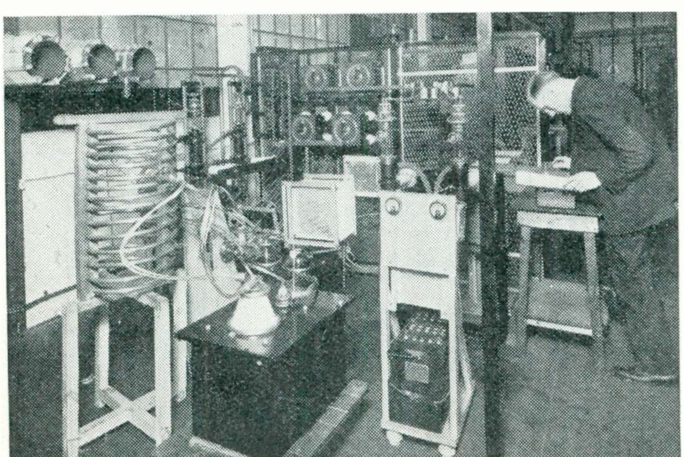
Two further condensers marked c_4 and c_5 in Fig. 2 can be of the electrolytic type. These condensers are used to by-pass the grid-biasing resistances R_4 and R_5 respectively. Condensers of the low-voltage type rated at 12 to 50 volts depending upon the actual bias value, are suitable, and capacities of between 10 and 40 microfarads are usual.

Two Other Positions

There are two other by-pass positions in the receiver diagram Fig. 2 which can be considered. These are the screen-grid by-passes c_6 and c_7. While electrolytic condensers are sometimes used for such locations, they show little if any advantage over paper-dielectric condensers of much smaller capacity values.

This is because of the fact that in these positions they need to by-pass some radio-frequency currents, and the equivalent series resistance of the electrolyte in these condensers maintains a minimum high-frequency impedance usually approaching an ohm even with fairly large capacity values.

The utility of the large capacity is thus lost, and a non-inductive paper-dielectric condenser of very much smaller capacity usually offers a substantially lower high-frequency by-pass impedance.



HIGH-VOLTAGE CONDENSER TESTS

Testing transmitting condensers under actual working conditions. Note the large inductance on the left

Rectifiers and Linearity

By Captain H. J. Round
M.I.E.E.

IN a radio receiver the rectifier performs a very vital function. In the old days of spark telegraphy such things as linearity of response were not even thought of; we did not even call them rectifiers—just detectors—and we did not worry very much how they worked, sensitivity being the only consideration.

However, the case is very different nowadays. Sensitivity, while of some importance because of the question of economical construction, is only second to linearity.

Craze for Drawing

We first began to think of detectors as rectifiers when Fleming introduced the valve, and what is more, drew its characteristics. Those very early characteristics were most interesting and it started the craze for drawing the characteristics of anything that received signals—electrolytic detectors, carborundum, perikon and galena—all got graphed, and later on the more complex tri-ordinate graphs of the amplifying valve threw new light on its action.

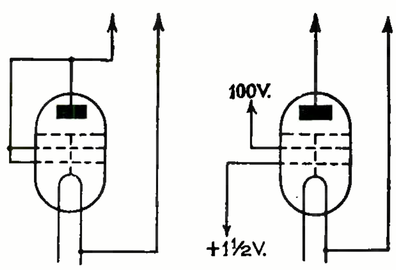


Fig. 3.—By strapping together the three grids and the anode of a pentode, one obtains a highly efficient diode, which will give almost distortionless detection. A variation on this is to apply a small quantitive potential to the control grid and a high positive potential to the screening grid

Three-dimensional space is far too primitive to graph out some of the modern octodes and their like.

The first thing these graphs showed was that we had a type of conductor which would have upset Ohm very much. Electricity would have been much more troublesome if conductors had all behaved like carborundum or a valve. In fact, I do not quite know what sort of a mentality we should have developed in the long run.

The essential point about a detector is that it should have a variable resistance—variable with the voltage given to it—so that when alternating-current voltage is applied the current flowing in one direction is greater than current in the other.

An ideal detector does not conduct at all in one direction but conducts well in the other, thus giving amongst other effects a direct-current component. This is one particular property in the detector which we require.

Unfortunately, no detector has the property of giving a direct current proportional to the input voltage applied; they all fail when the voltage gets below a certain strength to give any rectification at all, and even when rectification is being given, doubling the voltage applied usually results in more than double the alternating current.

Some performances of these rectifiers can be estimated from their direct-current characteristics. Langmuir indicated that a diode characteristic was approximately represented by the equation $i = KV^{\frac{3}{2}}$ if there were no limitation to the supply of electrons, and this is about the only rectifier which is amenable to calculation at all.

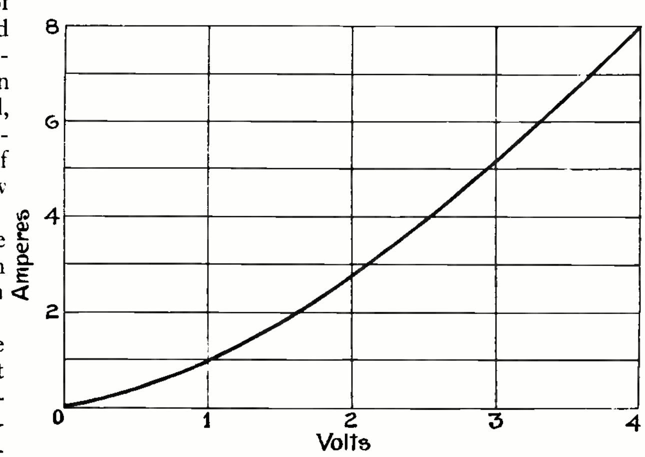


Fig. 1.—It can be seen from this curve that the output is not likely to be proportional to the input. Unfortunately few diodes behave according to theory

Near to the Law

Very few diodes behave exactly according to this law—independently heated valves coming the nearest to it.

Such a characteristic is shown in Fig. 1, and it can easily be seen that output is not likely to be proportional to input with such a circuit arrangement.

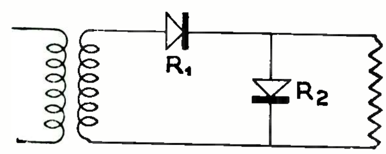


Fig. 2.—By using two diodes, the second being shunted with a resistance, almost straight-line detection is obtained. Cold detectors can be used in a similar manner

A good many years ago I was faced with the problem of obtaining a much straighter valve characteristic, the straightness was not wanted for plain rectification, but the object was similar.

Resulting Characteristic

I inserted in series with the valve a resistance of a value several times that of the valve. This resulted in a straighter but higher resistance characteristic. To get back to the same low resistance, I paralleled a number of these arrangements. This solution of a straight characteristic has the disadvantage of increasing the capacities sometimes beyond what we can stand.

This scheme of swamping the curvature of a rectifier with resistance is very useful in one particular case.

Volume meters and alternating current meters generally require to be fairly proportional in their readings, and power input is not of much importance so that the addition of series resistance is a possibility.

Thus a Westector biased to 1 volt and swamped by 5,000 ohms makes an excellent volume-meter rectifier with practically a straight-line response.

Jumping for a moment to triodes, an interesting case of improvement of characteristic due to this principle is to insert into a modern valve a series plate resistance until the mutual conductance (measured over the valve plus resistance) is down to that of the old type R valve. A characteristic will be obtained which is very much straighter than that of the R type of valve.

Lack of Economy

But, of course, in normal receivers the lack of economy in this scheme prevents it being done to any extent, and capacity effects of the valve may preclude us using such a scheme except for low frequencies. Incidentally, I hope nobody will pick me up about the contradiction in the words linear and rectification, for, of course, a rectifier should show infinite curvature at one point. What I mean by linearity is output proportional to input.

There is another way to get more linear rectifiers. This is to use some method of balancing a curvature which is in the opposite direction to the normal one of the rectifier. There are two known ways of doing this. One is to use the " saturation " effects in valves, and the other is to use the series-shunt arrangement of rectifiers.

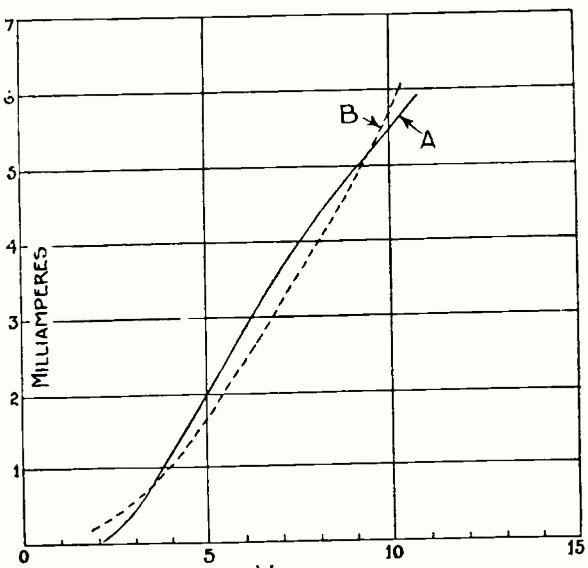


Fig. 4.—Curve A shows a pentode when used as a diode—almost a straight-line curve. Note curve from B how the efficiency drops off when the valve is strapped as in Fig. 3

Thus an arrangement such as Fig. 2 can be set up in which the tendency to bend upwards of the rectifier R^1 is restrained by the shunting influence of R_2. This shunting arrangement is being used for instrument purposes not only to give linear response but to give such effects as logarithmic response. Volume meters can be made to give a decibel scale.

Saturation effects are only given by valves, and the simplest saturation effect is that of the diode with the dulled filament. Up to a certain place in the curve greater straightness can be obtained by dulling the filament.

Some years ago I obtained a very straight diode characteristic by using a high-voltage filament (24 volts) dulled down to the right point. Due to the voltage drop along the filament in connection with saturation at all points, a very much straighter characteristic could be obtained.

G. M. Wright, in 1917, first noted the saturation curve obtained by fixing the voltage of the grid in a triode (with fine-mesh grid) and treating the plate and grid plus filament as a diode. The characteristics were not only sharper bending, but gave very clearly marked saturation effects, thus tending to balance the abnormal rise of the unsaturated valve.

H. L. Kirke and others have used this scheme for linear rectification for a long time. A modern form of this diode curve is given by a pentode. Thus I have drawn in Fig. 4 a PT2 pentode first as a pure diode between grids and plate strapped and filament, and then between plate and screen grid with 100 volts on the screen grid and about $+1\frac{1}{2}$ on the inner grid; a higher voltage on the grids giving a still higher saturation point.

Extraordinary Curve

The curve is really extraordinary and I think could be made of considerable use in quality sets. Possibly it has been so used.

The trouble with a diode is that one always wants to stick it in the circuit in such a way that the low-tension battery is in the air, and, of course, for set running that is practically impossible and the various types of parallel circuits are not by any means so easy to think about. The heater cathode helps one in the design of circuits providing the insulation between cathode and heater can be maintained. One interesting well-known detector—the power-grid type, which, of course, is more sensitive than either of the diodes—depends upon the curvature of the grid circuit and the curvature of the plate circuit balancing one another, thus getting an approximation to a straight line.

I always found, however, that one had very little licence in the strength one could apply to this detector, and a volume control after it was necessary for best working.

What " W.M." Offers

Again we present our readers with a fine and varied issue. " Wireless Magazine " prides itself on the fact that it gives readers authoritative articles on every subject of radio interest.

" W.M." has first call on the best radio technicians. A glance through this issue will show the high standard of our technical articles.

This fine standard will be maintained and, of course, improved upon as the months go by. We have many new ideas in constructor's sets and they will create a wide interest when they are published in the near future.

A feature of " W.M." service is that of supplying full-size blueprints, which can be used as templates, for half price. You will find full details on the last page of this issue.

Make certain of ordering your February " W.M." well in advance: there is bound to be a brisk demand.

Not Serious

If broadcasting stations only modulated to, say, 30 per cent, then distortion in the rectifier would not be serious, but high modulation, particularly such as that given by some Continental stations, requires a very straight rectifier working over a very wide range. Such a rectifier as the pentode diode should be very good for this purpose.

Again, for the very highest quality it is in my opinion necessary to maintain the rectifier always working between limited amplitudes and some element of volume control after the rectifier is necessary.

British Lion photo

YOU WILL SOON BE ABLE TO SEE THEM FOR YOURSELF!
Dave Apollon and His Band will be featured in the British Lion radio musical comedy, "In Town Tonight," now being made by Herbert Smith at Beaconsfield

Radio Medley

A Radio Fan's Causerie : : Conducted by BM/PRESS

Visual Tuning

RATHER to my surprise, I find that one's appreciation of visual tuning indicators grows with use. At first I was not too keen about them from my own point of view, although I realised their value to ham-handed operators. The experience of the past three months, during which I have used for periods of several weeks sets provided with this latest aid to tuning, seems to show that there is a lot to be said for them.

Of course, my reason for liking these tuning "meters" is a technical one; they really are meters, although they are not calibrated, and they are a very useful guide to the relative strengths of stations.

All these tuning indicators are arranged in the anode circuit of a valve and are operated in exactly the same way as a milliammeter would be. The band of light (or shadow) they produce is as much a guide to signal strength as the needle movement of a more orthodox meter.

This means that you can easily tell when a station is of such strength that it will give you good reliable entertainment for as long as you want—and usually without fading, for most sets provided with tuning indicators also have self-adjusting volume control.

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The Best Type?

There are three types of tuning indicator now in general use—two of them are provided with metal "armatures" which either open and allow more light through or else close to produce a shadow band that increases in width as the strength of the signal increases.

The third type is a small neon tube, in which the line of pink glow extends in length in proportion to the signal strength.

Having tried all three for a reasonable time for ordinary listening purposes, I still prefer the shadow-band method, because this gives you two points to watch, and it is therefore easier to tune in accurately to the point of maximum strength—or in other words, to the peak of the resonance curve.

The "fluid" light methods have the disadvantage that there is only one point—the tip of the beam—to watch when you are tuning. Still, this is a small matter compared with the advantage of having some form of tuning meter.

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Separate Loud-speakers

I have mentioned before in these notes the fact that many readers who consult the "Wireless Magazine" Set Selection Bureau ask for sets without a built-in loud-speaker so that they can use their own pet model separately. At the present moment there is no commercial set on the market (that I know of, at any rate) that can be bought without a loud-speaker. This is all wrong and something ought to be done about it.

I have just had a very good illustration of the merits of a separate loud-speaker. I have for a week or so been using a set that is made by a firm that also makes loud-speakers. The set is of the ordinary table type.

Two days ago I got hold of a spare model of the particular loud-speaker that is used in the set and had it fitted in a separate box baffle, one of those stuffed with slag wool, you know. As the set is provided with a

Cossor photo

HARD AT WORK TO GIVE YOU BETTER RADIO

A busy scene in the winding shop of one of the biggest radio factories in the country. The operators seen in the foreground are actually wiring up receivers

switch to cut out the internal loud-speaker when an external reproducer is being used I have been able to make interesting comparative tests.

Note that *both* loud-speakers are the same and they are being worked from the same set; the only difference is in the cabinets. Well, the result is what you would suppose it to be—reproduction from the loud-speaker in the box baffle is much better than that obtained from the loud-speaker mounted in the set.

To my mind this is an important step in the direction of better quality. Plenty of people would be prepared to buy a really good loud-speaker—in the £5 to £10 class, I mean—if they were assured that they could, every three years or so, buy a new set with which they could use it. As it is, nobody wants to buy a set with a built-in loud-speaker and then pull the latter out and throw it away.

There is no doubt that it would be worth while in many cases to remove the loud-speaker from the set and fix it up in a better type of cabinet—from the baffle and absorption point of view. And, quite apart from quality, the separate loud-speaker means that you can move it about and get it in the very best position for whatever room in which you happen to be listening.

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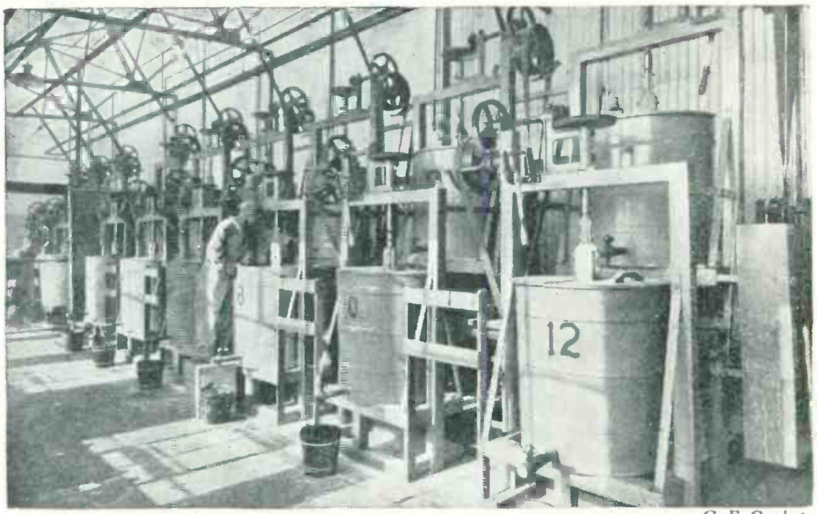
Cutting Out Whistles

I am surprised that more constructors do not fit variable tone controls to their sets. Not so much because in practice one really needs to control tone, but because these devices do very often enable you to cut out annoying heterodyne whistles. Many set manufacturers have realised this advantage, which is a very real one.

Whilst typing these notes, for instance, I am listening to a commercial set which is not provided with a tone control. As it is Sunday I have tuned in Radio Luxembourg—and there is a nasty high-pitched whistle on it; with a tone control I know I could cut it out, for I am able to do so with sets so provided.

In a home-built super-het it is, of course, possible to use a whistle filter after the second detector, but there are advantages in having a variable control. It is just as well to have all the top notes one can when it does not mean bringing in interfering whistles at the same time; and with a variable control you can adjust matters to suit any particular circumstances.



G. E. C. photo

MIXING THE POWDER THAT GIVES YOU HIGH TENSION

This is a battery of machines used to mix the electrolyte for high-tension batteries. Much depends on the proper mixing of the ingredients when it comes to getting a long life

Ekco photo

MODERN SET FOR MODERN HOMES

This attractive set, while being very modern in conception, is in keeping with most schemes of present-day decoration ideas

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When Valves Differ

A friend of mine has been playing about with a power amplifier that has an output valve costing £8—an expensive hobby if anything should go wrong!

What interests me about the thing is that he had tried two output valves with the same "paper" characteristics. He was greatly mystified to find that one gave very poor quality compared with the other, although they were both supposed to be identical in every way.

He checked them up and

found that one was much better than its rated characteristics, although it gave much poorer quality in practice. He put things right in the end by altering the matching arrangements.

When they were tackled on the subject the valve makers said that they were very sorry but such variations were unavoidable with valves of that type. A lot of consolation to the experimenter, wasn't it?

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If I Were a Set Maker

From time to time I pass uncomplimentary remarks about the policy adopted by most set manufacturers. (I have already referred to the case for separate loudspeakers.) Sometimes I am challenged to show what could be altered—the challenger hoping, no doubt, that I shall be caught out without a reasonable answer. This is what I should do if I were a set manufacturer:

Starting with the assumption that most people prefer to have a complete radio gramophone if they can get one at the right price, I should make a standard radio-gramophone cabinet; then I should have alternative radio chassis, power amplifiers, and loudspeakers.

The "radio" chassis would contain the tuning system and, in the case of a super-het, everything up to the second-detector stage. The separate power amplifier units would combine all the mains gear. With a selection of radio chassis and a number of power units to give different outputs it would be possible to make up almost any sort of set the buyer could desire.

But, further than this, I should try to design the radio chassis from year to year so that they would be interchangeable with the old models. In that way my customers would not have to buy a complete new set, but they could change over from, say, a straight two high-frequency set to a super-het with the minimum of trouble.

I know that a great snag would be the positions of the controls, and it might be necessary to go back to the type of cabinet where the front is cut right away and the control knobs mounted on a sub-panel. But that would not be a great disadvantage when all the advantages of the system are taken into consideration.

Anyway, I hereby present the scheme to set makers for what it is worth!

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High-Tension Batteries

There seems to be a war in the high-tension battery field—and battery users will get the benefit. Prices are now lower than most of us ever thought they could be, and there is no doubt that at the same time we are getting more efficient batteries.

There are still some comparatively expensive batteries about, but they give very good service. One 120-volt type I have just seen, made by a very reputable firm, is guaranteed for 144,000 milliwatt hours. It is true that the price of this particular battery is 12s. 6d., but there seems to be no question that it is good value for money.

Haven't you noticed that people seldom complain nowadays that their batteries keep on running down?

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Buying New Sets

It has struck me more than once that it is not an easy matter to sell a new set to a man who is satisfied with his present receiver, no matter how out-of-date it may actually be. I know of a case where a family bought a set four years ago; it still has its original valves although it is in constant use every evening—and it still gives the same rather poor quality from its moving-iron loudspeaker.

I have pointed out that a new set would sound very much better, but the people concerned will have none of it. They are quite satisfied with what they have. BM/PRESS, *London, W.C.1.*

Pye photo

FOR MODERN OR PERIOD SURROUNDINGS

A striking picture which shows how well the modern radio set becomes part of its setting. Radio deserves more prominence than it gets in most homes

H.M.V. photo

NEARLY READY TO GO OUT INTO THE WORLD!

Here you see a batch of receivers which have received their final work's test and are all ready to be housed in their cabinets

WHAT YOU SHOULD KNOW ABOUT SHORT-WAVE DESIGN

No. 2

Short-wave enthusiasts in London and the home counties will have heard this well-known amateur on the air. He is Mr. H. D. Price—G6HP of Sydenham

How to Get Smooth Reaction

This is the second of a new series of helpful articles by KENNETH JOWERS discussing the points that really matter in the design of short-wave sets. This month he tackles the problem of getting smooth reaction and his advice will be of the greatest value to all short-wave enthusiasts

REACTION, feedback, or regeneration—call it what you will—is the only single feature in a receiver than can entirely ruin results. Generally, poor design, incorrect component values and other faults of a similar nature will tend to reduce the efficiency, but they will not cause the receiver to be discarded as useless.

Very often I have seen a perfectly good set put on one side because the tuning varied in sympathy with the reaction: this is commonly called chasing. Reaction which causes a decrease in volume or is ploppy is often another reason for the discarding of a short-wave set.

Most Difficult Trouble to Overcome

Of all the common complaints that go hand in hand with short waves, I do feel that reaction troubles are the most prevalent and difficult to overcome if you do not know how. In the circumstances it will surely be in order if I devote an entire article to this one topic.

Since the early days, oscillating circuits have undergone many changes, slight ones admittedly, but changes which have overcome most of the little irritating defects only noticed after the receiver has been in use.

How many readers remember the times when, with a single valver and a two-coil unit, one endeavoured to bring in KDKA on 66 metres. This wavelength was, by the way, considered short in those days. To refresh your memory take a look at Fig. 1. By using a geared coil holder with a slow-motion drive, this method of reaction, simply variable coupling between two coils, did work well if the gearing was sufficiently smooth.

Actually the only unsatisfactory point about it was the trouble one had to take in getting a sufficiently fine enough adjustment to bring up the weak stations to reasonable strength for listening purposes.

To overcome this an arrangement was devised which was very popular for many years. In fact, today many amateurs still argue that throttle control is the best. In Fig. 2 you will see how this throttle business works. The grid coil is fixed, while the reaction coil can either be adjustable, or the coupling between it and the grid

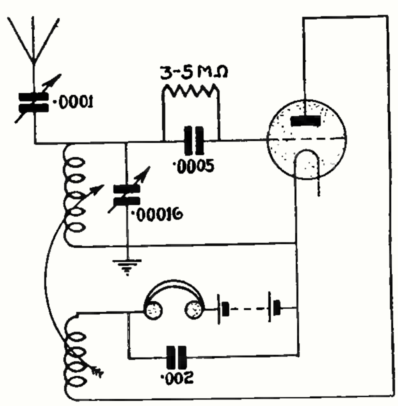


Fig. 1.—The simplest form of oscillating circuit. Reaction is obtained by varying the coupling between two coils

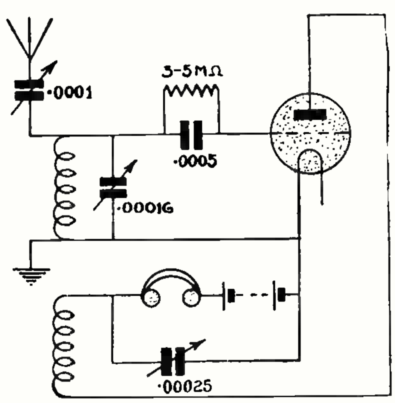


Fig. 2.—A simple variation of Fig. 1. Instead of variable coils, the circuit uses a variable condenser

coil varied until the best position is found and then permanently fixed. The throttle condenser then comes into action.

This condenser has a capacity of about .00025-microfarad, and should be fitted with some sort of slow-motion drive arrangement. By adjusting the capacity of the condenser, the detector circuit will very gently slide in and out of oscillation without causing any chasing, provided the coupling between the grid and reaction coils is correct.

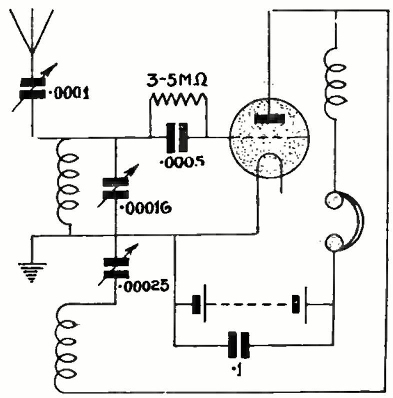


Fig. 3.—The conventional Reinartz reaction circuit—still one of the most popular among amateurs

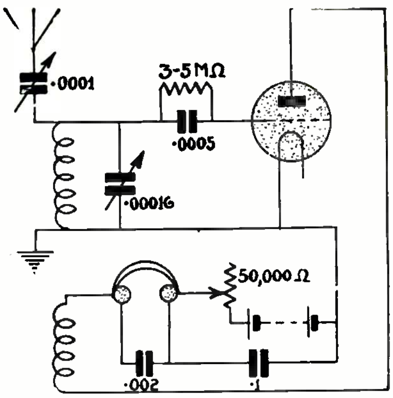


Fig. 4.—In this circuit oscillation is controlled by varying the anode current of the detector valve

Correct Combination

It is essential that the grid condenser and leak be the correct combination and that the detector valve has a low impedance. A condenser having a capacity of .0005-microfarad with a grid leak of between 3 and 5 megohms will not be far wrong.

For the detector valve, one of the low-frequency type seems to give the best all-round results. A valve having an impedance of between 10,000 and 15,000 ohms will be found most suitable. Before we leave throttle reaction do not forget to try connecting one end of the grid leak to low-tension positive instead of across the condenser, for with some valves this will increase efficiency.

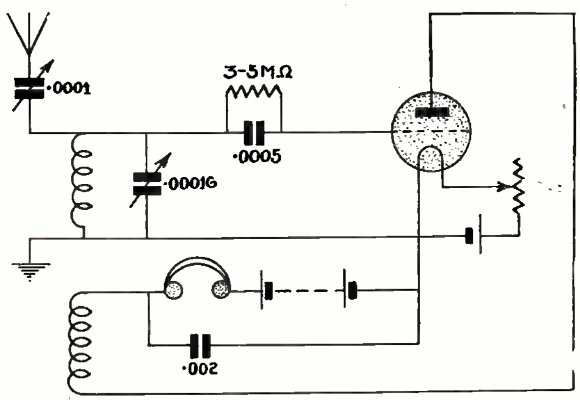


Fig. 5.—This is a simple variation of Fig. 4. The anode current is controlled by the adjustment of the filament voltage

In Fig. 3 you will see a variation of the accepted throttle circuit, generally called Reinartz after its inventor. Personally, I do not advise the use of this arrangement, for it has been my experience that too much depends on the high-frequency choke.

Oscillating With a Nasty Plop

If this resonates or has any dead spots, the receiver will go in or out of oscillation and, furthermore, it usually oscillates with a nasty plop. So unless you are sure about the efficiency of the high-frequency choke, leave this arrangement alone. I know that this is one of the most popular circuits, but it is mainly because it enables you to obtain reaction more easily on wavelengths below 20 metres.

Sometimes with a really obstinate set it seems almost impossible to get the reaction control smooth so that it slides in with just a rustle. Of course, if you have plenty of components on hand, this sort of trouble should not crop up. But how many of us have all the components we want!

Often readers and friends have called on me to see what could be done about putting their receivers in order. Some of them have been built very nicely with good components and occasionally to my own design but, try what they will, when the reaction condenser is advanced beyond a certain capacity an animal-like grunt preceded the reaction plop.

This trouble can be caused by the high-frequency choke being of poor design or construction, or to trouble on the rectifying side of the detector valve. By that I mean grid-leak connection or the values of the grid leak and condenser. That the entire low-frequency side may be unstable is not unlikely; perhaps the transformer has a low primary inductance. This is very usual.

Sorting Out Ifs and Buts

To sort out all these ifs and buts would take far too long, particularly if I had to get in touch with the reader by means of a letter. Also it is not very likely that the average amateur would be able to get to the real bottom of the trouble without a certain amount of help.

In such circumstances I have shown the circuit Fig. 4. An infallible remedy! It has the advantage that, whatever else is wrong with the circuit, within reason, with this and a little luck the receiver will oscillate freely without plops and grunts. Another point which makes it reliable is that it only requires one small extra component—a variable resistance.

About the Foolproof Circuit

Even though it is so foolproof, don't be hasty and jump to the conclusion that it is so straightforward.

First of all, the grid and reaction coils must be wound on one former, so the distance between them can be kept constant once the best coupling has been discovered. All you have to do is this. Take, for example, a 20-metre coil. On the average you will want a grid coil of about three turns on a 2-in. former when tuned with a .00016-microfarad fixed condenser. The reaction winding should consist of about four turns, the first turn starting about ½ in. from the negative end of the grid coil.

Leave out the variable resistance in the anode circuit of the detector valve and apply 60 or 90 volts direct to the anode through the usual impedance, such as a choke or pair of headphones.

Decrease the gap between the two coils until the receiver is just in continual oscillation over the entire waveband. Don't go to less than a ¼-in. gap or try to increase the number of turns, for this will cause complications.

Adding a Small Pre-set Condenser

If the circuit refuses to oscillate over the whole tuning scale, connect a small pre-set condenser in parallel with the oscillator winding. By increasing the capacity of this condenser you will be able to obtain the same effect as decreasing the coupling.

With that done satisfactorily, connect the variable resistance in the anode circuit of the valve; a variation

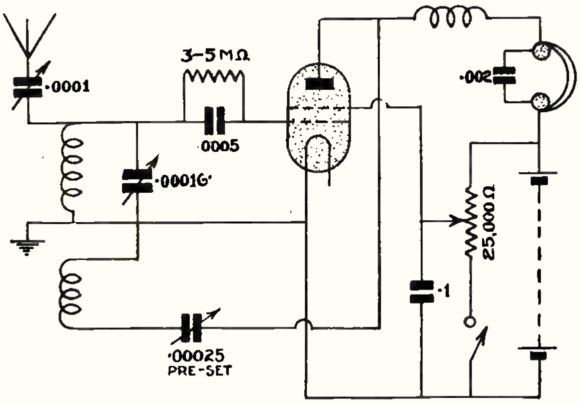


Fig. 6.—This is the most satisfactory circuit for obtaining reaction on the short waves that has yet been devised. Reaction is always very smooth

of this will cause an increase or decrease in anode voltage, and the valve will go in or out of oscillation as required.

The .1-microfarad fixed condenser across the resistance is very important, for without it the control is likely to be noisy in operation. What actually happens is that by decreasing the anode voltage on the valve, the milliamperage drops so that the valve refuses to oscillate. All you have to do is to find the zero position where the valve goes in and out of oscillation and the rest is quite simple.

Little Loss in Volume

You may find that as you decrease the voltage on the valve, the volume goes down as well. This decrease should not be noticeable. If it decreases a lot, adjust the coil coupling until the receiver is barely oscillating at the bottom end of the tuning scale. By the bottom end I mean the position where the condenser vanes are all out of mesh.

Then instead of decreasing the voltage on the valve, increase it, so that the milliamperage goes up as well. In this way the valve will start to oscillate and the entire detector circuit will be much more sensitive. That is just what is wanted.

Again, this arrangement has one defect. You will have more trouble adjusting the coils and resistance than with the previous method, but if you think the extra gain obtained is worth the trouble, then that is all there is about it.

If you have an old filament resistance handy, try the arrangement as in Fig. 5. You will again have to adjust the coils so that the circuit is in continual oscillation, but this time the amount of feedback is controlled by altering the filament potential. To do this a 30-ohm variable resistance is suitable, but make sure that it is smooth in operation.

Correct Values or a Time Lag

You will have to take care to get the correct values for the grid-leak and condenser circuit, otherwise you may get a time lag. This circuit is ideal if you want to use up an old valve: one that takes a fair amount of filament current. It will be very stable in operation and easy to control.

Any enthusiastic amateur will revel in the final circuit. It is a little more expensive, but if you incorporate it in your receiver you will notice an exceptional improvement in the results. Let us analyse the circuit, Fig. 6, and see why this arrangement is so much better than any of the others.

The first glance shows that it does not seem very much different, but notice that a screen-grid valve is used. As you probably know, this four-electrode type of valve is capable of giving enormous stage gain, and as the inter-electrode capacity is low the minimum wavelength will be lower with a decrease in losses.

The grid circuit is conventional with the reaction coil coupled to the anode through a small fixed condenser. You can, if you wish, substitute a small pre-set for this in case of coil variation.

If you look into the arrangement again you will see the whole detector circuit with the exception of the tuning condenser is fixed. To obtain our feedback variation, the screen-grid voltage is adjusted by means of a high resistance across the high-tension battery. As I have already told you, a screen-grid valve is capable of giving a high degree of amplification, providing the screen voltage is correct. You can see to that by means of the resistance across the battery.

Oscillation Without Plops and Howls

As you vary this voltage, you increase or decrease the working impedance of the valve. In this way the circuit is brought into a state of oscillation without any trace of threshold howl or plop. In fact, chasing or any variation of the grid tuning is almost impossible. Not counting the increase in stage gain, either of these points are of sufficient importance to warrant you trying out this circuit.

Make sure that you use a low-impedance screen-grid valve of the PM12A type. A high-frequency pentode will be satisfactory, but the screening voltage is rather too critical and unless you have a really good potentiometer stick to the screen-grid valve.

By the way, when you try some of these circuits remember to use as few reaction turns as you can, and if the reaction is still ploppy experiment with the values of the grid leak and condenser. A good high-frequency choke is essential.

Some of the so-called all-wave affairs are inclined to tail off round about 30 metres, so if you get a sudden dip with the receiver oscillating above and below a certain band, do not bother to increase the capacity of your reaction condenser or the number of turns on your coil, but change the high-frequency choke. A *good* high-frequency choke is essential for short-wave receivers.

The "cable" system of wiring, by which all the wires for a chassis are assembled on a jig, bound together and are then in position for soldering to the various components, is used in all H.M.V. sets

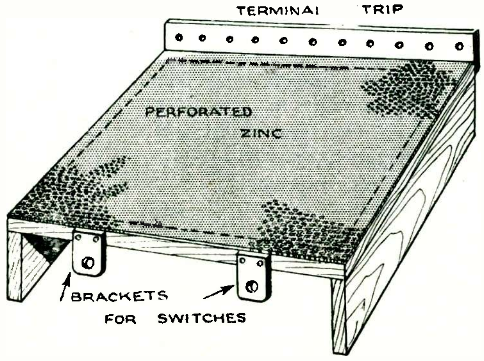
By R. W. HALLOWS M.A.

Wireless Jobs Made Easy for Mr. Everyman

OFTEN, I expect, you have longed to have some means of putting together quickly in hook-up form some of the interesting circuits that have appeared from time to time in "Wireless Magazine" and *Amateur Wireless*. Well, here's an idea that you may find useful, for it enables all kinds of experimental jobs to be done in double-quick time.

Fig. 1 shows what I call my experimenter's chassis. It is the kind of thing you can knock together in an hour or so, and once you have made it you'll go on blessing it. The actual base consists of a sheet of stout perforated zinc fixed to a rectangular wooden frame made of battens about 1 in. in width and ¾ in. thick. About 18 in. by 10 in. is a useful size, for this gives plenty of space and you don't want your style to be cramped when you are making experimental hook-ups.

The frame carrying the base is mounted upon a couple of upright battens about 3 in. high. At the back there is an ebonite strip carrying anything up to a dozen terminals, and at the front there are small metal brackets (details in a moment) which are just the things you want for mounting-volume control potentiometers, switches, and so on.



PERFORATED ZINC CHASSIS
Fig. 1.—A handy experimental chassis can be made out of perforated zinc with a terminal strip at the back, and brackets on the front for switches

Brackets

These brackets are not intended to stay permanently in one position. The beauty of them is that you can shift them in the proverbial two ticks to any part of the front of your base by merely removing and replacing a couple of wood-screws. You can cut them from any piece of stoutish sheet metal such as copper, brass, or aluminium.

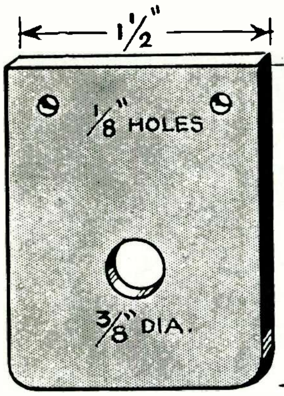
The details are shown in Fig. 2, and when you have inspected that drawing you will agree that they don't take long to make. The two ⅛-in. holes are for the screws which fix them to the frame; the big hole is for bush components to be mounted.

Perforated Base

And what's the point of the perforated zinc base? Just this. You earth it, of course, and since it is metal you can make earth connections to it. And you haven't a single hole to drill when mounting components or in passing leads through from the upper side to the under side. All that you want are there already. You can buy perforated zinc at almost any ironmonger's, and it's very useful stuff.

Terminal Panel

The terminal strip at the back of the baseboard consists of a



MAKING THE SWITCH BRACKET
Fig. 2.—Giving suitable dimensions for making the switch bracket for the zinc chassis

length of ebonite sheet about 2 in. wide. You can buy ready-made strips 12 in. long or you can very easily drill one to suit your own requirements. Don't stint the number of terminals: it is better to have three too many than one too few.

I find it very convenient to have all my terminals of the double-headed variety illustrated in Fig. 3. You cannot buy them ready made, but you can very easily improvise them. Purchase 4BA terminals of the long-shanked variety and at the same time lay in a supply of both round and milled-headed nuts of the same size.

If your wireless shop doesn't stock round- and milled-headed nuts you can purchase them from most big tool shops. The double-headed terminal then just constructs itself as shown in Fig. 4.

Myself, I prefer the butterfly nut illustrated in Fig. 5, for both "heads" of the terminals on the terminal strip. The great advantage of the butterfly nut is that you don't require pliers to tighten it down or to loosen it.

You can make a good firm connection with your fingers, and a nut has got to be jolly tight to call for the pliers to loosen it.

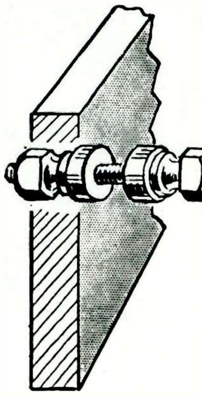
4BA butterfly nuts are again available from big toolshops.

Hooking Up

Let's see how this experimental chassis makes itself useful. When you want to make up a circuit you begin by mounting some or all of the components required. You do this simply by 4BA bolts passed through the ready-made holes in the baseplate and 4BA nuts.

Personally, I don't use hexagon nuts for the job. I employ either milled or butterfly nuts because they save so much time.

Most of us, I expect, have a pretty useful supply of surplus odd terminal nuts in our junk boxes that will come in very handy for this purpose. It's far quicker to run on a nut of this kind with your fingers than to use pliers or a box spanner. And finger tightness is amply sufficient for mounting components.



HANDY TERMINALS
Fig. 3.—A really handy terminal for the amateur is the double-headed variety

Next we begin to make the necessary connections. If it is a battery layout the perforated zinc is connected to L.T.—, H.T.—and Earth, and a large proporion of the necessary connections. It becomes at once the easiest thing in the world. For earthing purposes I again use 4BA bolts with milled nuts.

Wiring Made Easy

Some components, such as decoupling condensers and such, would probably be mounted beneath the chassis. There is no trouble about taking wires to them from its upper side. The holes are there and you just use them. Connections not likely to want alteration I usually make with pieces of No. 20 double-cotton-covered wire.

No. 20 D.C.C. has a whole heap of advantages. You get yards and yards of it on a half-pound reel; you can cut it with an old pair of scissors; it is just stiff enough to stay put where you want it to and sufficiently flexible to be bent as required.

For the connections such as those to tappings, which are likely to be altered, I use flex and crocodile clips, and, believe me, the crocodile clip is one of the experimenter's best friends. Invest in a dozen of them and you will agree that they are well worth their weight in silver at any rate.

One of their particularly strong points is that they enable you to avoid all soldered connections when you are hooking up. If some component has nothing but tags for its contacts, the crocodiles will "bite" on to them in the most satisfactory way.

Other Brackets

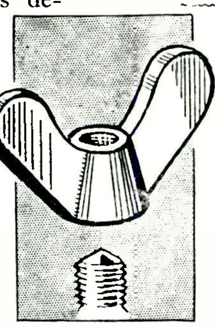
Possibly you will want to mount certain components above or below the baseboard in positions which cannot be attained if you fix them directly to the baseplate. For such emergencies keep a small supply of vertical brackets like those illustrated in Fig. 6. These again are cut from sheet metal of similar gauge to that used for the baseplate illustrated in Fig. 2.

The vertical part carries a $\frac{3}{8}$-in. diameter hole, and in the horizontal portion there are two 4BA clearance holes. Using 4BA bolts and the ever-useful milled nuts you can fix these brackets to your baseplate in a jiffy and a variety of components can be mounted with their aid with a great saving of time, trouble and language.

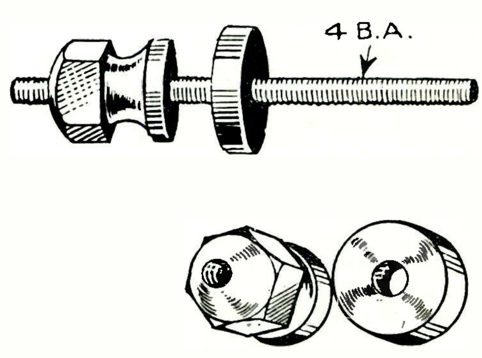
Special Brackets

Should you require a special bracket to take any particular component you can turn it out in a minute or two with the tin shears and the hand-drill. One of the best materials I know for making brackets is sheet aluminium about $\frac{1}{16}$-in. thick.

It is very easily cut



BUTTERFLY NUT
Fig. 5.—Better than the ordinary terminal head



MAKING YOUR OWN DOUBLE-HEADED TERMINALS
Fig. 4.—With some long-shanked 4BA terminals, and nuts of the same size, you can make your own double-headed terminals

with shears, and though it is soft enough to be shaped as required it still has sufficient stiffness to support quite heavy components without sagging.

About Potentiometers

Speaking of components mounted upon metal brackets connected to the zinc baseplate, reminds me that you should always be on your guard about potentiometers fixed up in this way. In those of good design the metal bush is insulated from the resistance windings and the travelling arm.

But there are potentiometers in which the bush is very much alive. If such a component forms part of a high-tension circuit it is very likely of a short occurring.

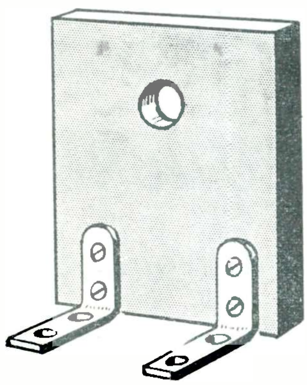
Be careful, therefore, before you mount the volume control or other potentiometers to make simple tests to assure yourself that the bush is not alive.

"Live" Bush

If the bush of a potentiometer, a switch or any other component is found to be in electrical connection with the working parts, a metal bracket cannot be used. Keep in stock just one or two mounts like that illustrated in Fig. 7. The upright portion consists of a small piece of ¼-in. ebonite, and it is supported by two Meccano angle brackets. The bush is thus kept completely insulated from the earthed baseplate and all is well.

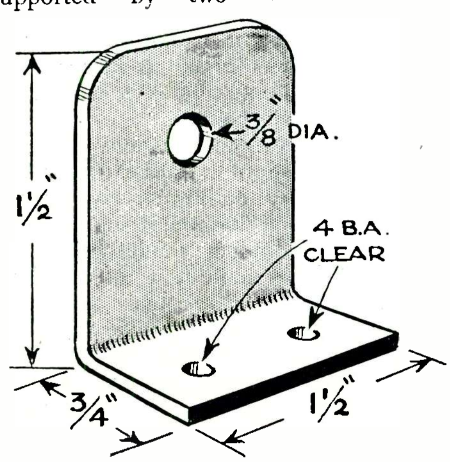
TURNING OUT SETS BY THE HUNDRED

One of the busiest of British radio factories is that of the General Electric Company at Coventry where hundreds of sets are turned out every day. This is the assembly section



MOUNTING "LIVE" COMPONENTS

Fig. 7.—Handy brackets for mounting components with "live" bushes can be made out of a piece of ebonite and two Meccano brackets



HANDY BRACKET FOR MOUNTING COMPONENTS

Fig. 6.—Very useful gadgets in the stock cupboard are metal brackets for mounting components off the baseboard or chassis

Transformers

How many readers, I wonder, know that a low-frequency transformer which has developed a "dis" in either the primary or the secondary windings can usually be repaired for much less money than is required to buy a new one of the same kind?

If you suspect a transformer it is not usually difficult to make certain by means of tests whether it is defective or not. To test the primary winding without removing the component from the set, disconnect the positive high-tension lead from its terminal.

Then connect this lead to the positive terminal of a milliammeter, joining the other terminal of the instrument to the H.T.+ terminal of the transformer. If current passes and there are no violent kicks of the needle when the transformer is shaken or smartly rapped, then all is well.

But the secondary windings may also "go." To test them, put the milliammeter into the plate circuit of the valve to whose grid the secondary of the transformer is connected and vary the grid bias. If there are no corresponding variations in the plate current the secondary has definitely broken down.

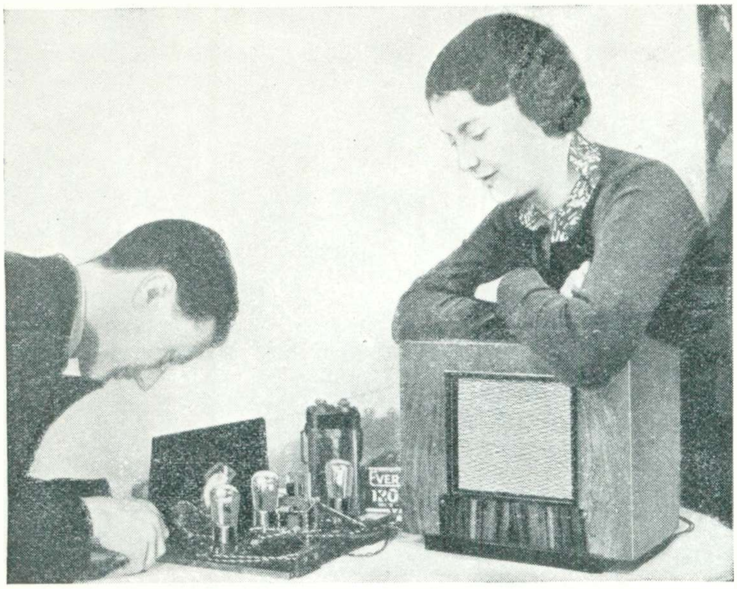
Watch These Symptoms

But even this test for a broken-down secondary is not infallible. It sometimes happens that when the transformer is cold the two ends of the break in the winding come together and a disconnection is not apparent. But as it warms up—for transformers do warm up—after being in action for half an hour or so the broken ends become gradually separated.

Then crackles become worse and worse, and often signals fade out altogether. Switch off the set for a bit and it may work again after the transformer has cooled down. Make a note of these symptoms.

Once you have spotted a break-down send the transformer to one of the firms which specialise in rewinding, and if it is worth repairing they will do the job for three or four shillings at the outside. Chokes, loud-speakers, and even telephones can be saved from the scrapbox in the same way.

In time rewinding odds and ends saves a small fortune.



This set will be ideal for the family couple who want reliable results, but whose purse is rather limited

Graduating to a Low-frequency Stage

with the £4 4s. Battery Two-valver

Last month we presented details of a simple and efficient battery two-valver that could be built for £4 inclusive of all accessories. Here we show how to add an additional stage of low-frequency amplification, a refinement which will ensure greater strength of distant stations and will make the set ideal for those living on the fringe of Regional areas. The addition only costs a few shillings.

LAST month we described in detail the construction of a very simple battery-operated two-valve set. The idea was to show beginners how they could start radio for as little as £4 4s. for that cost included all the necessary parts for making the set, wood for a home-made cabinet, valves, batteries, and a moving-coil loud-speaker.

Original Set

The original combination was, of course, a detector and a pentode. Now we are going to show how the set can be turned into a simple three-valver with the addition of an intermediate low-frequency stage between the detector and the pentode.

This, of course, makes the whole performance of the set very much more efficient and many more stations can be picked up at good strength on the loud-speaker.

Special Tuning Coil

It will be remembered that a special type of tuning coil giving better selectivity than usual on the long waveband was used in the original two-valve design. As the extra valve for the three-valver is inserted after the detector the tuning system remains unchanged.

In spite of this, though, the selectivity is adequate for all ordinary purposes and the set will give satisfaction in this respect almost wherever it is used.

The fact that the extra valve does result in improved performance is proved by the test report included in these pages. Twelve more stations were received during a short test than were picked up on the original two-valve design. All the other stations, of course, come in at slightly greater volume. Nobody can say that this performance is unsatisfactory either for a two- or a three-valver

In converting the set from a " two " to a " three " we have borne in mind the necessity for using as many as possible of the original components—although a few extra ones are also needed, of course. As a matter of fact, the additional parts, including the third valve, cost only 12s. 10d., a remarkable achievement when it is remembered that but a few years ago one valve on its own would have cost 12s. 6d.!

The Circuit

A glance at the circuit diagram will show how the addition to the original two-valver has been made. First we have the detector with its tuning system unchanged. But this valve has now been de-coupled so that no motor-boating can occur. This precaution is carried out by the use of a 5,000-ohm resistance in the anode circuit, by-passed by a .05-microfarad condenser.

Then we come to the intermediate low-frequency stage, which is coupled on the resistance-capacity principle. The first stage is still transformer coupled, it will be noted.

The coupling resistance is actually the 30,000-ohm resistance in the anode circuit, but it is also necessary to de-couple this valve and an additional 5,000-ohm resistance and .25-microfarad condenser are utilised for this purpose.

The resistance-capacity method makes use of a resistance and a condenser; the former has already been referred to, and it will be noted that a coupling condenser of 1-microfarad capacity is used. This combination of resistance and capacity gives good amplification and also good quality of reproduction.

Automatic bias was used for the pentode valve in the two-valve circuit, and this principle is now extended for the three-valver. In the original set this automatic bias was obtained by means of a 500-ohm resistance; a total value of 500 ohms is still required for the three-valver, but it is made up by 350-ohm and 150-ohm resistances in series.

A tapping is taken off between these two resistances, and this gives the bias for the intermediate low-frequency valve. The total 500 ohms still gives the bias for the output pentode.

Electrolytic Condenser

The 150-ohm resistance is by-passed by a .2-microfarad condenser, and the whole resistance network is by-passed by a 25-microfarad electrolytic condenser. In the original circuit a .1 plus .1 microfarad condenser was used; in the three-valve version the two parts of this condenser are joined in parallel and used as a .2-microfarad condenser.

Advantage of Automatic Bias

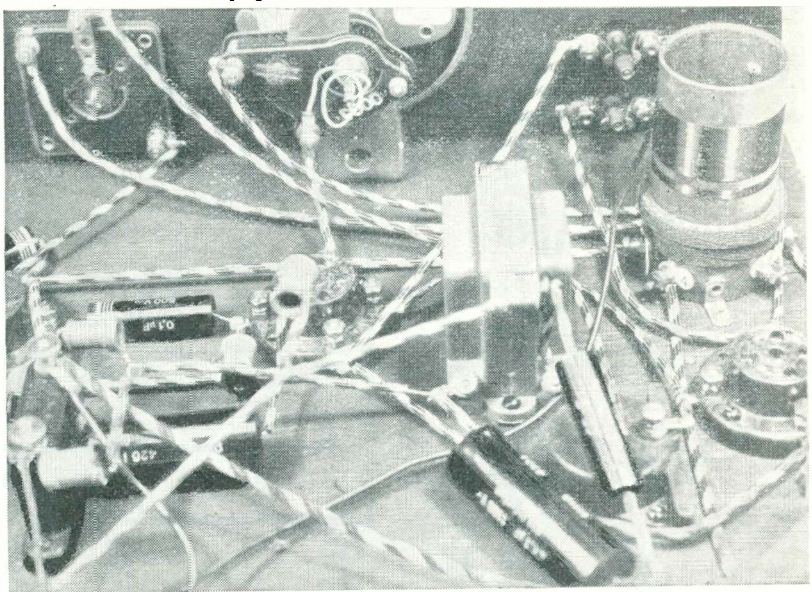
The great advantage of applying automatic bias in this way is that there is no need for a separate grid-bias battery with its associated plugs, sockets and leads; and, moreover, as the voltage of the high-tension battery falls the applied grid bias also falls and the quality of reproduction remains almost constant.

Battery sets often show signs of poor quality when the high-tension begins to run down, and this in many cases is due simply to over-biasing of the output valve, a point which is entirely avoided in this design.

It will be clear from the photographs and diagrams reproduced in these pages how the set is assembled. It will be interesting for those who built last month's two-valver to compare the pictures of that set with those published here; they will then be able to see how few are the alterations that have been made.

Included in these pages is a half-scale layout and wiring diagram; this is available as a full-size blueprint, if desired, for half price. These half-price blueprints (for 6d. each, post paid, that is) are available only for those readers who make use of the coupon on the last page of this issue by January 31, 1934.

Send your application to "Wireless Magazine," Blueprint Dept., 58/61 Fetter Lane, London, E.C.4, and ask for blueprint No. WM378.



WIRING AS SIMPLE AS A B C

The wiring of this simple battery three-valver is carried out on one side of the baseboard only. A glance at this photograph and the wiring plan on page 524 will show how easy is the construction

A copy will be sent by return of post.

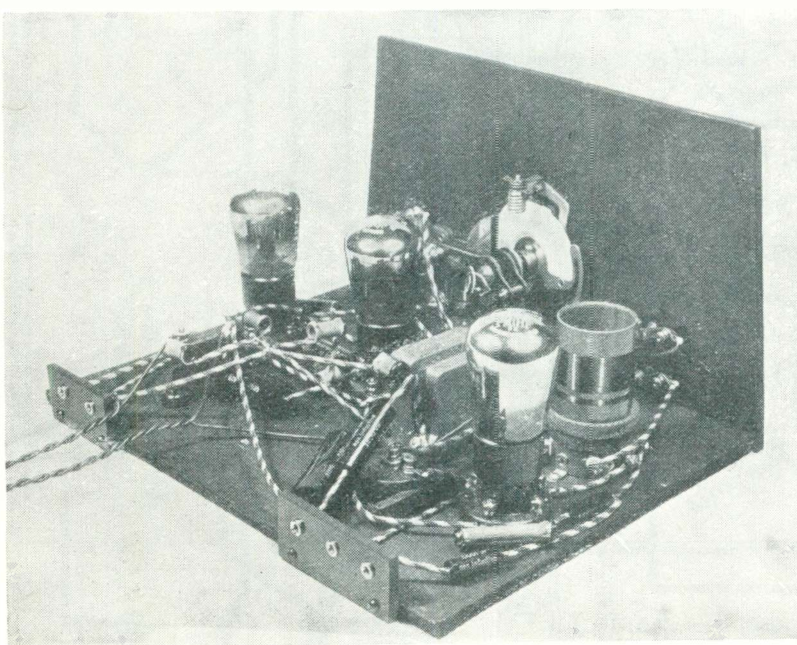
Both on the reduced scale reproduction in these pages and on the full-size blueprint it will be seen that all the wires are numbered separately.

Those who are converting the two-valver to the three-valver, by the way, should pull the former set right down, apart from the panel-mounted components, and start all over again in order to avoid the possibility of making a mistake.

Numerical Order

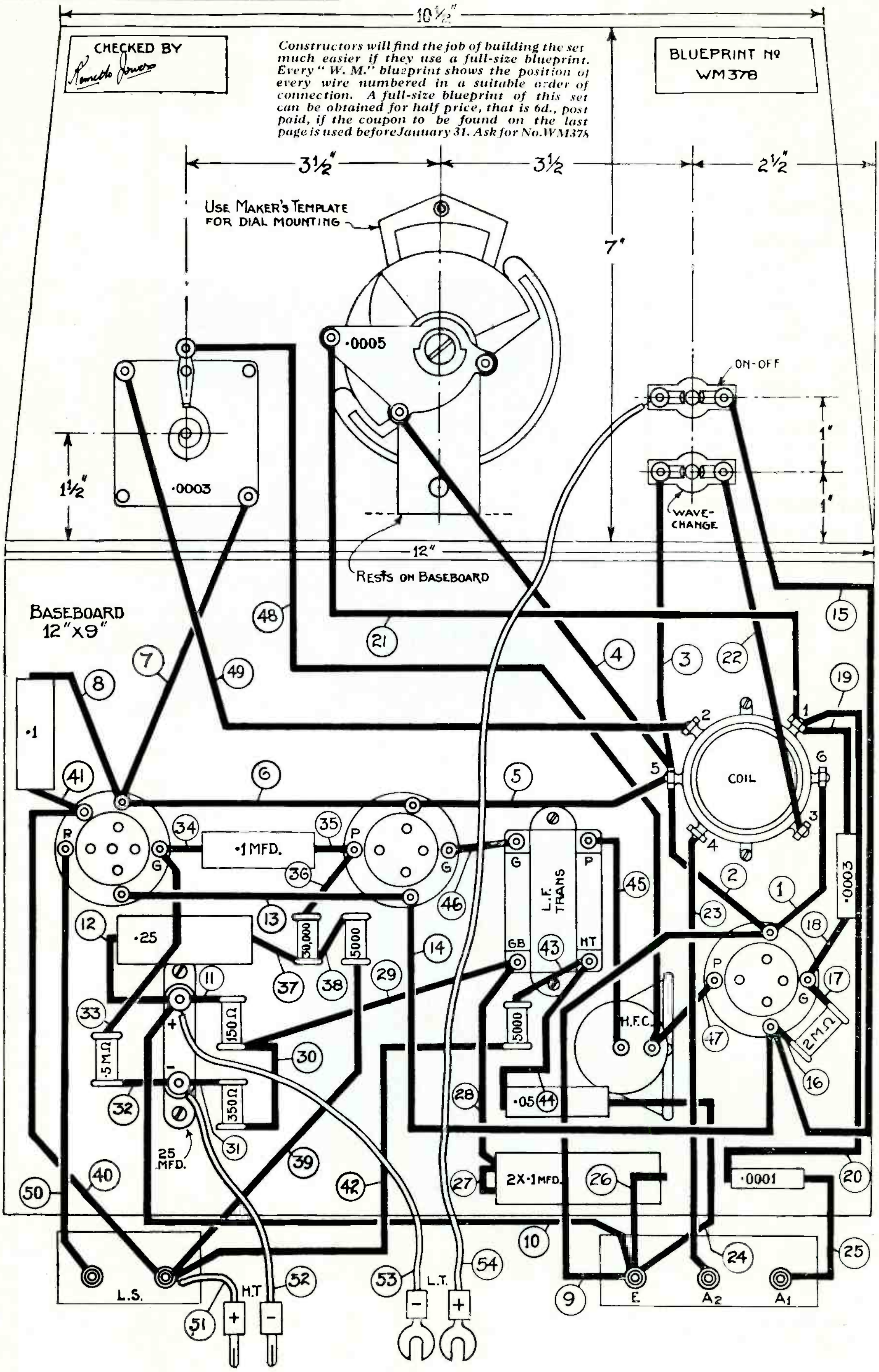
The set should be wired in the numerical order indicated by the numbers in circles, of course, and it is advisable to cross through the numbers on the blueprint as the corresponding connections on the set are completed. In this way it will be impossible to make a mistake.

It will be noted that there is only one high-tension supply point, a great advantage when it comes to connecting up the batteries By the way, although the set will give



WITH THE VALVES IN POSITION

From left to right the three valves are the output pentode, first low-frequency amplifier and the detector. Note that two of the valves used are of the ordinary triode type, so keeping expense down to a minimum


10½"
CHECKED BY
Constructors will find the job of building the set much easier if they use a full-size blueprint. Every "W. M." blueprint shows the position of every wire numbered in a suitable order of connection. A full-size blueprint of this set can be obtained for half price, that is 6d., post paid, if the coupon to be found on the last page is used before January 31. Ask for No. WM378
BLUEPRINT Nº WM378
3½"
3½
2½"
USE MAKER'S TEMPLATE FOR DIAL MOUNTING
7"
·0005
ON-OFF
·0003
1½"
1"
1"
WAVE-CHANGE
12"
RESTS ON BASEBOARD
BASEBOARD 12"X9"
·1
COIL
·1 MFD.
L.F. TRANS
G
P
GB
HT
·25
30,000
5000
150Ω
350Ω
·5MΩ
25 MFD.
5000
H.F.C.
·05
2MΩ
·0003
2X·1 MFD.
·0001
L.S.
H.T
L.T.
E.
A2
A1

satisfactory results with the 108-volt battery specified, the strength of signals will be increased if the voltage can be increased to 120 or even to 150 volts.

Although the set is wired for the use of a pentode in the output stage it is quite possible to use an equivalent triode. The signal strength will not be quite as great, but many people prefer the quality obtained from the latter type of valve.

Pentode Quality

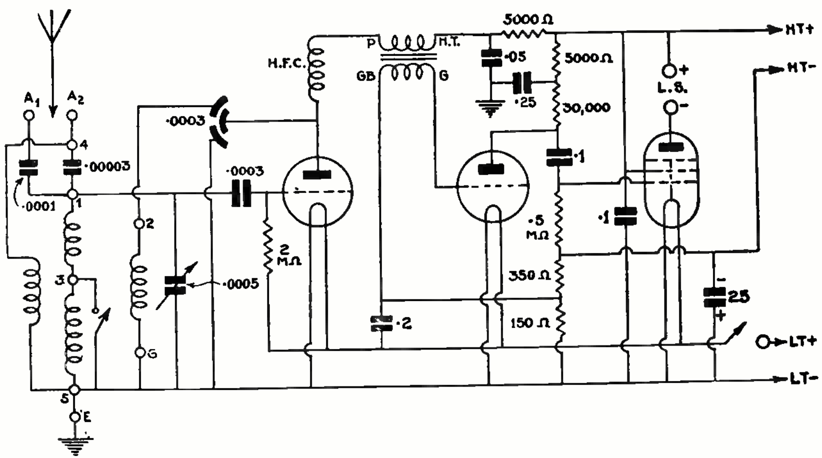
Pentode quality is inclined to be high-pitched, but that is usually put right by correct matching of the valve to the loud-speaker.

It should also be noted that in this set the high-tension voltage is fed direct to the screen of the pentode without the intervention of any dropping resistance. Tests prove that in most cases such a dropping resistance is quite unnecessary.

Secret of Tuning

The operation of the three-valver is exactly the same as for the two-valver, none of the "control" components having been changed at all. The secret of success with a set of this type is to pick the best aerial tapping and to get proper control of reaction. By increasing reaction it is often possible to separate stations that would otherwise be interfering with one another.

Turn the main control slowly and at the same time keep the reaction control at such a point that the set is always on the verge of oscillation, although not actually oscillating.



AS SIMPLE AS CIRCUITS CAN BE

Here is the circuit of the £4 Battery Two-valver with an added stage of low-frequency amplification. Note that the resistance-capacity coupling is placed between the first low-frequency stage and the output pentode

Oscillation will produce whistles, which are unpleasant, to say the least, and may interfere with neighbouring listeners. When a set is on the *verge* of oscillation a slight hissing or breathing noise will be heard from the loud-speaker; and when this sound is heard you may be assured that the set is in its most sensitive condition for reception.

Remember that the set is provided with two aerial terminals and that these greatly affect the selectivity. In the first (most selective) condition the aerial is fed through a .00003-microfarad fixed condenser, which actually forms an integral part of the coil design and is supplied with it, mounted inside the cylindrical former.

Aerial Tappings

This aerial is in circuit when the aerial is connected to the terminal marked A_2.

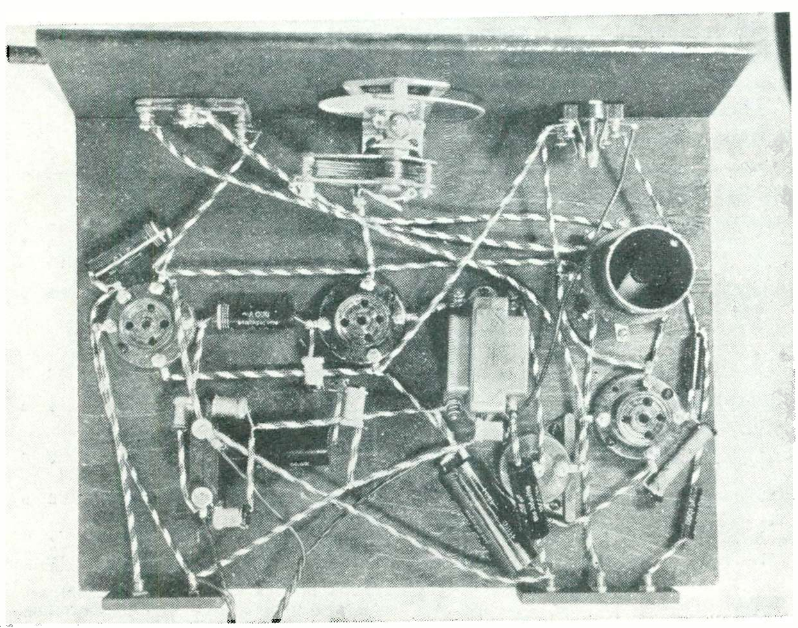
In the second position (that is, the terminal marked A_1) the aerial is fed through a .0001-microfarad condenser; when this connection is used the sensitivity of the receiver is increased, but at the expense of selectivity.

In practice it is necessary to make a compromise between selectivity and sensitivity, which means that A_1 will give the best results for some stations (the more distant ones, of course) and A_2 will give the best results for the nearer transmissions. The actual length and location of the aerial also have a great effect, and the aerial tappings will not necessarily remain constant when the set is used on different aerials.

Choice of Aerial

We must point out that a set of this type, without any high-frequency amplification, will not give really good results on a poor indoor aerial, and wherever possible it is advisable to use a fair length of outside wire.

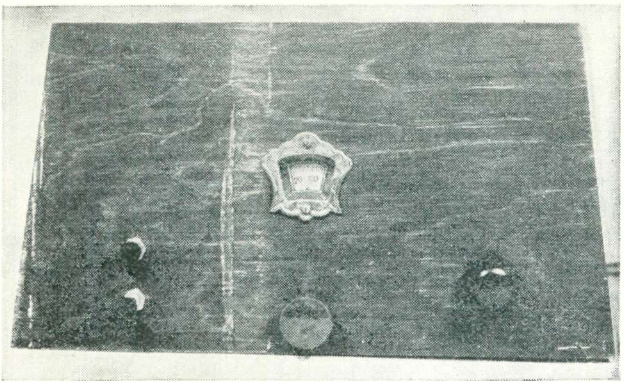
Improvement in the aerial-earth system produces marked improvements in the results obtained with simple sets of this type, although it is the fashion nowadays not to worry about such trivial details.



PLAN VIEW OF THE BATTERY THREE-VALVER

This plan view of the set should be used in conjunction with the half-scale blueprint that appears on the opposite page. The design is very straightforward and novices should not have difficulty in turning out a first-class outfit

Thirty-three Stations on Our Three-valver



SIMPLE LAYOUT OF THE CONTROLS
The controls are identical with those of the two-valver. On the left is the on-off switch above the wave-change switch, the tuner is in the centre and the reaction control is on the right

IT was greatly to my liking that the £4 two-valver should be fitted with an extra low-frequency stage for after I had tested it as a two-valver, and realised its possibilities, I did feel that if it had a little more in hand it would have been infinitely more useful.

You may remember that a few weeks ago I received twenty-three stations on this receiver as a two-valver, but there were quite a lot more stations which could not be brought up to good loud-speaker strength.

In the circumstances I was particularly pleased when the three-valver came along for test. From the outside it looked almost the same as the two-valver. The controls were identical. But immediately I tried it out it was obvious that although the actual volume was not greatly increased, the log would soon be in excess of the twenty-three stations I had previously heard.

Most of the more familiar European stations were brought in quite easily without having to push reaction to any extent. The selectivity could be increased very considerably without decreasing the volume, so that I was able to hear several more stations which previously were jammed by the local Regional or National.

For example, I thought it was pretty good to be able to hear Naples on 271 metres and Frankfurt on 251 metres without interference from the London National.

By keeping out of the way of the two local stations I could hear several more good programmes without any difficulty. Actually it seemed that the third valve enabled me to obtain better selectivity, a little more volume on all stations, in addition to about twelve new stations that I had not heard on the previous receiver.

These twelve stations are printed in italic in the station log.—*K. J.*

LONG WAVES

Station	*Dial Reading*
Hilversum	155
Moscow	149
Radio Paris	140
Droitwich	118
Eiffel Tower	106
Motala	77
Warsaw	59
Luxembourg	50
Kalundburg	43

MEDIUM WAVES

Station	*Dial Reading*
Budapest	173
Athlone	169
Stuttgart	156
Brussels No. 1	149
Prague	144
Langenberg	143
North Regional	142
Stockholm	138
Rome	136
Madrid	134
Munich	133
Midland Regional	128
Berlin	120
London Regional	110
Hamburg	99
Brussels	96
Poste Parisien	90
West Regional	83
Hilversum	80
Madrid	70
Naples	66
London National	50
Frankfurt	39
Trieste	36
Milan	16
Fécamp	12

COMPONENTS NEEDED FOR THE TWO- AND THREE-VALVERS

	s.	*d.*
BASEBOARD		
1—5-ply 12 in. by 9 in. with 3-ply wood panel 12 in. by 7 in. say	1	0
CHOKE, HIGH-FREQUENCY		
1—Graham Farish, type Snap ...	2	0
COIL		
1—B.T.S. dual-range, Droitwich type	3	6
CONDENSERS, FIXED		
1—Franklin .0001-microfarad, type tubular		6
1—Franklin .0003-microfarad, type tubular		6
1—Franklin .1 +.1-microfarad, type tubular	1	6
*1—Franklin .05-microfarad, type tubular	1	0
*1—Franklin .25-microfarad, type tubular	1	4
*2—Franklin .1-microfarad, type tubular	2	0
*1—T.C.C. 25-microfarad, type 25-volt electrolytic	2	6
CONDENSERS, VARIABLE		
1—Ormond .0005-microfarad, type R/503	2	3
1—Graham Farish .0003-microfarad differential reaction	2	0
DIAL, SLOW-MOTION		
1—Ormond, type R/361	2	6
HOLDERS, VALVE		
1—W.B. 4-pin		6
1—W.B. 5-pin		8
*1—W.B. 4-pin, type baseboard ...		6
PLUGS, TERMINALS, ETC.		
5—Clix metal sockets		5
3—Clix wander plugs, marked: H.T.–, H.T. + 1, H.T. + 2 ...		4½
2—Clix spade terminals, marked: L.T. –, L.T. + ...		4
RESISTANCES, FIXED		
1—Franklin 500-ohm, type ½-watt		6
1—Franklin 5,000-ohm, type ½ watt		6
1—Franklin 2-megohm, type ½-watt		6
*1—Franklin 350-ohm, type half-watt		6
*1—Franklin 150-ohm, type half-watt		6
*1—Franklin 30,000-ohm, type half-watt		6
*1—Franklin 500,000-ohm, type half-watt		6
SUNDRIES		
Ebonite strip 5 in. by 1 in. by $\frac{3}{16}$ in.		3
2 doz. ½-in. wood screws, say ...		4½
Connecting wire and sleeving, say		6
3 yd. thin flex (Goltone), say ...		8
SWITCHES		
2—Goltone two-point on-off ...	1	6
TRANSFORMER, LOW-FREQUENCY		
1—Graham Farish, ratio 1 to 3.5, type Pip	6	9

ACCESSORIES

	s.	*d.*
BATTERIES		
1—Marconiphone 108-volt, type B496	10	0
1—Exide 2-volt accumulator, type DTG	4	6
CABINET		
Wood for home-made cabinet as described, say	3	0
LOUD-SPEAKER		
1—W.B., type Stentorian Baby £1	2	6
VALVES		
1—362 HL2	3	6
1—362 ME2	10	0
*1—362, L2	3	6

Parts marked with an asterisk (*) are additional components needed for converting the two-valver to a three-valver.

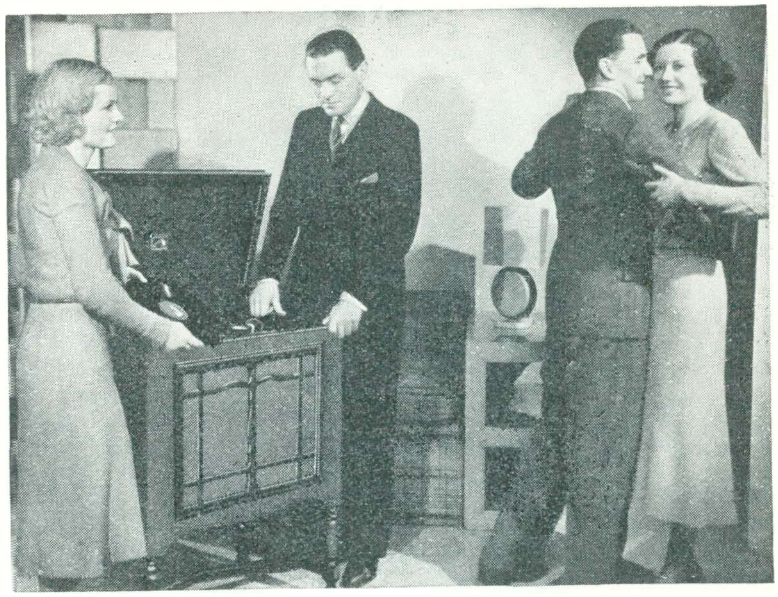
The following parts are not required for the three-valver: Clix Wander plug, H.T. + 2 and Franklin 500-ohm, half-watt resistance.

ALL ABOUT PICK-UP RESPONSE CURVES No. 3

FIRST of all, I should correct a mis-statement in the captions to the diagrams which illustrated my article last month. It arose through a misunderstanding, but had the effect of attributing opinions to me which I certainly do not hold.

It is not my view that an output scale on a rather compact voltage basis is preferable to one on a decibel basis.

Indeed, I rarely use a compact voltage scale, whereas I often use a decibel scale. It all depends on the immediate object in view. For experimental work where my object is to bring faults into prominence I usually use an *open* voltage scale.



These folk certainly seem to be getting ideal results from the gramophone side of their H.M.V. radiogram

The Ideal Response

By P. WILSON, M.A.

But it would not be reasonable or fair to exhibit a curve drawn on this scale to the public gaze; for however much one explains and qualifies in words, the picture has the unfortunate habit of catching hold of the imagination and the explanation is ignored.

More Suitable Scale

For general information, then, I believe that a decibel scale is more suitable, but I should like to see the relation between that scale and the frequency scale standardised, so that our eyes may become accustomed to one particular type of picture. It does not much matter what the standard relation is so long as it is generally accepted.

At first thought one might argue for equality between the distance representing an octave and that representing 3 decibels: an octave interval denotes a doubling of frequency and a 3-decibel interval denotes a doubling of power.

On the other hand, the ear is much more sensitive to changes of pitch than to changes of power. An increase of frequency of only 0.3 per cent is perceptible, and there are over 250 such intervals in an octave.

The minimum increase of power that is just audible by direct comparison is between 0.5 and 1 decibel. Any attempt to equate scales on the basis of relative audibility therefore just leads to an absurdity.

The conclusion of the matter is that only experience in drawing and using response curves can indicate what relative scales are most likely to provide the desired information without giving rise to misconceptions.

My suggestion, based on a good deal of experimental and journalistic experience, is that the distance chosen to represent an octave should also be chosen to represent 10 decibels. This is the basis on which Fig. 1 has been drawn.

Important Objection

There is, however, one important objection to the use of a decibel scale alone: it gives no indication of the A.C. voltages likely to be met with in reproduction, and therefore information is lacking of the amplification likely to be required to load an output stage.

To complete the story, therefore, we want a statement linking up the datum line of the decibel scale with a voltage output. Since it is convenient, for reasons connected with the calibration of constant-frequency records, to take the output at 1,000 cycles per second as the datum line, our requirements are met if the voltage output at 1,000 cycles is specifically stated.

Further Advantage

In practice this has the further advantage that the output at 1,000 cycles on a constant-frequency record is just about the same as the mean output from an ordinary record, excluding jazz records, which are usually louder than normal.

For the rest, if it is remembered that +6 decibels represents a doubling of voltage (N.B.—not *power*) and −6 decibels a halving of voltage, no confusion is likely to arise.

The next question to ask ourselves is what is the ideal response curve for a pick-up. On this, as I indicated in a preliminary way last month, there has been much divergence of opinion.

Usual Argument

The usual argument starts from the assumption (and, mind, it *is* an assumption) that, other things being equal, a level or uniform response should be aimed at. Whatever scales of measurement we used this would be represented by a horizontal straight line.

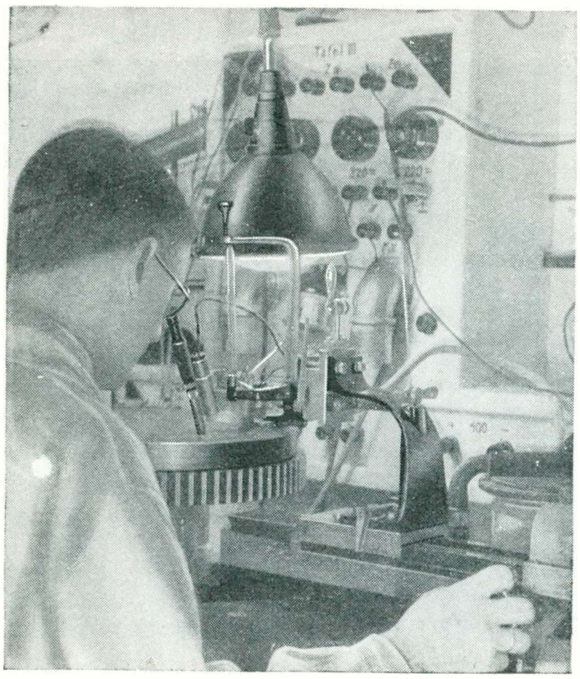
But other things are not equal. As is well known, the bass end of the scale is attenuated in recording below about 250 cycles per second so that there should be less risk of adjacent grooves running into each other. The amount of attenuation is about 14 decibels at 50 cycles.

Partly Fallacious

Again, the treble above about 4,500 cycles is attenuated in recording so that the curvature of the groove shall not be too difficult to follow; or, at least, so it used to be said. But I have long believed this idea of curvature to be partly fallacious, and it is significant that nowadays the recording of high notes is much stronger than it used to be.

After all, the curvature of the groove at any particular point of an ordinary record is not determined solely, or even mainly, by that of a single high note which is being reproduced at that instant.

There is a combination of notes all sounding together, and this results in a much less tortuous groove on the whole than that of the highest note in the combination.



Gulliland photo

EXTREME CARE IN GRAMOPHONE RECORDING
While the recording wax is being cut, an engineer watches the groove made by the diamond cutter to see that it remains smooth. The wax "string" cut out is automatically sucked away by a small vacuum device

The argument is important for a reason I shall come to presently. Here the point I want to make is that there is some attenuation in recording at both ends of the scale, and that a rising response from the pick-up in the bass by as much as 14 decibels at 50 cycles and a rising response of doubtful amount above 4,000 cycles would appear to be an advantage.

Experience shows that there is no doubt about the advantage of a rise in the bass, though a difference of 14 decibels between 50 cycles and 200 cycles (2 octaves) is thought to be too great in ordinary circumstances; the full amount can only be tolerated in a large hall.

Something of the order of 6-10 decibels is usually quite enough. Even here, however, there is one qualification that should be made. Many pick-ups do not in actual reproduction produce the same rise in the bass that the response curve shows! These pick-ups are all subject to amplitude distortion because of the over-balancing pull of the magnet on the armature.

Of Greater Amplitude

The bass notes on constant-frequency records are of greater amplitude than any notes on ordinary records (on the 25-cycle record there are only 50 grooves to the inch) and on these large amplitudes the pick-up may give far more than double the normal output.

To check up on this one has either to observe the waveform on an oscillograph or, alternatively, to re-measure the response curve using constant amplitude records of which there is now a series available.

So far as the high notes are concerned, it is found that any correction for recording deficiencies is usually not desired. Here again an exception must be made in the case of reproduction in a large hall (or in the open air) where a relatively greater response to high notes is tolerable.

As a result of these considerations many experts on reproduction now favour a response curve which decreases by about 3 decibels for each octave rise in the scale.

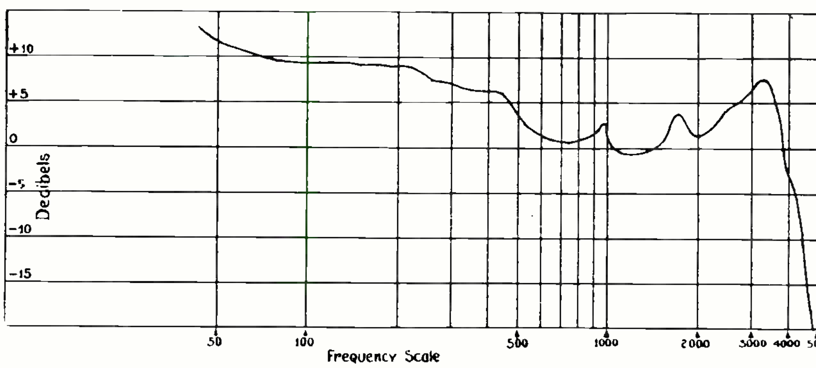


Fig. 1.—The author suggests that in published curves the scales should be chosen as in this diagram so that the vertical distance for 10 decibels is equal to the horizontal distance for one octave

My own inclinations are somewhat different, as will be seen from the diagram. They are based on purely empirical results. From time to time I have made or adjusted pick-ups to give different types of response, and have tried them out on a fairly large number of people.

My ideal curve is the result of

these trials. As we go up the scale there is a descending response which changes to an ascending one after about 2,500 cycles, followed by a flat, table-land of a peak at 4,500-5,000 cycles, and after that a second region of descending response. The output at the flat peak should not be greater than that at 1,000 cycles.

Explaining the Ideal Curve

I think I can explain why the curve should have this sort of characteristic. In the first place let us look at the argument in favour of a descending response. I have already mentioned that a needle has difficulty in following a groove of substantial curvature. On constant-frequency records the curvature increases as we go up the scale and more and more the needle tends to ride up and down in the groove, thereby "cutting the corners" instead of following round to the full amplitude.

As we go up the scale using constant-frequency records, therefore, a smaller and smaller proportion of the recorded note is communicated by the needle to the pick-up, and the actual voltage measured only represents a fraction of that which would be measured if the mechanical input were constant.

Other Way Round

To put it round the other way, a measured constant voltage output really represents an increasing ratio (as we go up the scale) of voltage output to mechanical input.

That would not matter if the same thing occurred in similar degree when an ordinary record is being played. But it doesn't. There is, of course, some riding up and down of the needle in the groove, but not nearly to the same extent, for as I have already pointed out the curvature of a composite groove is on the whole less than that of the high-note constant-frequency record.

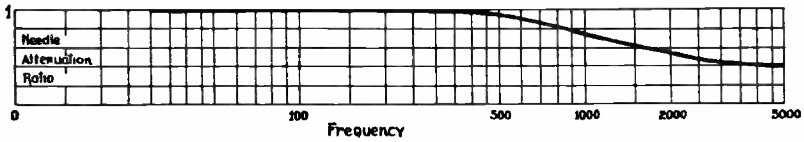


Fig. 2.—When playing constant-frequency records a needle only picks up a fraction of the true mechanical motion above 5,000 cycles. This diagram shows the proportion at various frequencies

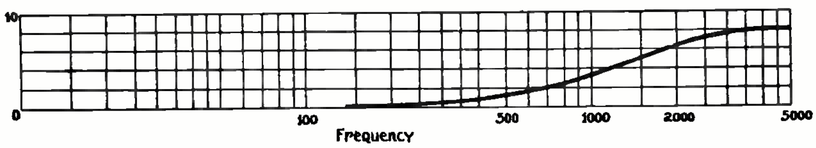


Fig. 3.—The author suggests that a pick-up with a uniform response when measured from constant-frequency records would really have a rising response as shown when playing ordinary records

It follows that a pick-up which gives a level response as measured from constant-frequency records will give a response rising with frequency on ordinary records. In order to allow for this our measured response should be a falling one.

How much fall should be aimed at cannot accurately be determined. It obviously depends on the shape of the needle point and upon the angle at which the needle enters the groove (needle angle).

An outside estimate for various types of needle can be inferred from the calibration of a heterodyne-note record, first by Buchmann and Meyer's optical method ("E.N.T.," April, 1930) and then by an electro-mechanical process using the needle as the actuating device. The details are given in Buchmann and Meyer's paper.

Taking the standard of the optical method as 1, a "loud" steel needle showed nearly 1 up to about 500 cycles, 0.7 at 1,000 cycles, 0.5 at 2,000 cycles, and 0.4 at 5,000 cycles. These ratios correspond to 0, −3 decibels, −6 decibels, and −8 decibels respectively.

The "needle attenuation" is thus about 3 decibels per octave above 500 cycles, but rather less at the higher frequencies (4,000-5,000).

Allowing for deficiencies in bass recording, this is the justification for the technical standard to which I have already referred.

It should be noted, however, that this standard over-estimates the high treble attenuation and does not allow for recording deficiencies. Besides, the assumption on which it is based (that the behaviour of the needle in a composite groove is different from that in a constant-frequency groove) is more nearly justified where the middle frequencies are concerned than it is for the very high frequencies.

It is therefore an advantage to have a better high-note response than the technical standard shows, provided we can obtain it without running into shrillness and without undue disturbance from surface noise.

No Sharp Peaks

Both conditions demand that there should be no sharp peaks, and the second condition also demands that the response should be kept low in the region where the characteristic surface noise is most objectionable. This is unquestionably in the 1,500 to 3,000 cycle region.

At the lower end the surface noise has a harsh, sand-papery quality, gradually softening into a coarseness and then to a hoarseness which I can imitate more easily than I can describe.

As we go higher in the scale, always assuming that there are no sharp peaks, the noise first of all concentrates into a somewhat hard hiss, and then softens into a rustle at 5,000-6,000 cycles.

Above that it seems to harden again into a whistle at about 9,000 cycles,

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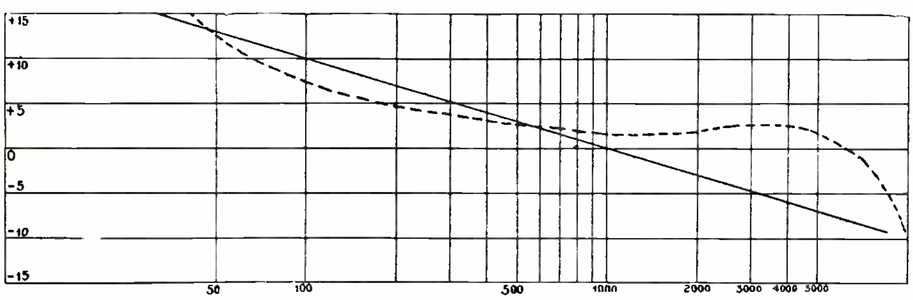


Fig. 4.—These curves show the standard response aimed at by many pick-up designers (falling by 3 decibels per octave), and that favoured by the author in order to maintain good high notes with a minimum of objectionable surface noise

On the Crest of the Waves

Radio News from All Quarters : By JAY COOTE

BULGARIA

So far, as regards radio broadcasts, Sofia has been the Cinderella of Europe, but if negotiations are successfully concluded the Bulgarian capital will be endowed with a "pukka" 50-kilowatt transmitter. Radio Rodno, the present station, will then be transferred to Varna as a relay of the National programmes; its wavelength is 332.9 metres and power, 300 watts.

♦ ♦ ♦

FIJI ISLANDS

Up to the present the white population has been compelled to rely on Honolulu (Oahu, Hawaiian Islands) for its radio entertainment or on the more powerful Brisbane broadcaster for news bulletins. It is now proposed to open a station at Suva which, if the scheme matures, would permit a relay of native music by Australian and U.S.A. studios. Through these channels Europe from time to time could also be given an opportunity of hearing such broadcasts.

♦ ♦ ♦

FRANCE

According to a French report the plans for the construction of the Rennes-Thourie station have been modified as the authorities intend to make it a station at least equal in power to Droitwich and the new Deutschlandsender. If rumour is to be believed, the output of this French transmitter may attain 200 kilowatts.

♦ ♦ ♦

The power of Strasbourg has been recently increased to 40 kilowatts, and Bordeaux Lafayette has stepped up to 25 kilowatts. Radio Lyons has been authorised to use its new 25-kilowatt station at the Tour de Salvagny, and tests are expected to be carried out before Christmas.

♦ ♦ ♦

HUNGARY

In order to secure an alternative programme the authorities are erecting a second transmitter on the Island of Csepel. The wavelength of 227.1 metres (1,321 kilocycles) will be retained for these broadcasts. As the station will be rated as a 20-kilowatter, its signals should be well received in the United Kingdom.

♦ ♦ ♦

ITALY

Work has already begun at Santa Palomba on the rebuilding of Rome's high-power transmitter. With a view to securing alternative national broadcasting services, it is planned to install two 120-kilowatt stations, and thus do away with such small relays as Rome (2) and Turin (2). Palermo, which it was intended to include in the Rome-Naples-Bari network, has decided to remain independent and to continue broadcasting its own local programmes.

♦ ♦ ♦

LATVIA

Stand by for tests shortly by the new 40-kilowatt station at Kuldiga, which will operate on 238.5 metres (1,258 kilocycles), and through which the Riga programmes will be available. Madona, a 50-kilowatter also relaying the capital's radio entertainments, shares a wavelength with Naples and San Sebastian, and can only be picked up when the former is closed down.

♦ ♦ ♦

MEXICO

Following the breakdown of the Pan-American Radio Conference on the redistribution of wavelengths, Mexico intends to erect high-power broadcasters on the Texas border. It is reported that at Saltillo (Coahuila) plans have been drawn up for the building of a 250-kilowatt station of which the main programme feature is to be political propaganda. The channel chosen for this purpose has been provisionally fixed at 556 metres (540 kilocycles).

♦ ♦ ♦

ROUMANIA

The Societatea di Difuzione diu Romania, the association responsible for the broadcasts in that country, is anxious to extend its network and, providing authority can be obtained, it proposes to erect three new 20-kilowatt stations at Chisinau (Bessarabia), Cernauti (Bucovina) and Cluj (Transylvania) with smaller relays at Timisoara and Tazi. The power of Bucarest is to be increased shortly.

♦ ♦ ♦

UNITED STATES OF AMERICA

During the winter months broadcasts from some of the most powerful stations in the United States are well heard in Great Britain. The best transmissions to tune-in are WPG, Atlantic City (New Jersey), 272.6 metres; WTIC, Hartford (Conn.), 288.3 metres; WBZ, Boston (Mass.), 302.8 metres; KDKA, East Pittsburgh (Pa.), 305.9 metres; WENR-WES, Chicago (Ill.), 344.6 metres; WABC, New York, 348.6 metres; WGY, Schenectady (New York), 379.5 metres; WJZ, New York, 394.5 metres; WGN, Chicago (Ill.), 416.4 metres; WLW, Cincinnati (Ohio), 428.3 metres, and WEAF, New York, 454.3 metres.

The Ideal Response—Continued from page 529

similar in quality to a heterodyne whistle. I am not quite sure about the top end of the scale because I have only once heard a pick-up which had any appreciable output up there.

The important point is that merely cutting off high-note response by means of a filter circuit is a bad way of avoiding surface noise. The 5,000 cycle surface noise is not nearly so intolerable as the 2,000-cycle noise.

What is really wanted is a not too deep trough in the response curve extending from about 1,000 cycles to something over 3,000 cycles, and an avoidance of sharp peaks over all this region and above. Highly damped peaks do not matter so much.

In concluding this article I should emphasise that my conclusions were first of all determined by experiment on all the friends I could induce to join in the game.

The analysis and explanation of the results came much later. They may require amendment as time goes on. But I feel pretty sure about the facts I have stated.

THERE has been an extraordinary change in the outlook of set manufacturers in one year. In 1934 the possibility of us having A.C./D.C. mains receivers was "pooh-poohed" by the majority of the larger firms who said that this type of set would never be much use. Anyway, the B.V.A. were not likely to issue the necessary valves.

It seems as if the push by the non-ring makers for this type of valve finally forced the B.V.A. makers to get down to the design of some really good A.C./D.C. valves. This they did, and now we have universal sets equally as good as normal A.C. sets and, in fact, in some cases better. They are certainly more free from hum.

PUTTING THE FINISHING TOUCHES TO A BIG SET
An H.M.V. engineer fixing in the radio chassis in one of the nine-valve automatic record changing radiograms. It will be seen that the "motor board" carries no weight at all. A smart-looking outfit, you will agree!

Tests of the New Sets

By the "W.M." SET SELECTION BUREAU

In this issue we have reviewed five receivers of outstanding merit. One, the K.B.383, will appeal to more than the average number of listeners, for it is the largest seven-valve universal super-het that we have as yet tested.

Then for those who cannot afford £19 19s. there is the universal Ekco, with its internal frame aerial.

Although there is not a very big demand for D.C. mains receivers, the G.E.C. are to be congratulated on providing an excellent D.C. super-het, the model) BC3545, for only £13 13s.

At the other extreme is the little Cossor three-valve battery set at £5 12s. 6d. Finally is a receiver of the kind of which we see far too little—the Lissen A.C. Band-pass Four, a kit receiver designed for A.C. mains. At £9 15s. it will meet with general approval.

Amongst these receivers we feel sure many readers will be able to choose a new model for the winter but, on the other hand, if still in doubt, drop us a line and we will give you the benefit of our experience.

There seems to be a slight tendency for manufacturers to consider making all-wave receivers. We certainly hope that this type of set will become popular, for until you actually try the short waves you do not appreciate just what you are missing.

Several makers have approached us to find out whether or not we really do think short waves are worth having. It looks as if before very long there will be at least three sets tuning from 12 to 2,000 metres, in addition to the few already available.

A.C./D.C. transportables are rather good at Christmas time, for you can take them anywhere and you do not want any aerial or earth.

We rather like the idea of Ferranti's who are putting out a loud-speaker cabinet to match up with most of their standard receivers. This little cabinet will take any of the usual Ferranti loud-speakers, and any other loud-speakers for that matter, and can be used either as an extension unit or with your present set if you wish.

We shall probably be able to let you have details next month of a new radio-gramophone with automatic mechanism that plays ten records and *both sides of them*. Seems too good to be true!

FREE ADVICE TO PROSPECTIVE SET BUYERS

To make the most of this free advice service, we ask you to answer the following questions :—

(1) The maximum price you wish to pay, and whether you are prepared to exceed this if there is no suitable set at your desired price.

(2) The locality in which the set will be installed.

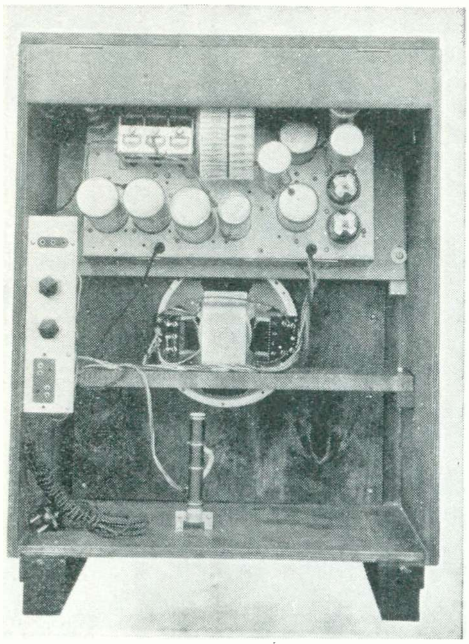
(3) The stations required, that is, locals only or a selection of foreigners.

(4) Whether you want an entirely self-contained set or one with external aerial and earth.

(5) Whether battery or mains driven. If the latter, whether A.C. or D.C.

A stamped-addressed envelope for our reply is your only expense. Address your inquiry to Set Selection Bureau, "Wireless Magazine," 58-61 Fetter Lane, E.C.4. Tell your friends about this useful service, exclusive to "W.M."

K.B. Universal Model 383



"The chassis is mounted at an angle to the cabinet and is very clean indeed—most impressive!"

THIS is one of the star receivers of the month. A seven-valve super-het for any type of mains! Every feature that the connoisseur requires is included, while the music lover, long-distance fan or local-station listener will agree that it suits his or her own particular needs.

At first we were not quite sure whether to call this receiver a table or console model. It looks rather like a pedestal set that hasn't finished growing.

> **BRIEF SPECIFICATION**
>
> BRAND NAME: K.B.
>
> MODEL: 383.
>
> TECHNICAL SPECIFICATION: *The largest universal super-het we have tested. It uses seven valves in a super-het sequence. A pentagrid-frequency changer (Cossor 13PGA) is followed by a single intermediate-frequency stage, using a variable-mu high-frequency pentode (Cossor 13VPA). A double-diode-triode second detector (Cossor 13DHA) is linked with a special noise suppression valve (Cossor 13SPA). The output stage consists of two pentodes in parallel (Cossor 40PPA) while the rectifier is of the half-wave type (Cossor 40SUA).*
>
> PRICE: £19 19s.
>
> POWER SUPPLY: A.C. — D.C. mains, 200 to 260 volts.
>
> MAKERS: Kolster-Brandes, Ltd., Cray Works, Sidcup, Kent.

Directly you start tuning you realise that the design of the cabinet has been very carefully planned. Any normal person can reach the controls without moving out of the armchair. All the knobs under the lid are just at the right level. The visual tuner is a little out of sight, but we could follow this by the reflection on the underside of the lid.

These controls are more or less conventional, consisting of a main tuner, a combined wave-change and gramophone switch, a manual volume control, and on-off switch. A special feature is the variable selectivity device, which enables one to alter the coupling between the primary and secondary of the intermediate-frequency coils and so vary the selectivity between 5 and 15 kilocycles.

The chassis is mounted at an angle to the cabinet, and is very clean indeed—most impressive! You can see condensers, all the valves, coils, gramophone sockets, while the aerial and earth sockets are on a little panel on their own.

There are two more controls which we have not yet mentioned. These are not very important, or rather we should say they do not have to be continually adjusted. One is a resonance-indicator adjustor. With it you can alter the efficiency of neon-gas tuning indicator.

The other is a variable noise-supressor. With this you can arrange it so that only stations of a definite programme value, free from fading and background noise of any description, are receivable.

When the receiver is set in this way, results are very fine. Some twenty to twenty-five stations can be tuned in with knife-edge selectivity and a complete silence between stations: the smaller noises and whistles are completely wiped out.

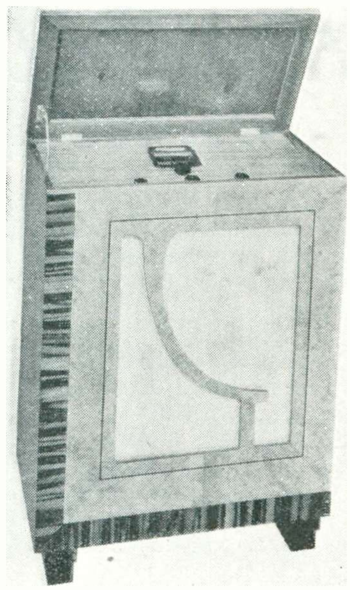
In daylight, when the background-noise level is rather inclined to be objectionable, this control is invaluable, for foreign stations can be brought in just like the local.

The circuit is more or less conventional, consisting of a combined detector-oscillator followed by an intermediate-frequency amplifier, double-diode-triode second detector, two power pentodes in parallel giving 4 to 5 watts and a half-wave rectifier. The seventh valve is an inter-channel noise suppressor linked with the second detector circuit.

We cannot speak too highly of the absence of hum, complete freedom from mains noises and the points we have just mentioned, such as variable selectivity.

There is no difference in performance when used on either A.C. or D.C. mains, and we have no hesitation in saying that it is one of the finest receivers we have tried so far this season.

On the long waves, selectivity is such that most European stations can be tuned in without interference.

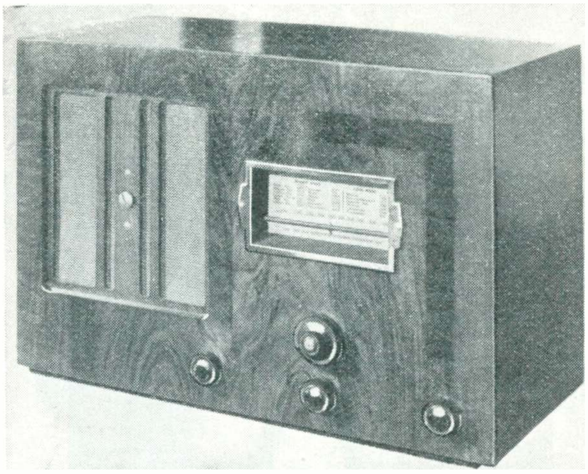


"At first we were not quite sure whether to call this receiver a table or console model . . . rather like a pedestal set that hasn't finished growing"

The automatic volume control is as near perfect as we have found on any English receiver, and stations that we knew were inclined to fade kept steady for long periods. As regards station-getting, we can assure you that under normal conditions fifty programmes can be received, while the actual log of stations, which depends on so many other points, should not be far short of a hundred at the least.

Wireless Magazine, January, 1935

Cossor 350 Battery Three



"Space is available in the tastefully designed cabinet for the high-tension and low-tension batteries, so if necessary the receiver can be entirely self-contained"

THE new Cossor Super-ferrodyne receiver is cheaper than most kit receivers. It has been designed to give maximum results with the very lowest cost.

If you do not expect mains quality and super-het selectivity you will be more than pleased with the excellent results that can be obtained from this little receiver.

At £5 12s. 6d., including loud-speaker, valves, and cabinet, the specification obviously cannot be very extensive, but even so, nothing of importance has been left out.

BRIEF SPECIFICATION

BRAND NAME: Cossor.

MODEL: 350.

TECHNICAL SPECIFICATION: A three-valver with high-frequency stage with variable-mu high-frequency screen-grid (Cossor 220VS), tuned-transformer coupled to a leaky-grid triode detector (Cossor 210HF). The low-frequency stage consists of transformer coupling to a small triode output valve (Cossor 220P). The undistorted output is comparatively low, but the quality is good for such a simple receiver. A loud-speaker of the reed type is incorporated.

PRICE: £5 12s. 6d.

POWER SUPPLY: Dry high-tension batteries and low-tension accumulator.

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

The high-spot of the receiver is the use, for the first time, of new iron-core coils made in one of the five Cossor factories at Highbury. These coils have enabled the selectivity of all Cossor receivers to be increased without decreasing the volume to any extent.

It is extraordinary that such a cheap receiver should use iron-core coils of the latest design, but that is not the only feature. It has been arranged that all the tuning can be done by means of one knob, with a small panel trimmer to overcome any unseen ganging troubles.

There is also a pre-detector volume control to prevent overloading of the screen-grid valve, while this high-frequency stage also employs tuned-transformer coupling.

The smaller components have been mounted below the chassis so the major portion of the wiring can be kept out of sight. Coils, tuning condenser, low-frequency transformer and several other small units have been completely screened, while the high-frequency valve is metallised.

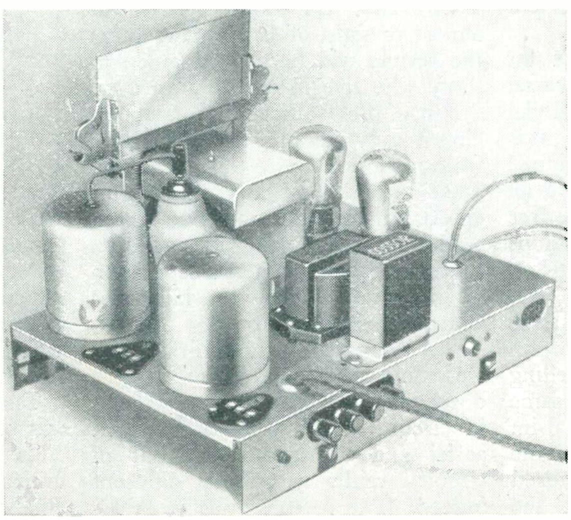
Space is available in the tastefully designed cabinet for the high-tension and low-tension batteries, so if necessary the receiver can be entirely self-contained. The loud-speaker is not of the moving-coil type; one can hardly expect that with a receiver of this price.

But don't get the impression that quality is not of a high order, for when using a small battery power valve, only taking about 6-milliamperes, better quality is often obtained from a moving-iron unit than from a moving-coil.

On the front of the cabinet are four controls. First comes the reaction knob on the extreme left. This need not be used very often. For example, the volume variation can be obtained by using the variable-mu bias control in the centre. The tuning knob beneath the dial is approximately 2½ in. in diameter. It has concentric with it a small trimmer in parallel with one half of the two-gang tuning condenser.

On the right is the wave-change switch marked L, S, G and Off.

Do not be disappointed because there are only eighteen station calibrations on the tuning scale. Cossors think it is a better idea to calibrate eighteen stations that can be heard in almost any part of the country than to mark seventy or eighty of which only a small percentage can be heard at any one time. The dial is also calibrated in wavelengths, so there is no need to worry about identifying stations not marked on the scale.

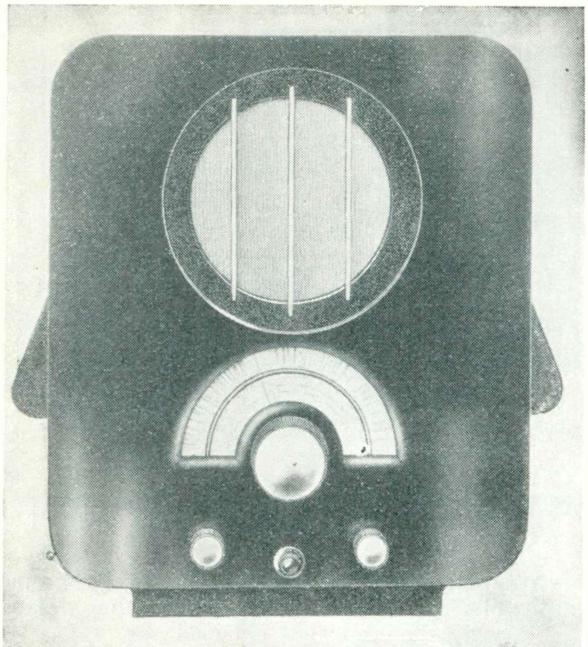


"The high spot of the receiver is the use, for the first time, of new iron-core coils made in one of the five Cossor factories"

We tried to tune in these eighteen stations on an aerial 65 ft. in length at a distance of about thirty miles north of Brookman's Park. North Regional was easy, but inclined to fade. London, Midland, and West Regionals all come in well, but Scottish Regional was spoilt by interference.

We were more than surprised to find that we could tune in about forty stations under our standard test conditions. A very satisfactory performance!

Ekco Super-het Model ADT 95



"The ADT 95 is one of Ekco's star sets. It is a nine-stage universal super-het. It has an internal aerial and is of the transportable type"

UNIVERSAL super-hets are gradually becoming more popular. Manufacturers and users alike have realised the advantages of a receiver that can be used on D.C. or A.C. mains at will. Incidentally, receivers of this kind, owing to their use of semi high-voltage heater valves, are usually entirely hum-free.

After many years in the radio industry, Ekco's should know all there is to know about mains working for in addition to their researches into the designs of mains units, they have applied their knowledge to the creation of a highly-efficient series of mains receivers.

The ADT 95 is one of Ekco's star sets. It is a nine-stage universal super-het. It has an internal aerial and is of the transportable type. It is a great achievement to have designed a receiver that does not require an aerial or earth, that is entirely free from hum and will bring in stations just as well as an ordinary super-het.

Ekco's well-known tuning scale is again used and station selection is by means of a light beam travelling along a tuning scale in the same manner as a pointer. The 3-in. knob fitted to the condenser spindle is an advantage not fully realised until one has actually handled the receiver.

In addition to the usual controls there is, in the centre of the cabinet, a static suppressor which is very useful to reduce the background noise level when reception conditions are bad.

At the rear of the chassis are sockets for an external aerial and these need only be used in the event of the user wishing to increase the volume of the stations heard. A three-point tone control gives high, low or medium toned reproduction as required.

When you first connect the receiver to the mains and switch on, do not worry about the time the receiver takes to warm up. It averages between 2 and 2½ minutes.

With or without an earth connection the hum level is very low. The receiver is excellent if you only want a low output. Some commercial receivers we have tested hum so badly when the volume is turned down that the hum level competes with the programme.

Our first test was carried out almost in sight of Brookmans Park; the results will be a good guide to those who live in any swamp area.

With the static suppressor in circuit only stations that were free from mush and noise were available. That means that only stations of entertainment value could be heard.

Under these conditions station tuning is razor sharp and separation of programmes only 9 kilocycles apart is a simple matter.

But this was hardly a fair test for we could not hear more than a dozen stations with the suppressor in circuit. With a standard 50 ft. aerial and the suppressor out of circuit, results were very different indeed. The receiver was so sensitive that tuning had to be very carefully carried out.

On either side of the Regional programme we could not hold stations less than two channels away, otherwise sideband splash was noticeable.

This is very good indeed when you remember that we were so close to the local station. Also remember that the sensitivity of the receiver is approximately 8-microvolts per metre at 350 metres. This speaks for itself. Anyway the French station Limoges only two channels away from the Regional could be tuned in without trouble, while Strasbourg was equally well received.

Lower down the scale selectivity was good enough for us to hear Hörby and Turin clear of the National. At the bottom end of the tuning scale Fécamp came in with several degrees to spare.

To give you further proof of the sensitivity of the ADT 95 we had with us an engineer who was interested in Swedish stations. Just to show him what we could do, Motala on the long waves was tuned in, followed by Stockholm, Hörby and nine other small relay stations on the medium waves. Some of these stations were only using a power of 250 watts.

The consumption on D.C. mains was 65 watts and 70 watts on A.C. This will give about thirteen or fourteen hours service for one unit. The undistorted output on D.C. mains was about 2 watts, rising to a good 3 watts on A.C. supplies.

BRIEF SPECIFICATION

BRAND NAME: Ekco.

MODEL: ADT 95.

TECHNICAL SPECIFICATION: Nine-stage super-het complete with self-contained frame aerial. A high-frequency stage (Mullard VP13A) isolates the combined oscillator-detector (Mullard FC4) from the aerial circuit. This valve is then band-pass coupled to a single intermediate-frequency stage (Mazda VP1321) and is followed by a double-diode second detector (Mazda DD620). An intermediate low-frequency stage (Mazda HL1320) feeds into a power pentode (Mazda Pen 35/20), while the rectifying valve is of the half-wave type (Mullard UR2).

POWER SUPPLY: A.C.—D.C. mains, 200-250 volts.

PRICE: £15 15s.

MAKERS: E. K. Cole, Ltd., Ekco Works, Southend-on-Sea, Essex.

Wireless Magazine, January, 1935

Lissen A.C. Three-valver

"Has a wide appeal for it will provide sufficient entertainment at really good quality. . . . We can thoroughly recommend this Lissen set"

EVEN though the super-het receiver is the most popular receiver owing to its inherent selectivity, there are still a great number of listeners who are of the opinion that super-hets and bad quality are synonymous. For those listeners the straight receiver still has a wide appeal, for it will provide sufficient entertainment at really good quality.

Incidentally, very few people really want to spend £12 to £14 for a large receiver when actually they only want the locals and perhaps two or three outstanding foreigners.

We have tried out a receiver using only one high-frequency stage—the Lissen 8093—and we consider it is one of the best sets of its kind available at the moment. It is soundly constructed, carefully designed and, as you probably know, Lissen do give good after-sales service.

Briefly, the receiver consists of a band-pass coupled circuit feeding into a variable-mu screen-grid valve, followed by a triode detector. The low-frequency stage is a parallel-fed transformer circuit, which combines the advantages of transformer and resistance-capacity coupling. The output pentode gives 2,500 milliwatts with particularly good quality.

The use of iron-core coils probably accounts for the selectivity, which here is very good for such a simple receiver. So that the sensitivity is always at maximum, the aerial coupling is switched to give optimum value on both wavebands. This is a much better idea than tapping the medium-wave coil and making this do for all wavelengths.

If you wish, a gramophone pick-up can be used, for there are two sockets at the back of the chassis for the purpose. Needle scratch can be cut off by using a two-point tone corrector which is also at the back of the chassis.

About the controls. By combining the bias regulator to the first valve with the reaction condenser the number has been kept down to three, so you will not have any difficulty in tuning.

On the extreme left at the front is this control we have just mentioned. The idea is that before you can apply reaction the screen voltage has to be at maximum, so the high-frequency stage must be working at full efficiency before you start boosting the detector stage. This keeps quality at a high level.

In the centre is the main tuner; just one knob and no trimmer or auxiliary control. The tuning dial is calibrated in wavelengths, black figures for medium waves and red for the long waves. Such stations as Fécamp can be tuned in with ease, for the minimum wavelength of the receiver is 197 metres, and the maximum 575 metres—an exceptionally wide coverage.

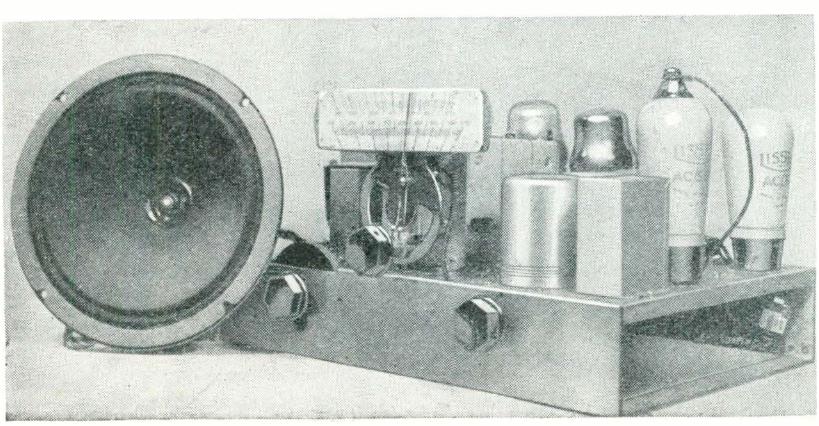
BRIEF SPECIFICATION

BRAND NAME: Lissen.
MODEL: 8093.
TECHNICAL SPECIFICATION: This simple three-valve receiver uses a variable-mu high-frequency stage with a screen-grid valve (Lissen AC/SGV) followed by a leaky-grid triode detector (Lissen AC/HL). The output of this is then coupled through a parallel-fed low-frequency transformer to a pentode valve (Lissen AC/PT). A full-wave valve rectifier is used in the mains section (Lissen UU41).
PRICE: £9 15s.
POWER SUPPLY: A.C. mains, 200 to 250 volts, 40 to 100 cycles.
MAKERS: Lissen, Ltd., Isleworth, Middlesex.

Naturally selectivity is not so good as one could obtain with a super-het, but with a little care no more than four stations on either side of the local Regional need be missed when the set is used at a distance of ten to twelve miles from a B.B.C. regional centre.

If you could see the chassis you would agree with us that it looks capable of standing up to long service. Appearance is clean and tidy, while all the larger components have been bolted to a steel chassis. The connections are all sound, and the whole receiver gives the impression of having been soundly engineered.

We can thoroughly recommend this Lissen set to all.



"The chassis . . . looks capable of standing up to long service. Appearance is clean and tidy . . . impression of being soundly engineered"

G.E.C. Super-het D.C. Five

THERE are very few D.C. receivers available at the present time for most manufacturers seem to have gone right over to the use of A.C./D.C. valves. The General Electric Company has for several years always produced a very efficient D.C. set that has been popular amongst a certain class of listener.

Now we have the Super-het D.C. Five created to provide an efficient receiver that looks well and is reasonably priced. To call the receiver a five-valver is rather misleading, for the fifth valve is actually a barretter lamp.

BRIEF SPECIFICATION

BRAND NAME: G.E.C.

MODEL: BC3545.

TECHNICAL SPECIFICATION: A four-valve super-het for D.C. mains with a screen-grid valve as a combined detector-oscillator (Osram DSB). The output of this is fed through a band-pass intermediate-frequency coil into the single intermediate-frequency valve (Osram VDS). Another screen-grid valve is used as a second-detector (Osram DSB), which is coupled into an output pentode giving 2,500 milliwatts (Osram DPT). A barretter lamp, type 251, is also included.

POWER SUPPLY: D.C. mains, 200-260 volts.

PRICE: £13 13s.

MAKERS: General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2.

The first valve is a combined detector-oscillator, band-pass coupled into an intermediate-frequency amplifier using a variable-mu screen-grid valve. A straight screen-grid valve is also used as a second detector, while in the output stage is a 2,500-milliwatt pentode.

The receiver is very selective, averaging about 9 kilocycles, while quality from the built-in moving-coil loud-speaker is of the highest order. Let us tell you something about the cabinet. This is commonly called a side-by-side pattern; the front panel is of veneered walnut.

There are four controls, consisting of a combined volume control and on-off switch, master tuner, separate wave-change switch, and a variable tone corrector. These operate in the usual manner, but the tuning scale is calibrated in wave-lengths and illuminated. The scale shows green for medium waves and red for long waves.

A point that we wish to stress is that, unlike so many D.C. mains receivers, this one is entirely free from ripple, so that when no station is heard the set is entirely silent.

Connections have been provided for an external loud-speaker, which should have an impedance of 7,000 to 10,000 ohms if it is to match up with the internal unit. A point that will interest many readers is the silencing key. This is a little switch incorporated so that one can cut out the internal unit in favour of the external unit if desired.

A jack is fitted for the gramophone pick-up, which can be of the normal balanced-armature or needle-armature type, providing the latter type has an output of at least .3 volt R.M.S.

The radio volume control also acts on the pick-up, so that there is no need for an additional regulator.

We checked up the set's consumption from the mains, for with certain types of D.C. mains receivers this is inclined to be heavy. With this receiver the average consumption is approximately 60 watts on a 200-volt supply, or equal to the current consumed by one moderate-sized lamp.

Another feature that will interest our readers is that there is no need to worry about voltage adjustment.

It is immaterial as to the actual length of the aerial used with this receiver, for it does not affect the selectivity to any appreciable extent, although below 30 ft. the volume control has to be turned up a little higher.

Do not gather from this that a short aerial is not of any use. On the contrary most users will find that they can obtain ample entertainment when using only a short indoor aerial.

During our first preliminary test at Welwyn Garden City we brought in some sixty to seventy stations of which about thirty-five or so were of good entertainment value. That's very good going considering the closeness of the local station!

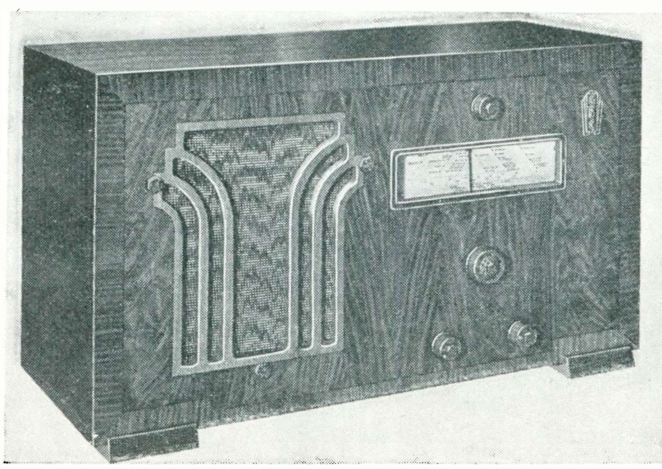
No doubt listeners more fortunately situated will be able to obtain a correspondingly better performance. On the other hand, any receiver that will bring in thirty-five *programmes* in one evening is worth having.

On the long waves we were surprised to hear Kaunas on a wavelength of 1,935 metres. This was quite free from interference, although Huizen is only a few degrees below. Moscow No. 1 was a strong signal, as was Droitwich, Eiffel Tower, Warsaw, Luxembourg, Kalundborg, and Oslo.

On medium waves so many stations came in that were not calibrated on the dial that it was difficult to make an actual log of every station heard, but most of those calibrated were identified.

After a while the receiver turned into a single control set, for there was no need to bother about the tone or volume controls as these could be set to give the required volume and pitch. Therefore an ideal home set!

The daylight range is not as good as the night range, but this is quite usual. A reasonable number of programmes is, however, always on tap.



"This is commonly called a side-by-side pattern; the front panel is of veneered walnut . . . an ideal home set"

Who Should Pay for Anti-static Devices?

ONE of the biggest electrical supply companies in the country has just taken the step of bluntly refusing to accept any legal liability for causing interference with broadcast reception.

Unfortunately it is by no means the first to adopt this attitude. Other supply companies up and down the country have said much the same thing before; but coming from the quarter it does, this decision of the London and Home Counties Joint Electricity Authority will probably give the long-suffering listener a bit of a jolt.

Jostled Off the Air

Many set-owners are already so badly victimised by man-made static that they are only hanging on in the hope that something will be done in the near future to improve conditions—by force of law if necessary. If the impression gets abroad that there is going to be no relief, these listeners may give up their licences in disgust, feeling that they have been unfairly jostled off the ether.

Of course, things will not be allowed to slide to that extent. Most electric supply companies—as well as the manufacturers of motor-driven appliances—realise only too well that the bulk of their customers own wireless sets and want to use them in peace and quietness.

Business Instinct

Their own business instinct therefore urges them to fit anti-static devices wherever possible and to take all reasonable steps to conciliate their public.

There are, however, cases where those responsible for large-scale electric installations are quite willing to go a long way to meet the requirements of the broadcast listener, but find that the expense of making conditions perfect in this respect is too great to justify their shouldering the whole of the burden.

Their attitude, like that of the electrical supply company mentioned before, is that they are carrying on their business in a perfectly legitimate way, and though anxious to conciliate everybody within reason, they are not prepared to expend large sums of money when there is no legal liability upon them to do so.

By a Barrister-at-Law

Finally, there are certain people who are not inspired by any spirit of compromise. They take no interest in wireless reception themselves and are too selfish to consider the rights of those who do.

This is the crucial point. What definite legal right has the broadcast listener to insist upon a static-free ether? As the law stands at present, the answer is none.

The law can, of course, be altered to give him such a right, but any regulations made to that effect must not press too hardly upon other well-meaning people, who naturally are entitled to resent undue interference with their own lawful affairs.

Looked at from this point of view the problem seems rather hopeless. It certainly is difficult, but where there is a will to remedy a grievance there is always a way.

As already pointed out, the incentive for manufacturers and supply companies to meet the listener is already producing good results, and is likely to grow more and more effective as time goes on.

Where goodwill breaks down, the rights as between the broadcast listener and those who interfere with his use of the ether will have to be settled by legislation some time or other, and the sooner the better.

Here the P.M.G., who claims a monopoly over the use of the ether, and the B.B.C., who transmits the broadcast programmes under Government licence, seem to share the primary responsibility for taking such steps as may be necessary to see that the listener, whose money they take, is protected from avoidable interference.

Position Abroad

The legal position has been more fully developed in other European countries than it has here. The general attitude taken abroad is that where two people are both engaged in an occupation, which is in itself perfectly lawful, then the one who is first in time stands also first in law. This, it may be added, is also a recognised rule of English law.

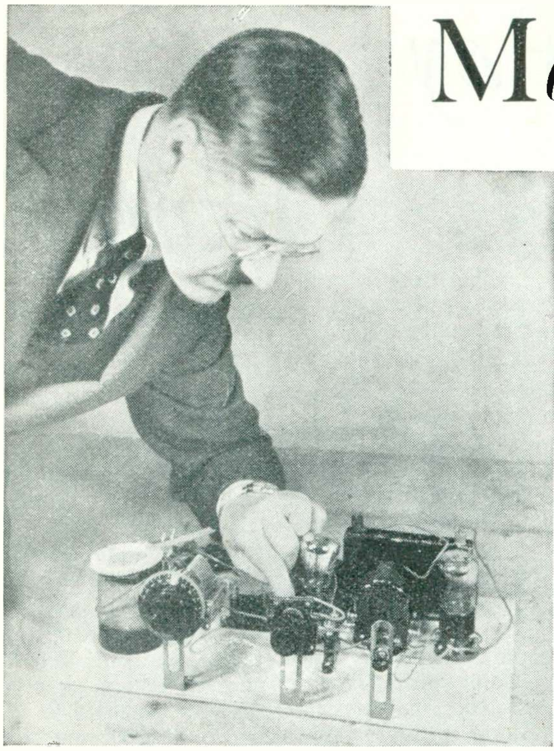
For instance, suppose one of the parties is a beauty specialist who earns a living by manipulating ultra-violet ray and similar spark-producing appliances, the other being an ordinary citizen with a predilection for listening to the broadcast programmes.

Then if the beauty specialist had started in business before the broadcast listener came to reside in that particular quarter, or before he had installed a wireless set, the former is entitled in law to carry on for a reasonable number of hours each day without incurring any responsibility as regards "static."

Gentle Persuasion

But in Germany there is a special organisation of broadcast enthusiasts, financed by their B.B.C., who are prepared to fit anti-static devices to any offending appliance when the owner will allow them to do so. If he is inclined to stand obstinately on his rights, they use other arguments which are usually sufficient to persuade him to change his mind.

When, however, the boot is on the other leg, and any listener already installed finds his reception subsequently being interfered with, then the law comes down quite definitely on his side. He can treat the offender as a "trespasser" and compel him to silence his outfit, under penalty of having the whole thing confiscated, in addition to paying a heavy fine.



The author, who is well known for his simple "beginner" articles, with one of his experimental hook-ups

More Experiments With Our Test Set

Last month PERCY W. HARRIS, M.Inst. Rad. E., described the construction of a portable test bench with which you can quickly try out any new radio ideas that come along. In this article Mr. Harris gives some advice on the way to begin experimenting, and he starts by describing a few experiments you can try with the aerial end of your set

HAVING built the experimental testing set described in last month's "W.M." you will perhaps be asking for a line of experimental work upon which to start. This month I am going to give you a few suggestions.

You will not need a lot, because once you have started others will occur to you and soon you will be loth to leave this board ; such is its fascination. The interest of merely assembling components according to a diagram, without really knowing what they all do or what they are for, soon fades, but if you have a little experience in practical experimental work, not only will you appreciate better the virtues of the various components at your disposal, but you will be able to use them more intelligently.

Aerial Experiments

I would like, then, to suggest you start a few aerial experiments, and before anything else, I would advise you to obtain two note-books of the school exercise-book type. One should be made up of the usual squared paper (ten squares to the inch) and the other should be a plain ruled exercise book.

Far too much experimenting in the past has been carried out in a haphazard way without any notes being made or results recorded. If you get into the habit of noting carefully the result of each experiment—even if these results are not at the moment interesting—you will find later on that you will save yourself a great deal of work.

Some new aspect of the experimenting will suggest to you that this or that method is better or worse than normal, and unless you have notes regarding the normal method you will have to start experimenting all over again along that line, in order to check your results.

Assuming you have made up the high and low-frequency units described last month—or something like them—you will have a complete receiver connected up to your aerial and working satisfactorily.

Tune in on some station of medium power (not the local, for this will probably be overpoweringly strong for experimental work) and then, with the variable-mu valve adjustment, turn down the volume until it is just comfortably audible and of such a value that you will notice big changes. The station should, if possible, be one which is not liable to fade.

Make sure you know what the station is and then, without touching the volume control, short circuit the aerial-series condenser and note the result so far as the strength of this station is concerned.

One of several things may happen according to the position on the tuning scale, the particular coil, the aerial coupling method you are using, the size of your aerial and other factors. Probably signal strength will increase—it may do so considerably—and you are liable to run away with the impression that not only is this condenser useless, but actually detrimental to the satisfactory working of your set.

Note Your Opinion

Do not, however, jump to any conclusions yet. Make a note in your book of your opinion of the increase or decrease or change in the signal strength and then, removing the short circuit, run over your tuning scale first of all with the condenser in circuit and secondly without it, noting what happens at every part of the scale.

You may find, particularly with some aerials, that one part of the tuning scale seems very dead and another more lively than usual, while it may happen that one particular station tunes in very loudly and cannot be got rid of over a wide portion of the scale.

Notice, too, what is the effect of

the condenser on sharpness of tuning; in the great majority of cases with the condenser in circuit you will find that signals are sharper even if signal strength is reduced. One reason for placing this condenser in the aerial with most sets is to prevent the aerial coupling being too tight. Can you think of others?

The size of this condenser is important and a series of experiments with differing values, each experiment being repeated over the whole scale, will enable you to find the best average value of condenser for your aerial *with that particular coil.*

Aerial-condenser Peculiarities

Be careful, however, not to be misled in your experiments by pecularities in the aerial condenser. While the compression type is excellent in practice for such condensers, there is no marking on them to show what is the particular value for a certain setting of the knob and, for that matter, even if you were to fit a dial to the knob or some kind of indicator it does not follow that the capacity is the same each time the knob is returned to the same place.

For such experiments, you really want a condenser of the ordinary tuning type with moving vanes and an air dielectric and if you have a friend who can give you a calibration chart of the condenser showing the actual capacity for various markings, so much the better.

Calibration Not Essential

It is not essential that it should be calibrated, however, for in a moment I will show you a method by means of which you can match this condenser setting with another. Use this air-dielectric condenser mounted on a stand or in a box with a dial attached to it and find the best setting for your aerial.

Now you will not wish to use this condenser permanently in this, or any other set for that matter. So having found the best value for your aerial with a particular coil (in the experimental or any other set) it is a good plan to match a compression-type condenser to it.

This can be done in several ways, and the following is a simple one. Use your standard receiver (the high-frequency amplifier connected to the low-frequency unit) and tune in some stations fairly well up the medium-wave scale. Having identified it, connect your standard air-dielectric variable condenser (which you have been using in the aerial) across the tuning condenser in the set (in parallel with it) and then reduce the tuning knob on your *set* condenser until the station is heard again.

This means, of course, that you have subtracted from your main tuning condenser just the amount of capacity that you have *added* by means of your additional condenser. Without altering the setting of the main condenser, remove your additional condenser and substitute a compression type and adjust this until the station comes in again.

The capacity of the condenser you have just added will now be the same as that which you have just withdrawn, and by means of the locking nut, you can lock this compression condenser at the value which you have already found to be the most satisfactory for use with your aerial. This method, of course, is a rough and ready one and you will not get a very exact value, but the difference between the exact value and the one you will get in this way would not make any difference, so far as the adjustment of your aerial to your conditions is concerned.

Band-passing has come in for a lot of discussion within the last two or three years and is largely used in commercial receivers, but one has rarely read much about practical experimental work in this connection and you may be interested to find out just what difference in tuning such a method can make.

It is not possible for me to describe all the various methods of band-passing and how they can be experimentally obtained, but there are one or two which will give you a good idea of the principles concerned and set you along the line of experiment which you will find particularly interesting.

Screened Coil Necessary

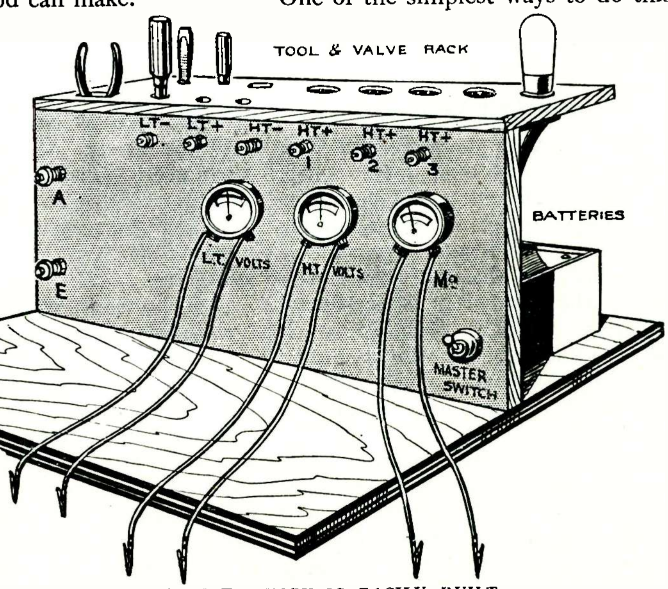
I am assuming that the coil you are using in your standard high-frequency unit is of the screened type. This is really necessary for the experiment I am about to describe. Get another identical coil, remove the aerial connection from your first coil and place it on the new one, connecting this to earth in the normal way so that both are earthed.

Simplest Band-pass Circuit

The coils should be well spaced—6-in. apart is not too much—and you will then get a circuit which is in its simplest form that shown in Fig. 1. You will notice there is no connection between the two coils.

Across the new coil you must also place a variable condenser of the same value as that used with the high-frequency unit coil, and if this new coil is tuned to some station high-frequency currents will be built up in this in the normal way.

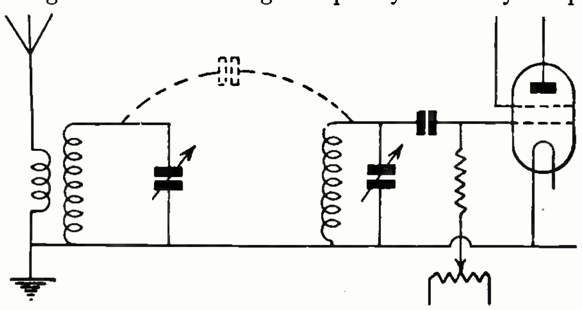
The station to which you are tuned will naturally build up the highest value and you now want to couple this circuit to the original tuning circuit in the high-frequency unit. One of the simplest ways to do this



THIS HANDY TEST BENCH IS EASILY BUILT
Percy W. Harris described the construction of this useful portable test bench last month. The terminals at the top are connected to batteries behind the board; the use of the remaining gadgets can be easily seen from the drawing

is by means of capacity, and you will be surprised how very little capacity is necessary for the coupling.

To prove this, take two pieces of insulated wire (Sistoflex will do, or ordinary plain tinned wire over which you have slipped oiled tubing). Connect one end of one wire to the upper part of the new coil and one end of the other wire to the top part or grid end of the high-frequency unit coil. You will ignore the aerial winding of the high-frequency unit coil.



SIMPLEST FORM OF BAND-PASS CIRCUIT

Fig. 1.—The author suggests that you try out this simple form of band-pass circuit. The coils, when mounted, should be at least 6 in. apart

Simple Experiment

Without allowing the two wires to come into contact with one another, twist them together for about an inch, so that only the insulation separates them; move both tuning condensers carefully and approximately in step and you will soon pick up a station (probably the local) of considerable strength.

Experiment with this tuning until you " get the hang of it " and you will find that you are not losing a great deal of signal strength and you will gain considerably in sharpness of tuning.

Sufficient Coupling

The capacity between the two twisted pieces of wire is very small, but quite sufficient at this end of the circuit to give all the coupling required. Further experiments will show you that you can actually reduce the number of turns twisted together without making much difference and the set will even work when the two wires are separated by a fraction of an inch from one another!

In all experiments of this kind, you will find the use of the variable-mu valve and its volume control a great convenience. You will have observed by this time that it is very difficult for the human ear to differentiate between strong signals, whereas differences in volume between signals of only medium strength are much more easily noticed.

If you are trying two different arrangements on a particular station and wish to know which is the stronger you will find it convenient to turn signals down until they are only just comfortably audible. In my experience changes of strength at this volume are most easily noticed.

Don't forget to draw a diagram of every arrangement you try and to note, in your notebook, just what happens in each case.

Forgive me for emphasising this again, but my own experience shows the more interesting the experiments, the less likely you are to stop to record them, trusting to your memory retaining results, or else (much more likely) making up your mind to " write them up " as soon as you have finished all the experiments.

Resist this temptation! Each new and interesting experiment wipes out a good deal of the recollection of the details of the last one and to be an experienced experimenter, you must acquire the habit of recording everything early.

So far we have dealt with connecting the condenser for coupling purposes to the " hot " end of the circuit where potentials are highest. The disadvantage of this arrangement is that the efficiency of transferring energy from one circuit to the other is a function of frequency and if a coupling is set to give the best general value at the lower end of the tuning scale (the higher frequencies) it will not be sufficiently tight at the upper end of the scale (lower frequencies).

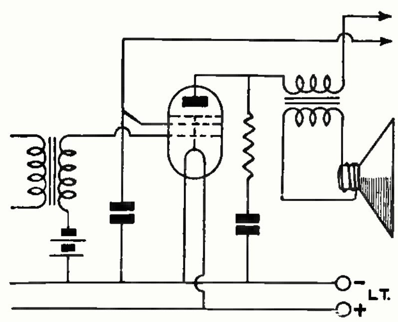
It is, however, possible to arrange combinations of couplings in such a way that while one part of the coupling acts most efficiently at the lower end, the other acts most efficiently at the upper end and thus a uniform transfer of energy can be obtained. Experiments of this kind are not done very conveniently or simply with commercial coils made up in cans, they require home-wound coils properly screened for really reliable experimental results.

However, by using the unwanted aerial coil in your high-frequency unit and with other tricks you can do certain experimental work in this regard. Turn up the articles* which have already appeared on band-passing in this magazine and see to what extent you can apply these theories. You will learn a good deal about them by trying them and, in any case, the subject will have acquired a fresh interest for you by now.

Loosely-coupled Circuits

Notice particularly that I have not dealt in this article with the *adjustment* of a band-passed receiver. Strictly speaking I have been describing loosely-coupled circuits, whereas a band-pass circuit is one in which two tuned circuits are so arranged with just the right degree of coupling that a kind of double-humped effect is obtained with a flattish top and sharp sides. This is made very clear in the article to which I have referred you.

There is another line of experiment I would like you to try in connection with aerials. Many people are under the impression that almost any outdoor aerial is preferable to an indoor one. They will be surprised, many of them, when they try a few of the experiments about to be described.



STANDARD LOW-FREQUENCY CIRCUIT

Fig. 2.—This shows a standard low-frequency amplifier, using a pentode output valve, recommended by the author

If you have a long, straight, unshielded garden with a good mast at the bottom and a straight run of aerial you are probably getting very good results, but if the room in which you are using the set is so situated that the aerial lead has to run parallel with a building, perhaps with a drain pipe or possibly over a lead roof before it reaches the actual

* "More About the High-frequency Stage"—page 261, April 1934 issue "W.M."

aerial wire, you may be losing as much as you gain.

In any case, get a good length of any flexible wire (a coil of No. 18 or 20 or even 22 double-cotton-covered wire will suit) and crawl up into your loft and tie one end round the rafters. Come down again bringing the wire with you, carry it downstairs into the room where you are using the wireless set and connect its end to the aerial terminal of your set in place of your usual aerial wire. Now tune in and see what happens.

Indoor Aerial Results

You may be surprised to find that just as good signals are obtained with this aerial, even on distant stations, as with your outdoor one !

So far, I have said nothing about earth connections, but there is one interesting experiment which I would like you to try, particularly if you have a garden conveniently near your set and a window opening into it also near the set.

Use your ordinary earth connection and then take a second earth tube, connect a flexible wire to it and the other end of this wire to the aerial terminal of your set. Now go out into the garden and push this second earth tube into the ground some way away from your normal earth and tune in. It seems rather a mad idea, but try it.

Earth as Aerial

After a few trials for different positions with the earth tube you may find you are getting excellent results by having a second earth in place of your aerial !

I have assumed, of course, from the beginning that before starting experiments of this kind you have made sure that your aerial insulators, wire, lead-in, and earth connections are all in good condition. Plain aerial wire deteriorates fairly rapidly, particularly in town, especially when the wire passes fairly near to a smoky chimney.

High-frequency currents such as we use in our wireless experiments do not penetrate very far into the wire and by confining themselves to the surface can only use that portion of the metal which is outside. This means, in effect, that if your wire becomes oxidised with a high resistance surface no matter how good the core may be, you are introducing unwanted resistance in the only part of the aerial that counts.

Personally I have used insulated aerial wire for a number of years as in my particular district bare wire deteriorates rapidly.

I find that I have come nearly to the end of my space this month, but if you follow out even some of the experiments, you will learn a great deal and justify the trouble you have taken in building the experimental set. Even if you have not built up this arrangement you will have been able to perform many of the experiments with an ordinary receiver, although you may have to upset the family listening !

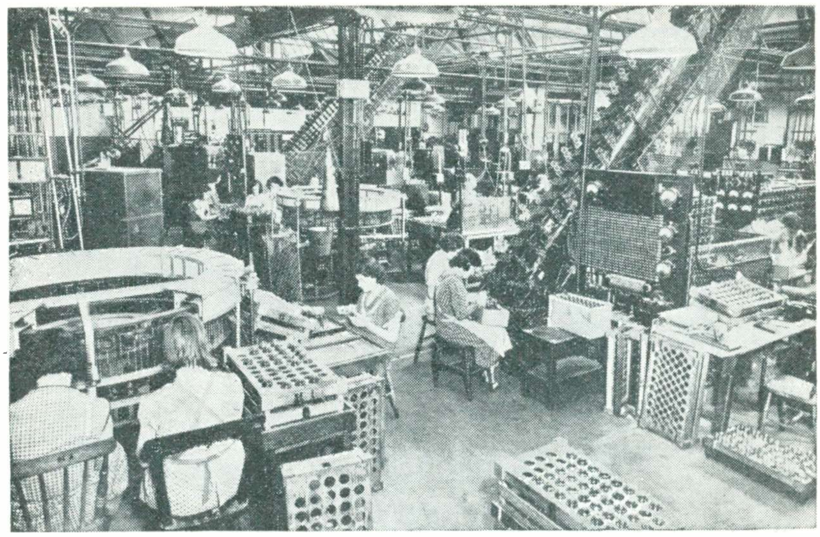
Here is a theoretical matter which may interest you. When you do the experiments I have described with the high-frequency unit you are working straight into a high-frequency valve which gives comparatively little damping to the circuit and is free from reaction effects.

Hardly Feasible

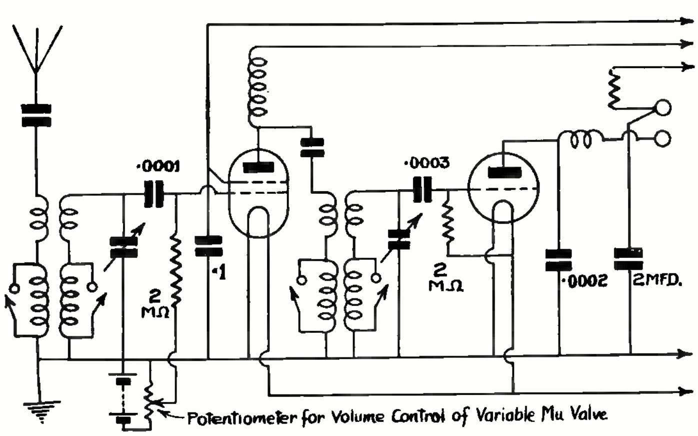
You must *not* expect to get really reliable results if you try to work out what I have told you with an ordinary straight detector and reaction set. This is particularly the case with band-pass experiments; it is so very easy to get misleading results particularly when changing from one coil to another if you are working with a straight detector and reaction.

Some of the reasons will occur to you, but here is one you may not have guessed. If you have a circuit with a certain particular damping and you combine it band-pass fashion with another circuit of the same damping and then compare results, you will get certain data.

If now without your knowing it and while you are changing from the single to the combination circuit the damping of one of these sets suddenly changes your results may be completely misleading. This is very liable to occur when one of the circuits contains reaction.



WHERE COSSOR BATTERY VALVES ARE MADE
A corner of the huge Cossor valve factory at Highbury, London. The two escalators take the valves to the " Ageing Room," where they undergo stringent tests before delivery



STANDARD HIGH-FREQUENCY AND DETECTOR CIRCUIT
Fig. 3.—The author suggests that you build this straightforward high-frequency amplifier and detector arrangement for your experimental work. On to the end of it you can add experimental low-frequency hook-ups

B.B.C. photo

A section of the Registry Department at the B.B.C., where all incoming letters are opened and stamped before being sent to the people to whom they are addressed

Files and Records of the B.B.C.

One of the many hives of activity at Broadcasting House is the keeping of huge filing systems for letters, records—gramophone and otherwise—music scores and scripts of plays. In this special article WHITAKER-WILSON records his impressions of a visit to the B.B.C. stockrooms with their 7,000 play scripts, 37,000 gramophone records and 16,000 orchestral and 150,000 vocal scores

IN a huge organisation like the B.B.C., one would naturally expect to find a business-like method of filing, because all commercial firms have it.

If I had been asked a few weeks ago any question regarding the files, or what I should have expected them to be like, I admit I should have been inclined to dismiss the idea with a mere observation to the effect that I imagined they would have something of the kind.

When the Editor asked me to visit Broadcasting House with the object of obtaining information for an article on the subject, candidly I thought he had sent me on rather a dull quest.

Having spent the whole of an afternoon inspecting the entire system of filing and preserving records of everything at Broadcasting House relative to broadcasting itself, I came away with something to think about.

To begin with, there is a department existing in the building which puts lonely wayfarers like myself on the right path. You must understand it is unwise for anyone to ring up the B.B.C. and begin asking questions. To ring up the B.B.C. is simple enough, but it only means conversation with one of the girls at the telephone exchange. You must know the name of the man you want, or at least you must be clear as to what department you want.

I asked for the Press Department —always my refuge in times of stress and trouble. The consequence was that, in due course, I met the various heads of departments concerned.

The first of these was Miss Mills, who is in control of the Registry. She rather disturbed my peace of mind by telling me that all letters went to her department before going to the people to whom they were addressed. I had imagined only letters addressed vaguely to the B.B.C. received that sort of treatment.

I very nearly blushed when I recalled some of the things I had said in various letters of the past to intimate friends on the staff. I jokingly told Miss Mills I should put *Private and Personal* on all my letters in future, which she seemed to think was not playing quite fair.

I mentioned I had left six letters at the reception desk in the hall that very afternoon, not an hour previously. "I know," she said. "I have seen them and they have been delivered." I gathered that this was the quickest way to get urgent letters to their destination.

The daily post at Broadcasting House is not a case of a postman's double knock and three or four letters and half a dozen postcards being handed in. The letters come in sacks. Generally there are well over a thousand of them. There may be two hundred addressed to artists with a request to be forwarded.

A moment's thought reveals that several members of the registry staff must be employed for some time tracing the addresses and redirecting the envelopes. The less of that sort of trouble you give them the better are they pleased.

The letters addressed to the B.B.C. are opened by an electric letter-opener. A boy shoots them into the machine, a handful at a time. They are then taken out, stamped, sorted, and delivered to the people concerned. There is a tray for each office.

A huge number of files divided into subjects exists in this department. Also there are many personal files (I tremble to think what mine must contain by this time!). There is an index of people who write and the subjects they write about.

If you, for instance, write to the B.B.C. and say you think a talk on Siamese cats would be appreciated, the fact is recorded, and your suggestion may be considered by the Talks Department. (Probably Val Gielgud would eventually give the talk. I believe he has three in his house.)

That is a rough example, but it at least shows the B.B.C. does not light the stoves with your letters.

Letters of appreciation and criticism are kept and are filed under those headings. So great has the correspondence become that Miss Mills has doubled the personnel of her staff in seven years.

I was taken next to the Play Library. In 1927 there were not more than a dozen plays in it. Now there are over 7,000.

The Department possesses files giving reports on all plays submitted for consideration. Copies are kept of those accepted. Before production, these are sent to the duplicating section and copies are struck off for the use of the producer and artists taking part.

Plays come in for consideration at the rate of about forty or fifty a week all the year round. In winter this number increases. One in every two hundred may be accepted—rarely more. Some of the reports make amusing reading. One effort was deftly summed up in the words, *pathetic drivel.*

Not a few come in written on both sides of the paper and in illiterate writing.

The actual file containing the plays is, of course, of considerable size. A play lasting an hour may represent a typescript of forty pages. The paper used is of a fair weight, and, in consequence, each copy may be anything from ⅜ to ½ in. thick. Fifty copies may be retained on hand, in which case the space required for it is by no means negligible.

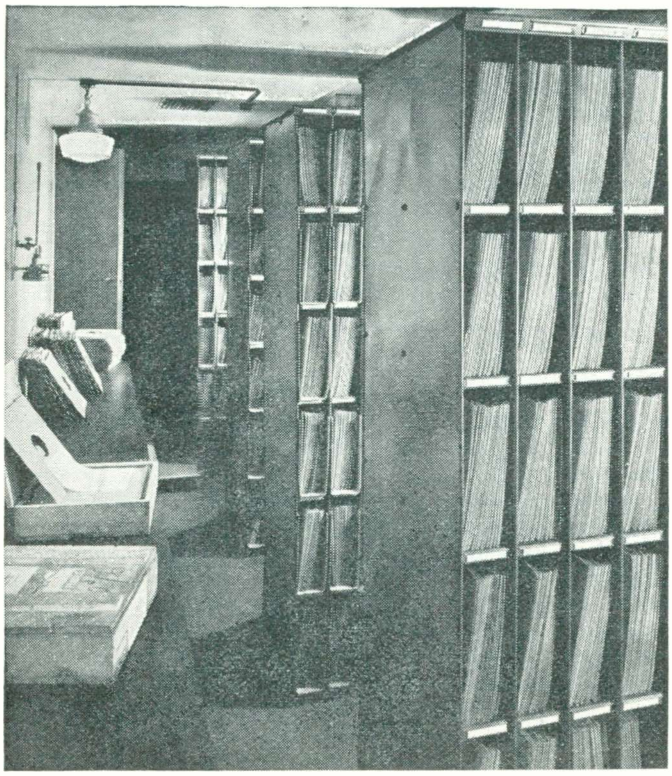
Every play is indexed and can be traced in a moment. There is nothing slipshod or untidy in the Play Library. Miss Shiel, the librarian, is to be congratulated on her work.

The Gramophone Library, which has been formed largely through the helpful co-operation of the gramophone industry, is under the care of Mr. Bowker Andrews, and is one of the seven wonders of Broadcasting House. The filing system there is as near foolproof as it is possible to get it in this world, I imagine.

There are some 37,000 records in the library. This statement is sufficient to suggest there must be a perfect system or there would be a perfect chaos; 37,000 records take housing!

I was asked to think of a number—in other words, of a record. I asked to see a copy of Bach's *How Jovial is My Laughter*, sung by Keith Falkner. I gave no other particulars, even though I knew it was an H.M.V. record.

It was quickly looked up in the card index and its number was found to be 26.P.10. I was taken into the library and Row 26 was pointed out to me. Then section P. It was the tenth record in that particular bin. And it took about as long to find it as it has for me to write these words.



B.B.C. photo

A GRAMOPHONE ENTHUSIAST'S PARADISE!

One of the most comprehensive record collections is that owned by the B.B.C. Here some 37,000 records, which supply the needs of record recitals for all B.B.C. stations, are stored

It might not be so astonishing if only the records were just kept there presumably until some of them were wanted—less so if they were only wanted occasionally. When one is told that every provincial station in the country is wanting them all the time and that about 5,000 discs are on the move to and fro each week a little thought reveals the fact that this library is a lively concern.

Each record is in a paper cover. Inside the cover is a card on which is written every necessary particular regarding the record. At a glance it is possible to see who has had it and when it was returned.

Several of these cards were sticking out. They belonged to records actually out on loan at the moment. If any particular card seems to have been visible for a considerable time someone in the library is sure to haul it out and see who has it. Unless it comes back quite soon there will be some inquiry about it. Provincial stations cannot keep records indefinitely.

So many recitals of gramophone records are given at the various stations that there are always requests for programmes to be made up.

The records sent are always in good condition. Two copies are kept, one for rehearsal and one for transmission. The colour of the paper covers indicate which is which. Red for rehearsal, yellow for transmission. Each record is inspected and cleaned before going back into its place.

The packing cases used for transport are firm and strong. They go by rail. I saw one being packed. The library has grown enormously during the past eighteen months. Practically every record issued—certainly every important record—is there, and as time goes on so will the library increase.

Continued on next page

Noiseless Pick-up Switching

IT is often convenient to be able to switch over quickly from one pick-up to another without switching off, or giving unhappy jerks to an amplifier.

Such an arrangement is essential when one uses double turntables, so as to be able to play records in succession without pauses for needle-changing, etc.

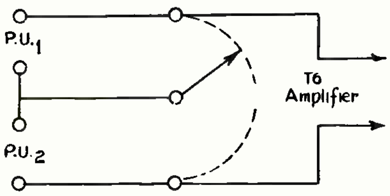


Fig. 1.—A method of switching two gramophone pick-ups with the aid of a shorting, and not a change-over, switch

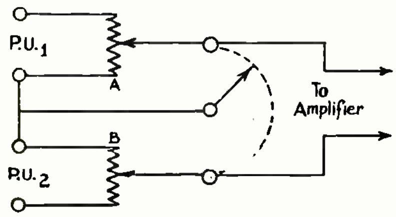


Fig. 2.—A system of pick-up switching by means of which the volume from each pick-up can be individually controlled

It is also useful when making direct comparisons between two pick-ups even if only one turntable is available. With a little skill the pick-ups can be arranged to play one behind the other in the same groove and the time taken in switching may be judged so that the second pick-up repeats the phrase just played by the first.

It is surprising what differences become obvious in those circumstances that are obscured when one has to try and hold the sounds in one's memory even for a few seconds.

The best arrangement is not the change-over switch, which one thinks of first of all, but the shorting switch as shown in Fig. 1.

By this method the pick-ups are connected in series between grid and cathode (or grid bias) and one or other of them is short-circuited by the switch. In these circumstances there is always a grid load even during the act of switching.

If a single-pole change-over switch having a central "off" position is used, both pick-ups can be played at the same time. If twin turntables are used, quite amusing effects can be obtained by superimposing one record on another in this way.

For the best effects in these circumstances, however, it is necessary to be able to control the volume from each pick-up. A suitable arrangement is shown in Fig. 2.

Theoretically the switch is unnecessary in this arrangement since when the volume control of the first pick-up is at A that pick-up is inoperative and similarly for the second pick-up when the slide of the volume control is at B.

In practice, however, one usually finds that there is some residual resistance at the points A and B, and if the switch is omitted neither pick-up can be completely cut out.

If the volume controls are tapered, as they should be, the slowest taper should be at the points A and B.

The circuit in Fig. 2 can be extended so as to provide a mixer for a number of pick-ups. Fig. 3 shows the circuit for four pick-ups.

Unless the volume control potentiometers are of low-resistance value, however, and unless special care is taken in regard to screening, a peculiar hum will arise. As usual, the more one complicates a circuit the more care has to be taken to avoid parasitic noise. But it can be done!

P. Wilson, M.A

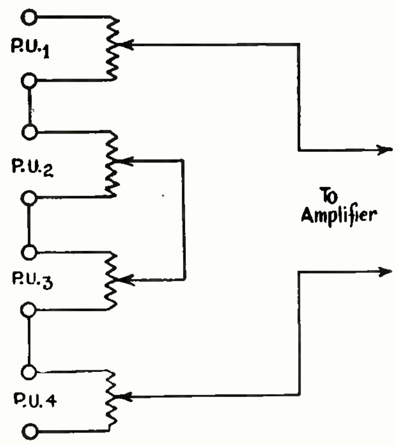


Fig. 3.—A mixing volume-control circuit for four pick-ups

Files and Records of the B.B.C.—Cont. from page 543

The same might be said of the Music Library under the care of Mr. Hook. It is a well-known story of how it developed from half a dozen scores to its present proportions, but I was amazed to learn Mr. Hook has begun to re-catalogue it. When he has completed the task, which will occupy him and his assistants for some time to come, it will be possible to trace any work either by its title or composer.

When found, it will be possible to see at a glance how long the work takes, what sort of orchestra is required for adequate performance, where score and parts can be hired or purchased, the cost, and the name of the publisher.

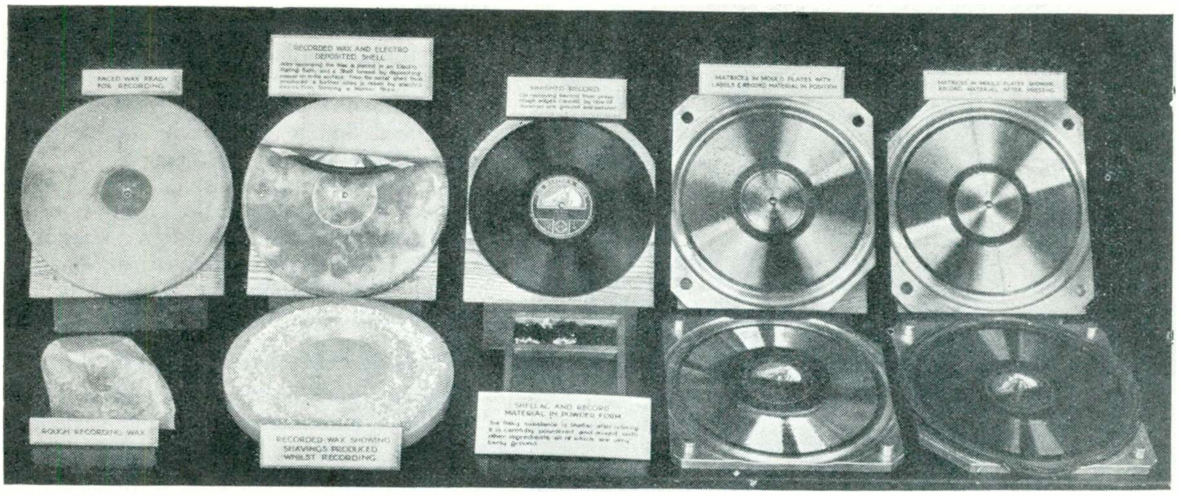
These last particulars might seem unnecessary, especially those referring to the hiring of score and parts, but it is hoped to publish his catalogue of music so that anybody (or any body of musicians) may purchase it. When you realise there are 16,000 orchestral works alone in the B.B.C. Music Library you begin to realise there is some music in the world after all!

Passing one of the shelves, I noticed a number which spoke for itself—10,319. That was in the orchestral section. Songs seem to have been written in thousands also. One I noticed was numbered 9,016. There are 150,000 vocal scores.

Works rendered by the B.B.C. Chorus must be kept up to the required numbers. There are two hundred and sixty members in that choir, and each must have a copy.

I can see the day soon coming when the B.B.C. will be the musical centre of the whole world.

Programmes going on all over the country from morning till midnight mean the performance of much music; yet it is possible to tell you what was sung and played, say on the Midland Regional, five years ago on the day you read these words.



V.M.V. photo

Fig. 1.—An interesting photograph showing the complete process from the rough wax, on the left, to the finished record in the centre. Readers should be able to read most of the wording on the cards with an ordinary magnifying glass

The Manufacture of Gramophone Records*

By Donald W. Aldous, A.B.R.I.

A BRIEF outline of modern recording practice may be an advantage before the actual manufacture of records is explained.

First, the studios, acoustically designed for the requirements of gramophone recording, with their adjoining recording rooms in which are two recording machines, the monitor loud-speaker, volume indicators, " mixing " and fading panels. Then the amplifiers associated with the microphones and recorders in other rooms; separate battery rooms; a room for the preparation of the sapphire cutting styli from the rough stone; air-conditioning plant to maintain the building at a level temperature suitable for the wax blanks. And last, but not least, the *modus operandi* of the recording session—adjustment of length of item to be recorded, balance of vocalists, instrumentalists and orchestra—so vital to obtain " depth " in a record or prevent " blasting "—and the myriad other important details that have to be attended to before the red light may appear in the studio and the " cutting " of a master record begins.

This cutting or recording process is carried out as follows. The recording machine may be described as a precision lathe, with its heavy face-plate or turntable rotating at a constant speed of 78 revolutions per minute. The highly polished wax blank is placed on the rotating turntable, which is traversed radially under the electro-magnetic cutting head, the cutting stylus itself is a sapphire needle and so traces an Archimedean spiral in the wax having about one hundred cuts or grooves to the inch.

In some machines the cutting head is moved and the turntable fixed, but in both methods provision is made for the adjustment of groove distances and depth of cut.

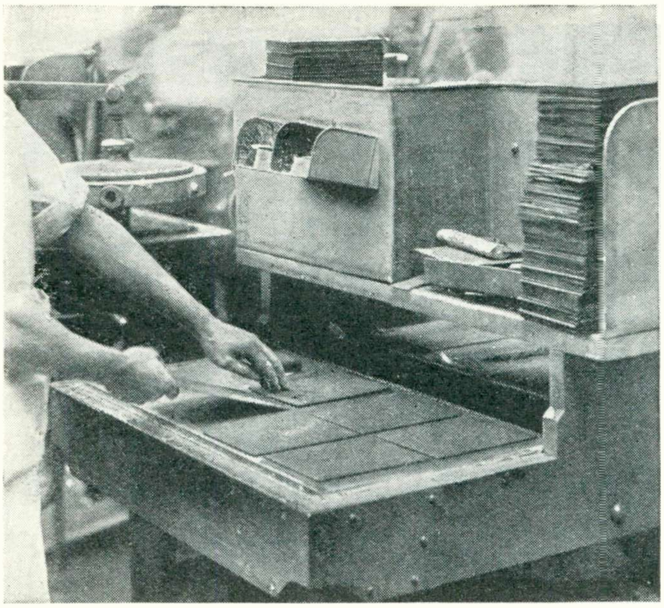
Lateral Recording Policy

The intensity and frequency of the original sounds determine the extent of the lateral displacement of the stylus on both sides of the mean spiral and, with certain other factors, controls the number of grooves to the inch to be cut.

As is well-known, the amplifier interposed between the microphone and cutting head is designed to reduce the amplitude of frequencies below about 256 cycles per second or, in other words, it has a bass cut-off.

This is a compromise to enable a reasonable playing-time to be obtained, and to prevent groove-wall break-down under the present " constant velocity " system

*This description includes section C of a comprehensive article, "Gramophone Recording, Record Manufacture and Record Defects," published in Volume 3 of the British Radio Institution's Annual, which may be obtained for 2s. from the Secretary, The British Radio Institution, 36 Gordon Square, London, W.C.1.



H.M.V. photo

Fig. 2.—The press-room operator is laying "cakes" or "biscuits" of record material on the hot plate to be softened

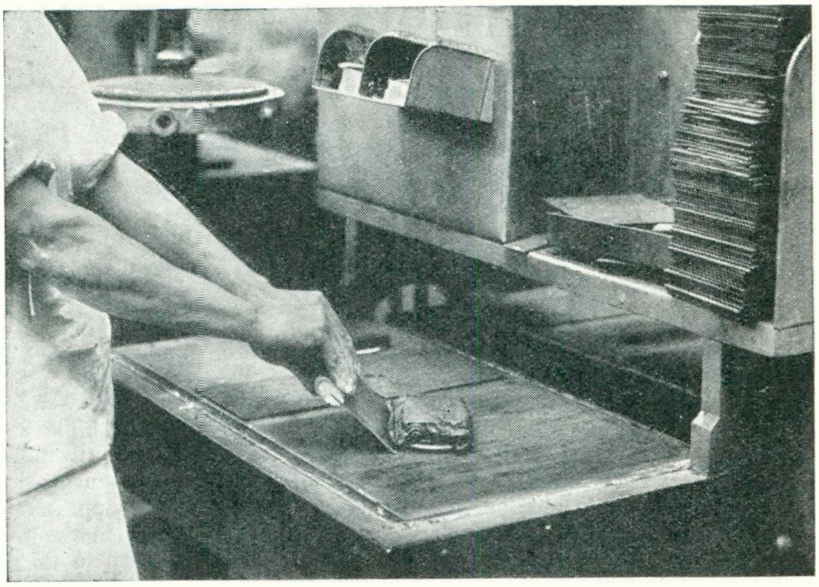
alternative method to the electrolytic process already mentioned. The waxes are placed in a vacuum chamber and gold is deposited in a thin layer on the recorded surface by a process known as cathode spluttering, a form of electronic bombardment. It is claimed that surface noise is reduced due to the continuity of the metal layer deposited by this method.

The master matrix is delicate, and when removed it has to be handled carefully to ensure that it shall not be damaged, for now it is the only record that the manufacturers have of the original performance, the wax blank usually being ruined when the copper shell is detached.

Pressing "Mothers" from "Masters"

Special pressings are now taken from the "master," and after undergoing various tests, which if found to be satisfactory lead to the next operation, which is to make a number of "mothers" from the master matrix, so that the masters may be stored and kept as the permanent record in fireproof vaults capable of holding 250,000 such master shells.

These mothers are made by a similar electro-plating process, but to make certain that this further copper shell will come off



H.M.V. photo

Fig. 3.—The softened "biscuits" are seen being scraped off the hot plate. They are then rolled in a ball ready for placing in the press

of recording. But, of course, to counteract this deficiency the reproducing pick-up should have a response the inverse of the recorder.

Processed

So the recorded wax blank is produced, or, as it should be termed now, the "filled blank." These filled blanks are sent to the factories in heated vans to be processed.

Here, after the eccentric run-out groove has been put on, the filled blank is dusted with very fine graphite powder to render the surface electrically conductive to make electro-plating possible. This process requires considerable skill and experience, for the success of the subsequent processes, including the polish of the finished record, is largely dependent on getting an even and brilliant layer. Fine bronze powder is occasionally used for this operation.

Growing the "Masters"

After this the "blank" is immersed in an electro-plating bath for about sixteen hours and so a master matrix is grown of the necessary thickness. The copper is deposited in a smooth form, and when removed from the face of the wax it bears on the underside an exact replica of the original filled blank, the only difference being that whereas grooves occurred in the wax blank, so ridges appear in the copper—the copper "master" is negative of the positive wax blank.

It is interesting to note the modern revival of one of Edison's ideas applied with up-to-date facilities as an

properly, the copper master is first nickel-plated, cleaned and then the plating operation repeated. After the copper has grown to the required thickness, it is taken off and so the "mother" is produced, identical with the original but in copper instead of wax.

Making the Working Matrices

A number of these "mothers" are made, and it is from these positive records that the final stampers, or moulds, which obviously are negatives, are produced. These are formed by a repetition of the electro-depositation process, but this time a thin copper sheet is formed and, after having their surface plated with nickel or chromium to alleviate erosion, they are finally backed with an

⅛-in. copper disc to increase their rigidity and give durability.

These are the "working matrices" or dies, and we now have a negative of the original recorded wax, or filled blank, ready to be placed in the semi-automatic stamping presses to make the familiar commercial pressings (see Fig. 1).

Raw Materials for the Record

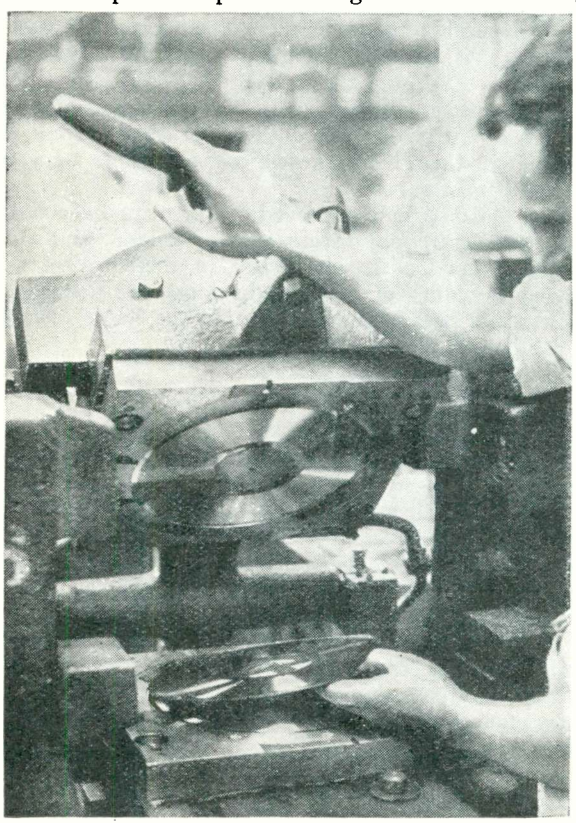
We come now to the raw materials for the moulding compound of the record. The ingredients usually include a mixture of resin, copal, carbon or lamp-black, slate powder, and up to 22 per cent of shellac.

Some manufacturers use other natural or synthetic gums in conjunction with the shellac, the main and most costly ingredient, but generally shellac, copal and resin as binding agents, slate powder as a filler, and carbon or lamp-black as a colouring agent are in the composition of the plastic record material. Cotton or wool flock is often included as a toughener.

As can be seen, it is only necessary to alter the colouring agent to make records of a different colour from the almost universal black disc. The shellac is first graded in large mills, which automatically reject any containing impurities.

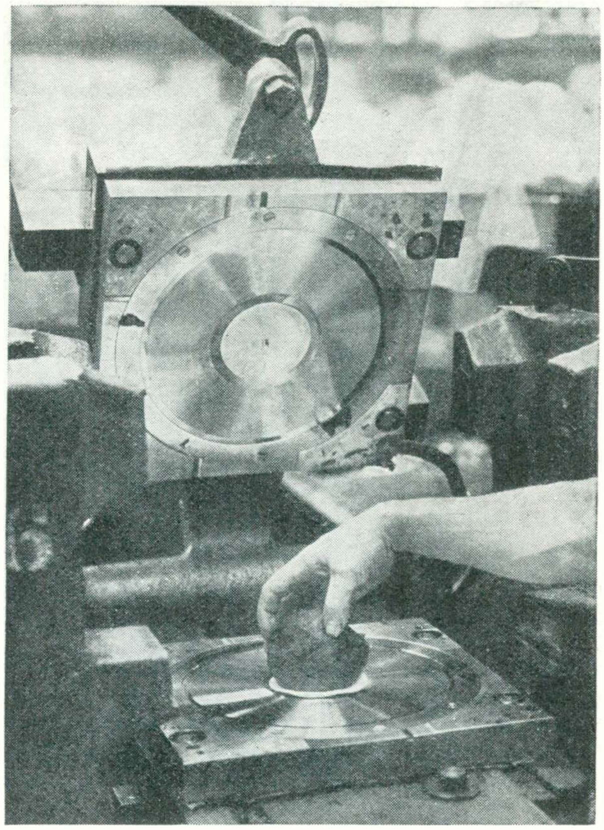
Grinding and Mixing

Perfect uniformity in texture of the mixing materials is essential as any foreign matter is injurious, and to this end during the course of manufacture the material is ground at least once, usually twice, to such an extent that 97-98 per cent passes through a sieve containing



H.M.V. photo

Fig. 5.—The press is kept closed for about one minute after which the record complete with labels is revealed. The record is finished except for a trimming and burnishing of the edge. One operator produces sixty records an hour



H.M.V. photo

Fig. 4.—This is the hydraulic stamping press. The required size of softened " biscuit " is being placed over label No. 1 preparatory to the press being closed and locked by the pressman. Note the steam and cold-water pipes at the back

40,000 holes to the square inch, namely a 200-mesh screen, in fact, till it is fine enough to be floated on air.

Each batch of these materials used has to be tested and approved by the laboratory. The correct proportions of each ingredient in the recipe and the methods of pulverizing and combining the mixture vary with different manufacturers, and are never disclosed.

Broken into "Biscuits"

The mixed material emerges from the rolling mill in sheets of equal thickness. This material is thermoplastic, namely, above a certain temperature it becomes soft, but on cooling it hardens. It is therefore rolled out between heated steel rollers and when it has cooled it is broken into "biscuits."

These biscuits are 13½ in. by 5 in., and weigh 8 oz. for ten-inch records; 17½ in. by 6½ in., with a weight of 12 oz. for twelve-inch records (see Fig. 2).

Pressing Records from the Stamper

From the mixing factory the biscuits of record material are delivered to the Pressing Shop. Here the metal matrices or stampers are mounted on the top and bottom mould plates of the hydraulic press and test pressings taken to make certain that no damage has occurred to either matrix and that the plates have been concentrically set in the press. Also from every batch produced specimen records are examined to ascertain whether any faults have appeared in the pressings, as upwards of 2,000 records are pressed from a good stamper.

Now the pressman places on a hot plate the requisite

Columbia photo
Fig. 6.—Here the operator is seen buffing, or trimming, the rough edge of the record as it revolves rapidly in a special machine. First of all a coarse abrasive paper is used. This is followed by a fine grade and lastly a polishing pad completes the process. Cardboard discs are placed between the finished records to prevent them being scratched

amount of biscuit, which is once again brought to a plastic condition, and after rolling the softened biscuit into a ball (see Fig. 3) the pressing operation is carried out as follows :—

The title label No. 1 is placed over the centre pin, face downwards on the lower matrix, title label No. 2 face upwards on the centre pin of the upper. Then the softened compound is placed on top of label No. 1, and the hinged top of the press closed and locked (see Fig. 4). A hydraulic valve is then automatically opened and a pressure totalling at least 70 tons is applied between the faces of the two matrices.

Steam is immediately circulated behind the matrices till the compound is almost liquefied, and this is followed by cold water to reduce the temperature thereby solidifying the compound. In less than one minute the press is opened and the record lifted off the face of the lower matrix, after which the overflow material around the edge is gently broken away. And so we have the record, complete with title labels, almost in its finished condition (see Fig. 5).

Final Testing and Inspection

The edge of the record is now buffed, or trimmed, and polished on special machines (see Fig. 6), and so to the testing and inspection departments. Here the records are subjected to a number of stringent tests, visual and aural, to determine, amongst other points, their wearing qualities, extent of surface noise, whether the artist(s) " got on to " the record as well as possible, and so on.

One instance of the thoroughness of these tests is that sample pressings from all new recordings are tested for wear and they must pass the standard or they are rejected and must be re-recorded, supposing it to be a recording fault, before being accepted for issue.

Final Selection Committee

When this has been completed, the recordings, which may vary in quantity from two to five of each performance, are submitted to a testing committee which selects the best artistic and/or musical reproduction. The selected master pressing is then submitted for the artist's(s') approval.

As a matter of fact, any layman could examine dozens of rejected records without discovering the reasons for them being thrown out, so minute are some of the blemishes.

The finished and approved records are once more inspected, copyright royalty stamps affixed, and after a final hand-polish are placed in their covers and passed by conveyor belts to the huge record stores to await their packing for dispatch to the home markets or shipment.

MORE ABOUT THE NEW DETECTOR—Continued from page 497

Our super-het enthusiasts are doubtless wanting to know whether they are to be left out in the cold. Certainly not ! But here again the rheostat idea must be abandoned. Still, as a second detector my new method takes some beating, as those who have already tried will agree.

In the case of the super-het, however, it is essential to include a blocking condenser and resistance in the grid circuit of the diode. This is shown in Fig. 2, where the intermediate-frequency transformer is connected to the grid of the detector through the blocking condenser c, and a grid leak, which may be variable for the purpose of controlling volume, is added between grid and grid-bias negative. The value of the leak may be .25 megohm, while the capacity of the blocking condenser must not be less than .01 microfarad and not more than .1 microfarad.

In all other respects the circuit remains the same as that given in my previous article.

A complete diagram for the battery user is given in Fig. 3. I am unable to recommend automatic bias for this portion of the receiving circuit, and I hope readers will not mind the insertion of our old and trusty friend, the 6-volt grid-bias battery.

Those who have no objection to a 2-volt accumulator for heating the diode filament—and thus getting the best possible results from the system—may like to know of an excellent non-spillable small type of accumulator specially made by Peto & Radford, called the Dagenite MP 9.

It only measures $3\frac{1}{8}$ in. by $1\frac{1}{4}$ in.,—there should be little difficulty in finding a niche for it on the baseboard.

The price is 11s. 6d. and its capacity is 10 amperes for a slow discharge.

News of the Short Waves

By KENNETH JOWERS

READERS are querying what has happened to the 20-metre amateur stations. None of the reports this month mention 14-megacycle " W " stations except from Northern Scotland. As an example of this, BRS1481 of Guernsey, who has just rebuilt his receiver, found that he had not heard one American station during the past month.

The trouble was that he listened between 2200 and 2300, a time only suitable for 40- and 80-metre band reception. Even with a very sensitive receiver, such as a large Scott or Philco, I cannot hear very much below 25 metres after 1900.

Barrett photo

This photograph of Captain Ulm was taken in the cabin of his Airspeed "Envoy" just before he set out on his ill-fated flight across the Pacific. The gear was for telephony communication on both medium and short waves

Almost any simple receiver, even a one-valver, will bring in the Americans if you listen at the proper time of the day. Just recently during the afternoon I have been able to log W8XK on its 19-metre channel at good headphone strength on a simple one-valver. The station has been coming on the air a little after 3 p.m., and I have been able to hold it until about 5 p.m.

What I consider to be a really good achievement was the reception of W8XK on 13 metres on several Sunday mornings running between 1230 and 1330. This station was louder than W3XAL during the summer months. With a little care one can hear American stations of various kinds from midday until 7 a.m. the following morning.

Sometimes if conditions are very bad there may be a slight gap between 1400 and 1500, but this is the only gap there will be.

Remember that during January and the early part of February the American stations will be coming over at approximately the following times: W8XK, on the 13-metre band, from 1200 to 1400; W3XAL, on the 16-metre band, between 1400 and 1700; W8XK and W2XAD, on the 19-metre band, at about 1500 until 1900, with perhaps 25-metre Americans coming in between 1800 and 1900.

The American stations on 31 metres start coming in during the middle part of the evening, while finally at about 2100 the 50-metre stations start up and keep going until the early hours of the morning.

Just recently I have also been able to hear the 75-metre amateurs until as late as 7 a.m. Incidentally, if your ordinary family broadcast set is any good, try listening for American stations between 240 and 310 metres. For the last three weeks I have been able to receive no less than 17 American stations on my McMichael portable between midnight and 1 a.m.

◆ ◆ ◆

Don't worry because some of the familiar amateurs cannot now be heard. Some of the W's are off the air for various reasons. Quite a number of them are in the U.S. Naval Reserve, and have to go to sea for training, while others at this period of the year take the opportunity of rebuilding their gear.

That old stand-by, K4SA of Porto Rico, has had to go into the interior, and will be off until the middle of this month.

◆ ◆ ◆

A very good report has just been received from W. A. Clemenson, of Hampstead. He has received a QSL card from the Indian station VU2FY, which at the time of the contact was only using 10 watts.

R. W. Everard comments on the reception of 40-metre stations. He has logged F8CC of Algeria, F8MA of Morocco, CT1IH, EA3CY, and EA5BC amongst others. All using telephony, and on the loud-speaker. Mr. Everard has now 180 verified reception reports, which he thinks are better than a mere log of a thousand stations or so. He mentions this point in view of the trouble there will be in verifying the logs of listeners in the suggested contest.

◆ ◆ ◆

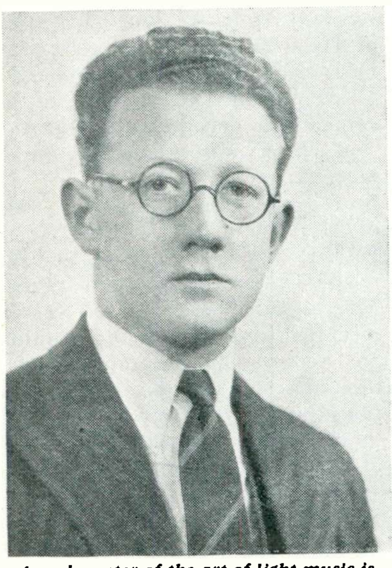
L. G. Morse, who many will remember as W1CAA, is back on the air again on 20 metres using telephony, and would very much like to have reports from European listeners. He is on the air every day working Bill Ingersoll, W9DXJ, at his camp in Crane Lake, Minnesota. By the end of the year, however, Bill Ingersoll will be back using W9BHT at Canton, Illinois. Both of these stations come over very well, and are worth hearing.

A new photograph of Lew Stone and his band of thirteen, taken specially for our contemporary, "Radio Pictorial." This band broadcasts every Tuesday night from the B.B.C. studios

Your New Year Programmes

By T. F. Henn

SEVERAL more letters from readers abroad have reached me full of appreciation for the brief details of forthcoming programmes I try to give each month. One or two have suggested that I give details in, say, this January issue for programmes in March. That is impossible for the programmes are arranged, at the most, only six or eight weeks ahead.



A real master of the art of light music is Reginal King, who is, by the way, an accomplished pianist

Anyway, readers in outlandish spots abroad can rest assured that I will always do my best.

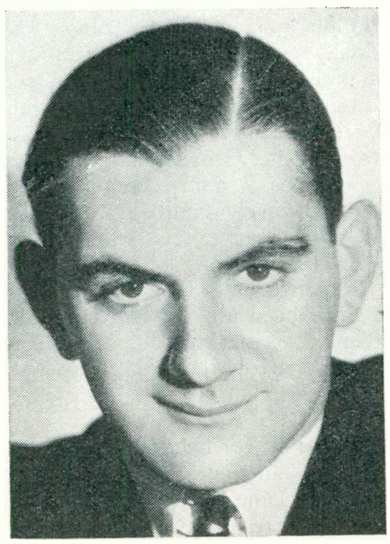
I happened to be passing the portals of Broadcasting House the other night at about 11.15. Strangely enough I noticed quite a dozen or more people hurrying into the entrance hall carrying violins. One had a 'cello. Surely not rehearsals at that time of night!

The following morning, as a matter of interest, I 'phoned up the B.B.C. and asked the reason for this strange apparition. As usual with stunts like that, the reason was perfectly simple. The *ghosts* were members of the newly formed Empire Orchestra on their way to start work by broadcasting to Canada.

I made a point of borrowing a short-waver and tuning in to this orchestra. And it sounded very fine, too! Eric Fogg is the conductor and Melsa, a violinist whom you all know, is the leader of the orchestra.

Whilst on the 'phone to B.H., I asked if the B.B.C. had any great plans up its sleeve for the New Year. The conversation boiled down to the non-startling fact that light entertainment, plays and Promenade concerts were to be the outstanding events for the first three months. We will talk about the Proms later.

Judging by a list of light presentations I have before me, radio is going to be very much alive in the New Year. For January one of the important productions will be arranged by Austen Croom-Johnson, of *Soft Lights and Sweet Music* fame. His new show will be called, *I've Got to Have Music.*



Felix Mendelssohn, a descendant of the famous composer, has just composed four new dance tunes

Another well-known leader in London's dance music, Lou Preager, whose band broadcasts from Romano's

Other good things for 1935 include more non-stop shows by Geraldo, new *Songs From the Films* shows by John Watt, a Sandy Powell revue, and a concert performance of *Love Needs a Waltz*.

Among the new plays I would strongly recommend you to listen to Whitaker-Wilson's *Trial of Dame Alice Lisle*, which is being presented on February 17.

Now about those Christmas Proms! The B.B.C. tell me that they hope these concerts will become as essential a part of the Christmas holidays as are pantomimes and circuses. There is no harm in hoping, my dear programme organisers, but you know as well as I do that at the best of times the big majority of listeners *hate*—I use this word in its strongest sense—symphony concerts.

Here is Sidney Kyte, whose band broadcasts from the Piccadilly Hotel, snapped by our cameraman during an actual broadcast performance

Why? Simply because ninety per cent of these people have not got sets that will do justice to massed strings, the blare of the brass and all the other delicacies that make the life and soul of good music.

The B.B.C. can console themselves that they have thousands of listeners who do appreciate these concerts and, therefore, I consider the Corporation is perfectly justified in allotting a good proportion of programme time to them.

These three vocalists and Mr. Kyte's baton clustered round the microphone at the Piccadilly Hotel during a late-evening broadcast

If you were to take a programme for the whole of an eight-week summer season of Proms and cut out all the items that were not 100 per cent popular, the balance would be a fair idea of the items in this coming Christmas season.

Overtures to *Tannhäuser*, *Barber of Seville*, *Marriage of Figaro*, *Egmont*, *Euryanthe*, *Bartered Bride*, *Mastersingers* and Sullivan's *In Memoriam*, are just a few of the popular favourites that have been chosen.

Then there are Purcell's *Trumpet Voluntary*, Elgar's *Enigma Variations*, the beautiful *Solemn Melody* for organ and strings by Sir Walford Davies, Wagner's *Ride of the Valkyries*, Holst's *Perfect Fool* ballet music, and Beethoven's *Symphony No. 5*.

A favourite radio artist, Jean de Casalis is perhaps better known as Mrs. Feather, you've heard her on the 'phone

The organist of the Regal Cinema at Kingston, Reginald New—another great favourite who broadcasts frequently

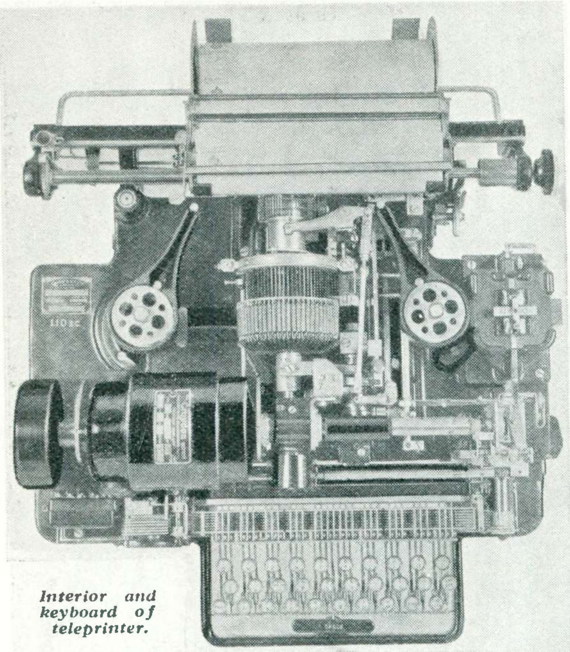
Among the artists are Harold Williams, Solomon, Supervia, Roy Henderson, Oda Slobodskaya, Titterton, Albert Sammons, Heddle Nash, May Blyth, Stiles Allen, Jo Vincent, and Eva Turner. That surely speaks for itself.

Undoubtedly this Christmas season will be a feast of the best classical music. In fact, it might almost be called a light-orchestral season.

Good as these concerts are, I still hold to my view that the majority of listeners do not want them. Give them vaudeville, music halls, more vaudeville and more music hall—that is so-called public taste.

I have just seen an advance proof of the talks for the New Year. Amidst chats on ancient ruins, spiders and making jellies, I found a series that will be welcomed by all. You remember some time ago we had a series of *Conversations in the Train*, which were broadcast on Saturday nights.

A new run of train journeys starts on January 5. Very interesting stuff!


Interior and keyboard of teleprinter.

"Voice Frequency"

How the Post Office is using radio principles to increase the amount of telegraph traffic that can be handled

By W. T. LOWE
and B. S. T. WALLACE

Illustrations by courtesy of Engineer-in-Chief Drawing Office G.P.O.

PRACTICALLY the whole of the main telegraph system of the British Isles is now carried on over what may be broadly described as valve circuits.

Phenomenal growth of the trunk telephone service and mechanisation of the telegraphs entailed a rapidly increasing number of channels to all large towns.

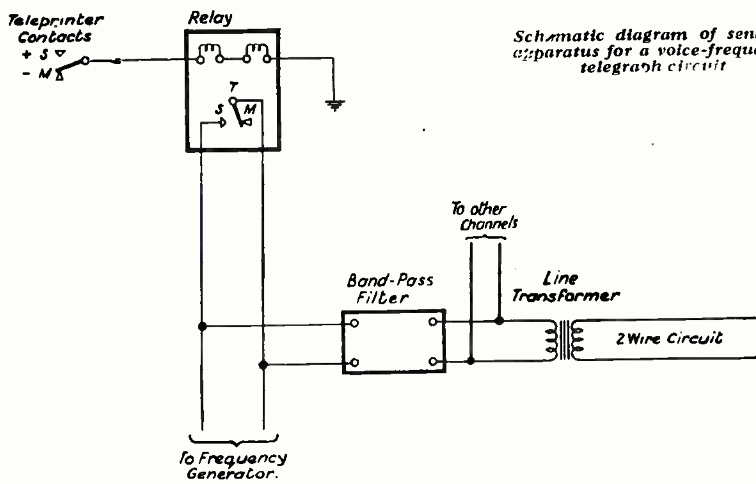
Construction of ducts for accommodating new cables is a very costly business. So attention was given to increasing carrying capacity of the present lines.

This has been accomplished by superimposing low-frequency currents—or "voice frequency" as it is technically termed—on existing loaded telephone pairs, for telegraph purposes.

As many as eighteen telegraph channels can be operated simultaneously over one telephone pair without mutual interference.

The frequencies used range from 120 to 1,740 periods per second and in some cases a little higher. Individual channels are separated by 120-cycle gaps to avoid interference. This is based on international agreement to permit of inter-state working.

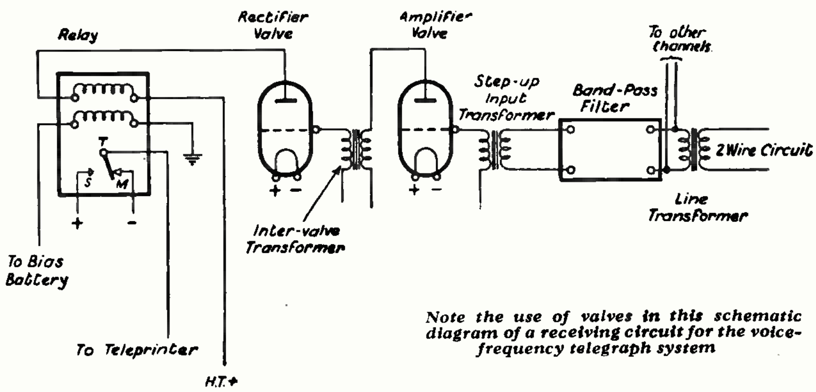
Each range of channels working on a particular pair is called a "system." Each channel has its own fixed frequency. So as to limit the spread and avoid interference from neighbouring channels, this frequency is passed out at the transmitting end and selected at the receiving end through band-pass filters.



Schematic diagram of sending apparatus for a voice-frequency telegraph circuit

Torpedo Shaped

Different frequencies are supplied by one motor-generator driven by a 24-volt battery. It is a comparatively small machine shaped like a torpedo. The generator output is connected to the respective channels via the filters and a transformer by means of an ordinary standard relay actuated by the telegraph transmitter—comparatively simple.



Note the use of valves in this schematic diagram of a receiving circuit for the voice-frequency telegraph system

It may here be pointed out that except over minor routes, all telegraph traffic is now signalled by teleprinters. Popularly, these may be described as electric typewriters. The depression of a key sends out timed impulses corresponding to the particular letter selected. These are picked up by the synchronised instrument at the distant end, and ingenious mechanical devices cause the letter required to be printed.

Necessary Current

The current necessary to control this operation is 20 milliamperes—a simple problem where direct line operation is concerned, but more involved when voice-frequency channels are utilised.

So the receiving equipment for voice frequency is a little more interesting than the transmitting end. As the recording instrument requires 20 milliamperes it must be worked from the local circuit of a relay.

On physical lines, the P.O. standard relay fulfilled this requirement, and was operated at some value between 5 and 15 milliamperes, the lower figure being the minimum for reliable performance.

Receiving End

On voice-frequency channels the received impulses, after passing through the appropriate filters, are first amplified by one stage of low-frequency, and then rectified by an arrangement similar to an anode-bend rectifier. The uni-directional output of this valve must actuate a relay for operating the teleprinter.

Practical consideration limited the current available for operating a relay from this last anode circuit. It therefore became necessary to design a special relay that would not only operate reliably and consistently at 3 milliamperes input or less, but which also had a magnetic system that ensured firm connection at the local contacts without any trace of chattering.

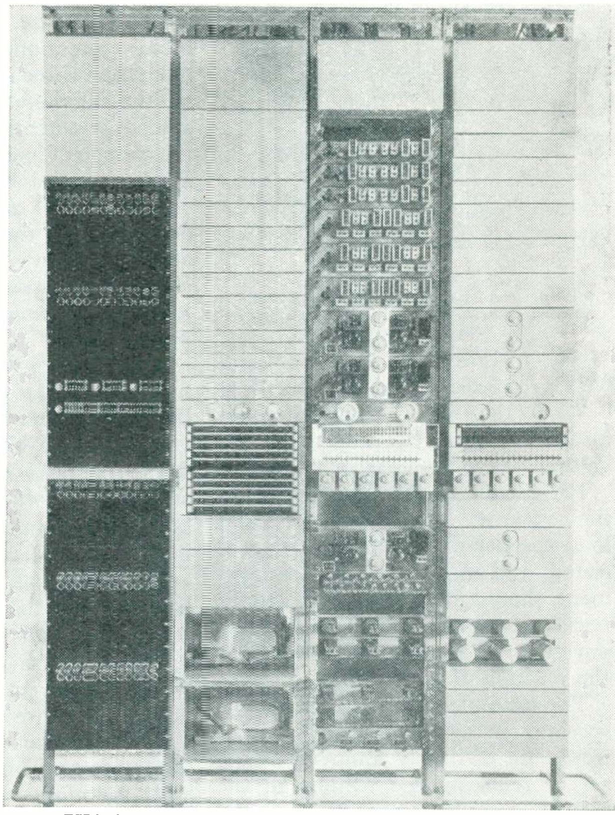
The contacts also had to be of low resistance, as far as possible free from oxidisation, and able to stand up to the comparatively high voltage of the local circuit.

For this purpose the Standard Telegraph and Telephone Co. developed a very ingenious relay of entirely new design employing permalloy for the magnetic system. The success of the present voice-frequency system is dependent largely on this relay.

Some idea of the sensitiveness of permalloy will be gathered from the fact that any adjustment of the contacts or pole-pieces of the relay must be made with non-magnetic tools. It is said that girls are best able to adjust these relays as the metal buttons on a man's trousers are liable to upset their balance!

The receiving equipment on each voice-frequency channel, including valves, filters, and relay, is rack-mounted in an all-metal chassis about the size of an all-mains receiver chassis.

Both high and low tension for the valves are supplied from accumulators at the main stations, but in some special cases all-mains working is employed. The system is very flexible. Essential values at the sending and receiving points remain constant, irrespective of the length of line. And the need for complicated balancing and adjustment of voltages required on ordinary lines is done away with entirely.

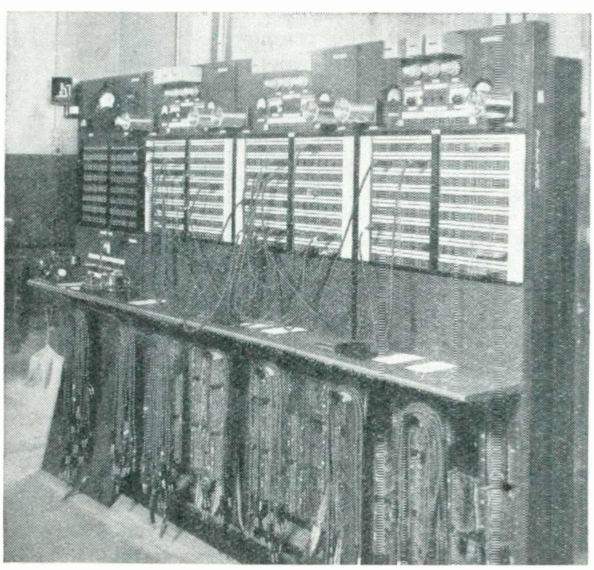


EXAMPLE OF NEAT POST OFFICE CONSTRUCTION
Control board equipped with voice-frequency relays, the purpose of which is explained in this article

Special arrangements for linking towns throughout the British Isles can be effected in a few moments by means of cords and plugs to enable direct working between any two of them. Or one can communicate simultaneously to several.

Even should a total breakdown, due to a severance of all cables, occur between London and any large town, communication could quickly be established over spare voice-frequency channels via other towns.

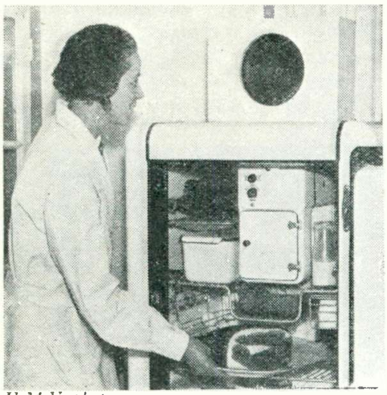
As each voice-frequency generator supplies the currents for a large number of towns, a reserve is always kept running and can be connected up by the flick of a switch.



IN THE CENTRAL TELEGRAPH OFFICE
Voice-frequency control board used in the Central Telegraph Office instrument room

Continued on next page

Individual Volume Control for Separate Loud-speakers



H.M.V. photo

MUSIC IN THE KITCHEN
Making good use of an extension loud-speaker—finished in cellulose to match the refrigerator

WHEN two or more loud-speakers are connected to the same amplifier some means of directly adjusting the volume of each is usually needed.

Each control should only affect the volume from the particular loud-speaker with which it is associated, and in addition the arrangement should be such as to keep a reasonably constant load on the output stage of the amplifier whatever the position of the controls.

For example, one may have loud-speakers in different rooms, and it would be distinctly annoying if the act of reducing the volume in the kitchen were to upset that in the drawing-room.

The simplest form of circuit to achieve the desired result is that shown in Fig. 1. Here potentiometers are used across the output of the amplifier and the slider and one end are taken to the loud-speaker. If there is a matching transformer on the loud-speaker chassis it is better to put the potentiometer across the secondary.

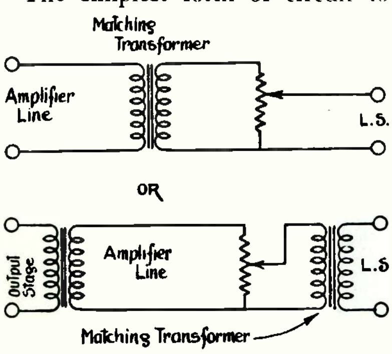


Fig. 1.—Potentiometer used as a loud-speaker volume control

In either case the resistance value of the potentiometer should not be more than three times the impedance of the loud-speaker as connected across the potentiometer. Otherwise the change of load will be substantial as the control is moved, and the volume of all other loud-speakers connected to the amplifier will be affected.

Thus suppose the loud-speaker has an impedance of 5 ohms, and a potentiometer of 100 ohms is connected between the matching transformer and the speech coil. Then the load across the secondary will vary between 100 ohms (when the loud-speaker is completely cut out) and $\frac{100}{105}$ of 5 ohms, which is rather less than 5 ohms, at full volume—a load change of more than 20: 1.

With a resistance value of 10 ohms, however, the load change would be from 10 ohms to $\frac{10}{15}$ of 5 ohms or 3.3 ohms—a load change of only 3: 1.

The actual change of load on the output valve would not be so big as this because the load from the second loud-speaker would remain constant and therefore would reduce the combined change ratio. In practice the 3 to 1 rule I gave earlier will be found satisfactory.

If the potentiometer were connected on the primary side of the matching transformer a larger resistance value for the potentiometer would be appropriate. Thus if the step-down ratio of the transformer were 20: 1, a value 400 (the square of 20) times as big would be required. Taking three times the loud-speaker impedance of 5 ohms and multiplying by 400 one gets a value of 6,000 ohms.

With specially designed volume controls better arrangements than this can be devised.

One ingenious arrangement is contained in the Centralab constant-input resistance, whose circuit is as shown in Fig. 2. Here there are two resistance elements controlled by one spindle in such a way that the total resistance across the amplifier line remains constant while that across the loud-speaker varies.

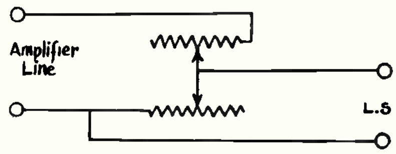


Fig. 2.—Centralab constant-input resistance

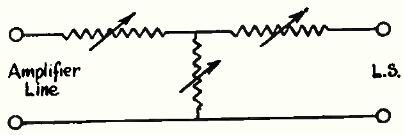


Fig. 3.—T-pad volume control

An even better arrangement is the T-pad in which three variable resistances are controlled by one spindle (Fig. 3). *P. Wilson.*

"VOICE FREQUENCY" Continued from page 553

For special circuits, such as private renters of teleprinters, and for small cross-country installations, valve generators supply the transmitting frequencies.

The majority of teleprinter motors operate at 100 volts D.C., and this is being standardised by utilising metal rectifiers where no D.C. supply is available. They are fitted with transformers adjustable in 5-volt steps to meet varying voltages and give an output of 100 volts at .5 ampere. They are also simultaneously utilised to supply the line transmitting currents where necessary. An interesting feature of these rectifiers is the 80-microfarad condenser used for smoothing the output.

This gives a brief outline of the terminal equipment of a modern telegraph circuit. It must also be remembered that all trunk cables pass through numerous valve repeater stations, where the high and low tension and biasing must be kept constant and the signals passed on undistorted.

Faults that arise are confined to mechanical defects, the valve equipment being practically foolproof.

Radio Valves in Other Fields

NEW applications of the thermionic valve and its relations arise every month, and it is safe to say that there is hardly an industry in existence which does not at some point make use of valve equipment, whether for actual processing, process control, measurement, safeguarding, or other purposes.

Radio receivers and transmitters naturally consume by far the bulk of the valve makers' present output and the growth of new uses is as yet small, but this latter field is so vast that it may in time become a very important rival.

It may even lead to the development of new valve types which could in turn be applied to further advances in radio itself.

Familiar Use

One of the uses familiar to most people is the valve amplifier for high-power reproduction of speech and music. This public-address equipment is used for entertainment and crowd control purposes at all kinds of meeting places; race tracks, baths, etc.

Railway stations employ it for rush traffic control; factories use it for labour control and the transmission of messages to foremen and other executives who have to move about and are therefore difficult to reach by telephone. Many busy showrooms use it for passing orders to their stores, thus saving time wasted in ringing and answering 'phones; churches have it; politicians operate their own equipment; medical schools teach heart sounds with amplifiers and special microphones—in fact, this one development alone has created a revolution in many walks of life.

Commonplace in U.S.A.

A second group of applications is to be found in the combination of photo-electric and allied cells with valve amplifiers. It must be confessed that we have been rather slow in taking up these ideas, which are, however, becoming commonplace in America.

One, very well known, is the use of a light-sensitive cell and valve amplifier for operating relays to switch on street lamps, office or workshop lighting, warning signs, advertising signs, etc., as soon as the local illumination falls below a given level.

Another is the burglar alarm, in which the interruption of a beam of light falling on a cell causes a pulse of current, which is amplified and operates a relay controlling an alarm.

A third is the "door control," in which a person approaching a door interrupts a beam of light, and the resulting amplified electric pulse sets in motion a motor which opens the door.

This is widely used for the service doors of restaurants and in factories where trollies pass through from one workshop to another, etc. The saving in time often pays for the equipment in a few months!

The matching and sorting of colours in several industries is rendered more accurate and speedier by the use of photocells and colour filters in conjunction with special valve amplifiers and some indicator such as a milliammeter in the anode circuit of the output valve.

The amount of light reflected or transmitted by a coloured material or paint may be compared with a standard to a very high degree of precision.

Photo-electric cells and valve amplifiers will warn the power station engineer when too much smoke is going up his chimney, because this will obscure a beam of light focused across the interior of the stack. And an amplifier connected to a thermopile or thermo-electric junction will tell him the temperature of his white-hot furnace, just as it tells the iron-founder the same thing about the molten metal in his retorts, or enables the pottery manufacturer to keep his ovens at the best heat for any class of clay or glaze.

Paper-makers check the uniform thickness and width of their product with photocells and valve amplifiers. Printers, using high-speed rotary presses, guard against costly damage which may result from failure to stop the machine at once in the event of a paper breakage by placing a photocell at each edge of the travelling paper band.

The slightest split which may develop into a tear lets through a flash of light which causes a photo-electric impulse and so, via the amplifier and a relay, shuts down the power before trouble starts.

Manufacturers of articles such as cigarettes, chocolates, canned goods, and other products which involve very large numbers of packages use photocells, with and without valve amplifiers, for counting packages as they pass on band conveyors into the packing department.

For Checking Weight

They can also check the weight by arranging for the flexible band to pass over a platform to which is attached a shutter. If the platform is depressed sufficiently for the shutter to cover or expose a light cell, the amplified impulse withdraws a deflecting plate and the tin or package passes on. If it is underweight the shutter movement is less, and the deflecting plate remains in position to shunt the reject off the band.

Leaving valve-cum-photocell applications, we find another field in the valve oscillator as a generator of energy for metallurgical processes, biological, medical, and many experimental purposes. A familiar instance is the eddy current heating of the valve itself, during pumping, in order to drive out any gases absorbed by the electrodes. Similarly, eddy-current furnaces are used for heating metals and alloys where very close temperature control and even heating is required.

Destroying Bacteria

Valve oscillators have been used to produce intense mechanical vibrations in the range of frequencies above the audible spectrum by means of which bacteria in milk can be destroyed without heating the milk itself.

By way of contrast, something of the same kind is turned to account in a ship's sounding apparatus which gives a continuous record of the depth of water below the keel. This is got by vibrating a metal plate with a powerful valve oscillator, and measuring the time taken for the "echo" to return from the sea bed.—*F. Y.*

"W.M." Long-wave Converter

Designed by the "W.M." Technical Staff

Here we present details for building a unit which is primarily intended for sets of the American and short-wave variety with no provision for long-wave working. This unit will enable owners of such sets to tune in stations between 1,000 and 2,000 metres. It is designed for use on either A.C. or D.C. mains

IT is all very well buying American receivers with eight or nine valves, but the expense of converting them to receive long-wave stations is usually great. Fortunately, most buyers of American or medium-wave-only receivers console themselves with the fact that, as the set has so many valves, *all* the medium-wave stations can be heard so the half a dozen stations on the long waves can be forgotten.

Colonial Sets

Nowadays British manufacturers are also making large quantities of what they term Colonial receivers, which tune from 12 to 500 metres. These sets are becoming very popular for English listeners have just begun to realise the possibilities of short waves. After the novelty of hearing seventy or eighty stations has worn off, the fact that long waves are unobtainable becomes more and more annoying.

The Long Waves

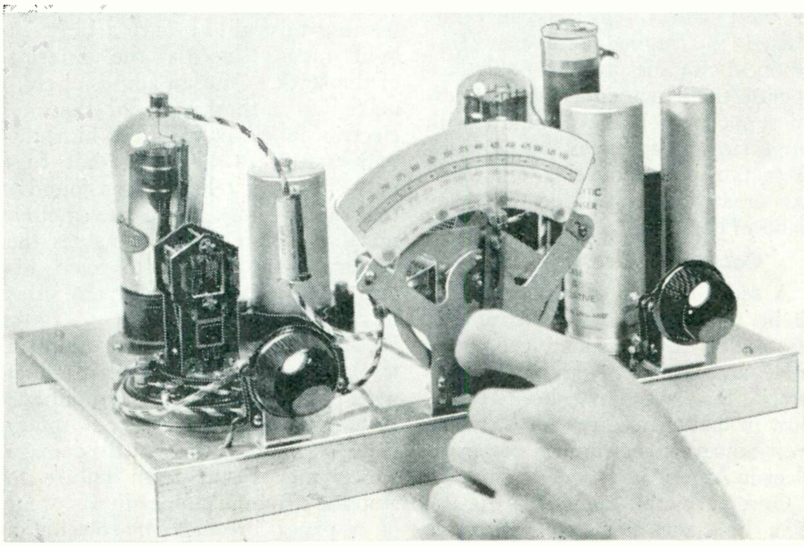
Admittedly, some of these long-wave stations have medium-wave relays. Warsaw, Motala, and Kalundborg are typical examples, but almost every receiving-set owner does at one time or another want to hear the Sunday programmes from Luxembourg, Huizen, or Radio Paris.

As these stations do not possess any relays on medium waves, these programmes cannot be heard unless one is prepared to make modifications to the receiver.

Our correspondence has shown that there is an increasing number of readers who want some simple means of modifying their medium-wave receivers and at the same time wish to avoid unnecessary expense. It is not practicable to modify the tuning arrangements in a commercial receiver, particularly if you are unfamiliar with the design. Also any alteration to a factory set automatically renders the guarantee void.

For these readers we have designed a long-wave converter which can be added to any receiver with one or more high-frequency stages or to a super-het. You all know that a short-wave converter enables you to hear short-wave stations on a medium-wave receiver.

Actually, what happens is that you add a single-valve combined detector-oscillator, working on the autodyne principle, making use of the high-frequency stages in the broadcast set by using them as intermediate-



CONTROLS ON THE LONG-WAVE CONVERTER

Controls are three in number: on the left is the selectivity control, in the centre is the tuning control, and on the right is the oscillator condenser frequency amplifiers, tuned to a wavelength of about 1,800 metres.

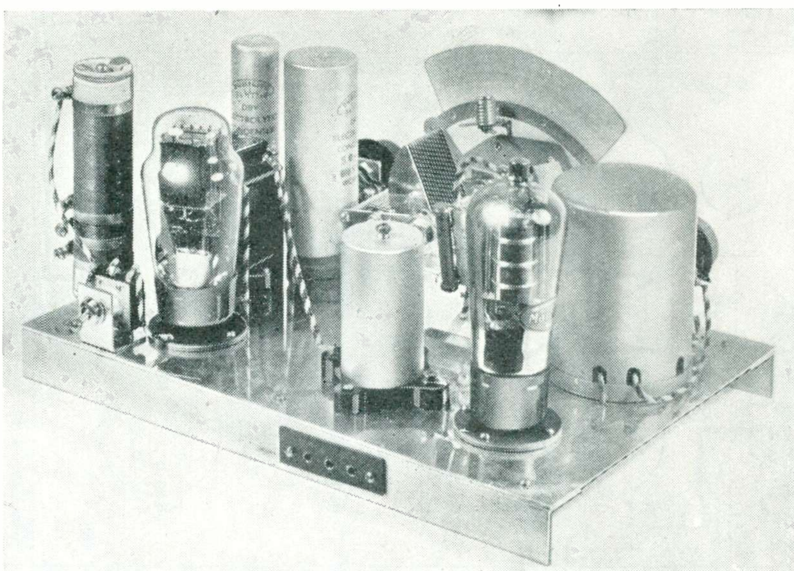
Now we have reversed the process by constructing a combined detector-oscillator circuit which, when connected in front of a medium-wave receiver, enables you to tune in long-wave stations. Admittedly, this type of unit is not 100 per cent efficient, for as the intermediate-frequency is round about 500 kilocycles, higher than the frequency of the stations you wish to receive, the actual stage gain is of low order.

Limitations

Even so, the eight or nine worth-while long-wave stations can be brought in at full loud-speaker strength without any difficulty.

You must be prepared for second-channel interference. By that, we mean that you will be able to hear your local medium-wave station on the long waveband as well, but it will not interfere with your reception of, say, Luxembourg.

You will see from the illustrations that the unit is particularly simple and that it is designed for A.C. or D.C. working without alteration. This means that it can be connected to any mains receiver without considering the power supply.



A.C./D.C. VALVES FOR UNIVERSAL USE
On the right is the triode detector-oscillator having the grid terminal at the top. The other valve is the mains rectifier

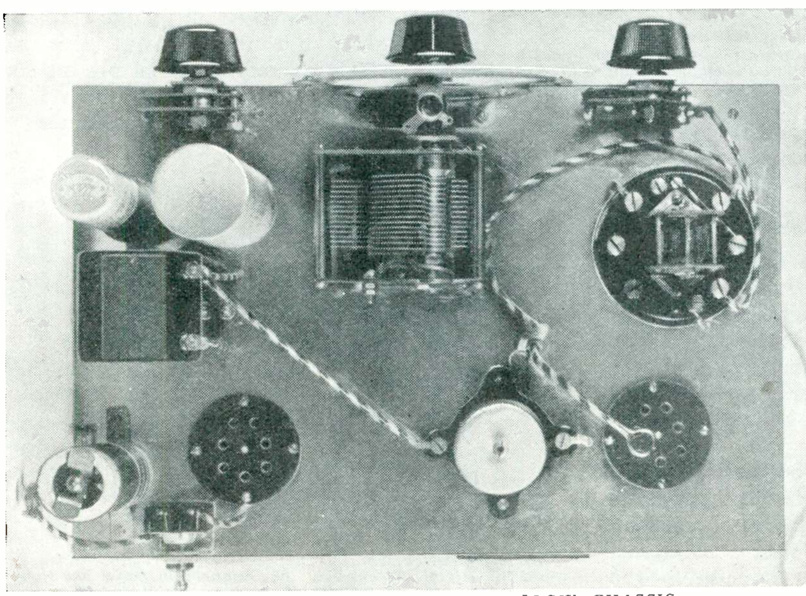
Reinartz Principle

Fundamentally the unit is a simple oscillating detector of the Reinartz principle. A Goltone dual-range coil is used, but without the usual wave-change switching. The grid coil—that is, the winding between terminals 1 and 2 — is tuned by a .0005-microfarad variable condenser and covers all wavelengths between 1,000 and 2,000 metres.

To preserve selectivity the coil is tapped well down towards the earthy end, while a .0003-microfarad pre-set condenser, in series with the lead-in, gives additional selectivity should it be required.

Reaction—or oscillator winding, as it should be called—is series-tuned by means of a .0005-microfarad variable condenser, but has also in series with it a resistance of 500 ohms.

This resistance overcomes any possibility of instability, prevents that nasty grunt which is so prevalent with mains receivers, and does materially improve reception. The detector works on the leaky-grid principle—and note that the cathode is connected directly to earth.



LAYOUT ON THE TOP OF THE SHALLOW CHASSIS
A clean layout making for simplicity of construction. Notice how the smoothing choke is kept away from the filament dropping resistance

Circuit Details

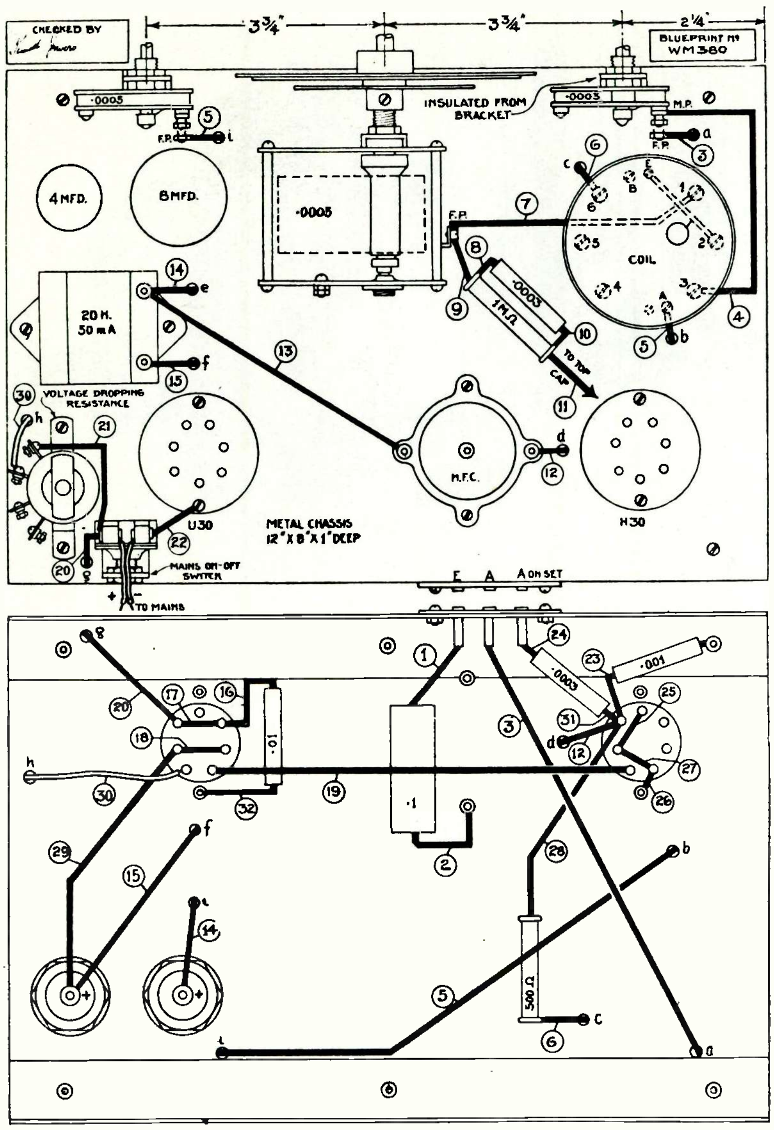
In the anode circuit of the detector valve, a Marconi H30, there is, first of all, a high-frequency choke by-passed to earth by means of a .001-microfarad condenser. The other side of this choke then feeds into the mains supply section. This consists of a full-wave (U30) rectifying valve connected as a half-wave element, having a D.C. output smoothed by means of a low-resistance choke and two 8-microfarad electrolytic condensers.

The filaments of the two valves are joined in series, while the voltage of the mains is broken down to the required voltage by means of a tapped resistance.

Receiver Coupling

The output from the H30 is fed into the broadcast receiver through a .0003-microfarad coupling condenser.

Construction should not present any difficulties. The baseplate consists of a sheet of aluminium, 12 in. by 8 in., which is raised an inch by means of two pieces of aluminium channelling. This channelling is



THIRD-SCALE LAYOUT AND WIRING PLAN

A full-size blueprint of the "W.M." Long-wave Converter, of which the above is a third-scale reproduction, can be obtained for half price, that is 6d., post paid, if the coupon to be found on the last page is used before January 31. Ask for No. WM380

bolted to the baseplate along the front and rear edges so that you actually have a complete chassis that can easily be made at home.

Building the Long-wave Converter

The first components to be fitted are the tuning, reaction, and pre-set condensers. The tuning condenser is in the exact centre, with the .0005-microfarad oscillator condenser on one side, and the pre-set on the other. The distance between the spindles of these condensers and the centre is 3¾ in. If these condensers are mounted correctly, then their control knobs will be approximately 2¼ in. from the end of the baseplate.

Next mount the Goltone coil. Two bolts are provided for the purpose and all you have to do is to drill two holes in the chassis and mount the coil so that the terminals are arranged as indicated on the wiring guide.

You will have some trouble in cutting the holes for the valve holders unless you go about it in the right way. A 1¼-in. centre bit fitted in a carpenter's brace will churn out two clean holes if you go about it carefully. The best way is to begin drilling through the top of the chassis, and when you are almost through turn the chassis over and go through it on the underside. You will then obtain a very clean hole.

Mounting Components

The high-frequency choke is mounted with two small bolts; nothing larger than 8 B.A. will do. The smoothing choke and the filament voltage-dropping resistance are both fixed by 6 B.A. bolts, while the electrolytic condensers are single-hole fixing.

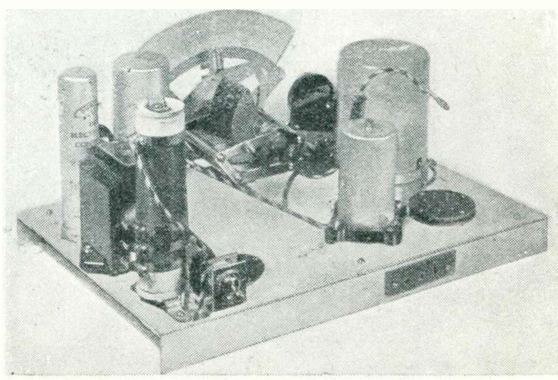
The quickest way to drill the holes for these is again to drill with a centre bit, but of ¾-in. diameter. Clean the edges of the hole with a small round file and the condensers should fit quite tightly.

On the underside of the chassis there is nothing very much of importance. A three-way terminal strip is bolted to the channelling, while the .1-, .01-, .001-, and .0003-microfarad condensers are connected in the wiring, as is the 500-ohm resistance.

Wiring Hint

When you start wiring up, do not make the mistake of drilling the holes for the connecting wires too small. If you do this and later pull the wires tight, there is every possibility that the edge of the hole will cut through the sleeving and cause a short-circuit.

That's about all for the construction, but don't forget that the .0003-microfarad aerial pre-set condenser must be bushed off from the bracket on which it is mounted.



BACK VIEW OF THE UNIT

An on-off switch, which breaks both sides of the mains, is seen on the left of the chassis. The connection panel has three sockets: on the left is earth, centre is for aerial lead-in, and on the right for connection to the aerial terminal of the main set

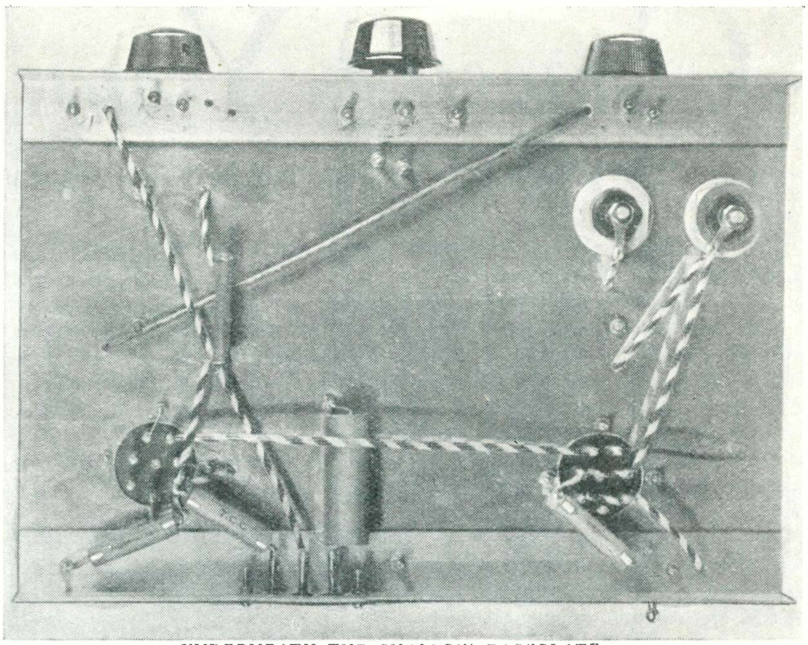
Make quite sure that the filament voltage-dropping resistance is correctly adjusted; otherwise you will probably overrun the valve heaters, and there is nothing more likely to cause the cathode to disintegrate. The tapping on the resistance nearest the baseplate is the common one and the second wire is taken to the terminal on the top end of the resistance that corresponds to your mains voltage.

Connecting Up

Next connect the unit in front of your existing receiver. The aerial lead-in wire should be connected to the A socket on the unit and *to nowhere else*.

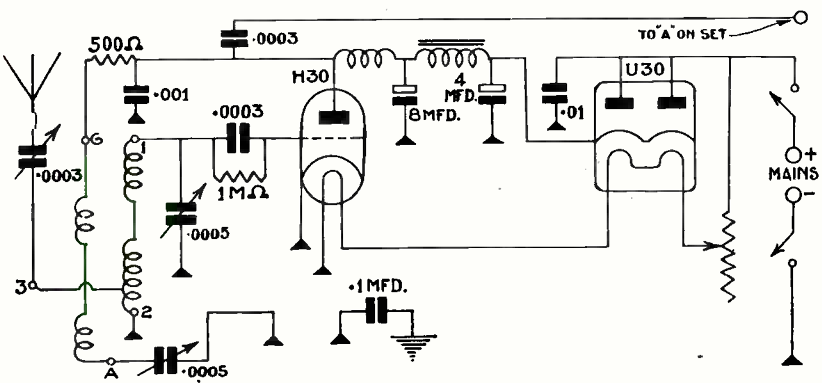
The socket marked E should be taken to a good earth connection, while the terminal marked A on set should be connected to the aerial terminal on the family receiver, that is the terminal from which you have just taken the lead-in wire.

Then plug the unit into the nearest power point and give it about two minutes to warm up. If you are on D.C. and nothing can be heard after two minutes, reverse the socket in the power point.



UNDERNEATH THE SHALLOW BASEPLATE

Little comment is needed here. The only point to notice is the fixing of the tubular condensers, which are connected to fixing bolts wherever possible



CIRCUIT OF THE "W.M." LONG-WAVE CONVERTER

The circuit of the converter unit is a conventional autodyne combined detector-oscillator complete with its own power unit. The small black triangles denote connection to earth

Tune the family set to round about 500 metres, preferably to a spot where you cannot hear any medium-wave stations, and turn the volume control reasonably well up.

The unit should then be adjusted until the tuning condenser is in almost its central position, so that you are tuning round about 1,500 metres. Then adjust the .0005-microfarad reaction condenser. You do not get the maximum volume with the condenser either in the minimum or maximum position. Remember that this .0005-condenser is not strictly a reaction condenser, but an oscillator control to obtain the correct frequency. The frequency required, of course, is governed by the wavelength to which the family receiver is tuned.

Anyway, you will notice that as you increase the capacity of the condenser, in one certain position there will be an increase in background noise and the volume will peak. If the capacity is increased still further, then the volume will drop off fairly rapidly.

COMPONENTS NEEDED FOR THE "W.M." LONG-WAVE CONVERTER

	£	s.	d
BASEPLATE			
1—Aluminium 12 in. by 8 in., with two angle supports 12 in. by 1 in. by 1 in.		2	8
CHOKE, HIGH-FREQUENCY			
1—Goltone, type SHF		4	0
CHOKE, LOW-FREQUENCY			
1—Varley, type Nichoke II ...		10	6
COIL			
1—Goltone, type GIC2		9	6
CONDENSERS, FIXED			
2—T.C.C. .0003-microfarad, type tubular		1	0
1—T.C.C. .001-microfarad, type tubular		1	0
1—T.C.C. .01-microfarad, type tubular		1	0
1—Dubilier .1-microfarad, type tubular		1	0
1—Dubilier 4-microfarad, type electrolytic		4	6
1—Dubilier 8-microfarad, type electrolytic		5	6
CONDENSERS, VARIABLE			
1—J.B. .0005-microfarad, type Baby		10	6
1—J.B. .0005-microfarad, type Dilecon		2	6
1—J.B. .0003-microfarad, type Dilecon		2	6
DIAL, SLOW-MOTION			
1—J.B., type Arcuate		5	9
HOLDERS, VALVE			
2—Clix 7-pin, type chassis-mounting			9
PLUGS, TERMINALS, ETC.			
1—Clix top-cap connector, type 23			2
1—Clix 3-socket strip			6
2—Clix plugs, marked; Aerial, Aerial 1			4
RESISTANCES, FIXED			
1—Erie 500-ohm		1	0
1—Erie 1-megohm		1	0
1—Bulgin series filament, type MR45		3	6
SUNDRIES			
Oiled sleeving ... ... say			9
Round tinned copper wire, No. 20 gauge, for connecting ... say			6
3—2½-in. metal mounting brackets say			9
SWITCH			
1—Bulgin double-pole on-off, type S104		2	0
VALVES			
1—Marconi H30		13	6
1—Marconi U30		15	0

Choosing Your Records

We Help You to Pick the Best Records for Your Radiogram

AN excellent selection of seasonal records here for you this month.

The first label made me rub my eyes and wonder whether all was well with me. The fourth reading seemed to make it certain that Signorina Gracie Fields *does* sing *Ave Maria*—the Bach-Gounod arrangement of it. I could hardly believe my ears!

She is excellent, and her Latin has no trace of Rochdale, either! She sustains her notes amazingly well and succeeds in singing this attractive classic as well as I have ever heard it sung.

Gracie Fields turns her attention to Bach. Whitaker-Wilson signifies his approval. Good for you, Gracie!

On the reverse she sings *Sally, You're More Than all the World to Me*, and *Cherie*. You simply must get this record even if you only keep it as a curio (H.M.V., C2705, 4s.).

While I am on the subject of twelve-inch H.M.V.'s, I may as well talk about three others. Marek Weber and his Orchestra (on C2699) give a very creditable account of a selection from Gounod's *Faust*. It has been done before—many selections are to be had—but I think I should say I have not heard any more attractive than this.

On C2701 the Massed Bands of the Southern Command do a little *Faust* and the *Poet and Peasant Overture*. It is a record of the Tidworth Tattoo of 1934. Quite good.

The most attractive of these three discs to me is a Harry Lauder record. *It's a Fine Thing to Sing*, with *We Parted on the Shore* on the reverse. Very good specimens of the art of Sir Harry. I sincerely recommend the disc to your attention. Its number is DB4028 (6s.).

I have five ten-inch discs of H.M.V. The first (B8246, 2s. 6d.) is another massed band affair, recorded at the National Band Festival, held on Michaelmas Day, 1934, at the Crystal Palace. One side is seasonable—*Christians, Awake!* Quite a thrill to hear such a volume of sound. The reverse is an arrangement of the chorus from Handel's *Messiah*, "Lift up your heads," which was recorded at the same time.

The next is a sacred music record. Master John Brookman, accompanied by Herbert Dawson at the organ, sings *Nearer, my God, to Thee*, and Adams's old song, *The Star of Bethlehem*. For a choirboy record this is exceedingly good (B8241).

Jack Hulbert has gone astronomical, so it seems. B8238 proves it, for it contains *Who's Been Polishing the Sun* and *What a little Moonlight can do*. The former is from the film *The Camels are Coming* and the latter from *Roadhouse*. Both are excellent.

If you can afford a Richard Crooks record, I can sincerely recommend Tosti's *Parted* and Grieg's *Ich liebe dich* (I Love Thee). It is a lovely record, and well worth every penny you have to pay for it (DA1394, 4s.).

Another celebrity disc, and this time of Beniamino Gigli singing *O Sole Mio* and *Senza Nisciuno*, is also worth having if you can afford this and the Richard Crooks. Anyhow, the number of the Gigli record is DA1373.

I have three Parlophone records for you. The first (R1976, 2s. 6d.) is by the Trocadero Ensemble, with organ. On one side they play *Nightingale in the Lilac Bush* (which I like immensely) and *Chinese Storyteller*. This is very well produced, with good tone and a satisfactory bass. Ask to hear it. I imagine you will end by buying it.

The next Parlophone is R1965, which is a piano solo record. Eileen Joyce plays Liszt's *Dance of the Gnomes* and a *Serenade* of Richard Strauss arranged by the pianist, Walter Gieseking. Both works are difficult to play, and both are effectively played by her. She is definitely a good pianist.

Then there is a waltz of Brahms' played by Edith Lorand and her Viennese Orchestra on R1966. Very effective. I like the band very much.

Two Regals, MR1486 and 1476. The first is a record by the Casey Kids called *Christmas Eve in Casey Court*. It is produced by George Buck, whom you will know as a radio comedian. Very good in places—not so good in others. Still, quite entertaining, which is all I ever expect to be able to say about records of this variety.

The other I can definitely recommend. It is by the Café Colette

By

WHITAKER WILSON

And what spot of bother is coming next? Clapham and Dwyer in the twilight before the Columbia mike

Orchestra, under Walford Hyden. Ever lunched at the Café Colette? No? Nor have I. Anyhow, you can now lunch at home and put this on. *Moonlight Kisses* (perhaps you had better have your supper to this!) and *Tunes from the Tyrol.* A very attractive disc.

I find there is a third Regal here. I had not noticed it. I bring it to *your* notice because it is called *The Big Hit Parade of* 1934, and contains twelve selections from the Regal-Zonophone star records of the past year. The number is MR1514, and it is worth having. These Regals cost 1s. 6d.

Four large Columbias. First (DX650, 4s.) Stanley Holloway in *Marksman Sam*, and on the reverse *Albert Comes Back*. Very good. If you like Stanley's style, here's your chance. He is in top form.

A notable set of memories (on DX640) turns out to be *Drury Lane Pantomime Memories.* Such classics as " Git yer 'air cut " and " Hitchy Koo " come up for review by the Columbia Light Opera Company.

Love's Old Sweet Song becomes the title of a descriptive ballad with people like Mary Jerrold and Hubert Harper in the cast. I suggest you hear it, because these things are not everyone's taste. They are not mine, to be quite frank. The production, however, is so definitely good that I feel I ought to suggest you hear the record and judge it yourself (DX597).

Two little Columbias on DB1467 (2s. 6d.), the Orchestra Raymonde give a description of the *Indian Mail*, and, what means more to me, play a delightful little intermezzo called *Glow Worm.* Nice band!

Malcolm McEachern (" Jetsam ") sings the *Cobbler's Song* from *Chu Chin Chow* and Mendelssohn's *I'm a Roamer*, with orchestra.

And now at the last minute comes in half a dozen records from the House of Decca. The first I set eyes on is a recording of Prokofiev's ballet suite, *Chout*, played by the famous Lamoureux Orchestra of Paris under the able directorship of Albert Wolff.

Modern, even to a point of cacophony, but I must admit that its frankness and daring left me rather spellbound. It is so unusual, so blatant, and so well recorded that I must recommend it to serious-minded enthusiasts. You wireless fiends must watch your diaphragms: this may crack them. The technical term, I believe, is to put them out of centre (Decca-Polydor CA8188-9, 4s. each).

More to my liking is a *Merry Widow* selection played by a concert orchestra with two soloists, Bernice Claire and Henry Shope. You really can't beat Lehar for this type of stuff. The number is Decca K737 (3s.).

Chopstick Recommends—

ORGAN MUSIC

★**With Eric Coates Thro' London,** Quentin Maclean at the Trocadero Cinema, Elephant, 2s. 6d. **COL DB1457**

This should be very acceptable. All Coates' hits are here—"Knightsbridge," "At the Dance," "Bird Songs at Eventide," "Three Bears," "Covent Garden," "London Bridge," are some of them.

★(*a*) **Love in Bloom,** (*b*) **Two Cigarettes in the Dark,** Harold Ramsay at the Granada, Tooting, 2s. 6d. **PARLO R1972**

Excellent this, particularly because the organ is accompanied by a guitar and singer. Well recorded with plenty of bass.

MISCELLANEOUS

★**The Three Little Pigs,** Walt Disney Impressions, 1s. 6d. **DECCA F5312**

Very cleverly done. Reminiscent of a similar show in one of John Watt's broadcasts. Ideal for the kiddies. They will love it!

★**Fox Favourites No. 2,** Roy Fox and His Band, 3s. **DECCA K743**

All the popular rages are here. "Little Man," "Isle of Capri," "May I?" "Love in Bloom," "Nasty Man," "Soon," "All I Do is Dream of You," are the contents of a remarkably well-recorded disc. Ideal for this time of the year.

DANCE MUSIC

★(*a*) **He Didn't Even Say Good-bye** (f.), (*b*) **Long May We Love** (f.), Lew Stone and His Band, 1s. 6d. **REGAL-ZONO MR1473**

The first recording of this band on Regal-Zonophone. If you are a dance fan, here is your opportunity. One of England's best bands playing the best tunes at the best price.

★(*a*) **I Never Slept a Wink Last Night** (f.), (*b*) **Love, For Ever I Adore You** (w.), Teddy Joyce and His Band, 2s. 6d. **H.M.V. B6543**

Well played, both of them. The waltz rather took my fancy. Nothing exceptional; just a nice tuneful one ideal for dancing.

★(*a*) **Just a-wearyin' for You** (f.), (*b*) **Two Little Flies on a Lump of Sugar** (f.), Jack Jackson and His Orch., 2s. 6d. **H.M.V. B6541**

Two well-known foxtrots; (*b*) is getting a shade old, though. Both are played with the quality one expects from Jack Jackson's band. Worth getting.

★(*a*) **Learning** (f.), (*b*) **Smoke Gets in Your Eyes** (f.), (*a*) by Eddie Duchin and His Orch., (*b*) by Paul Whiteman's Band, 2s. 6d. **H.M.V. B6540**

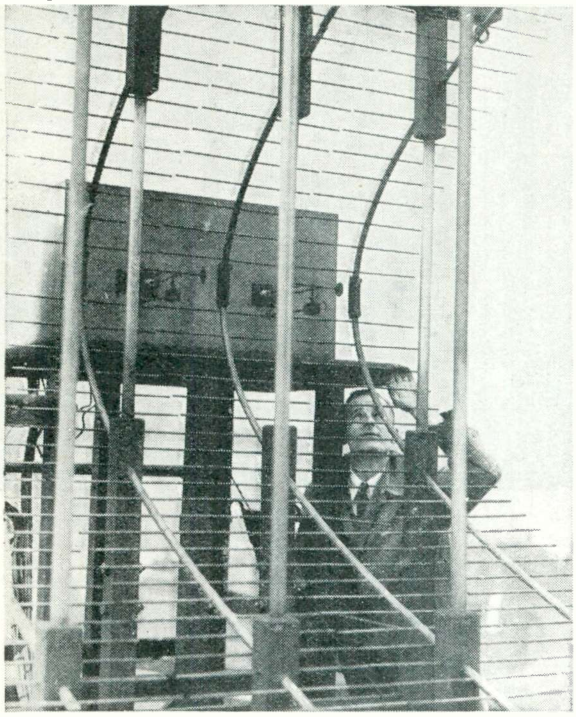
This is what one might call a super dance record. (*b*)—or to give it its full name, "When Your Heart's on Fire, Smoke etc."—(Paul Whiteman's version) is definitely the best I have heard so far. This master of rhythm is not losing a scrap of his old form. Really brilliant!

★(*a*) **Manhattan Rag** (f.), (*b*) **Baby, Won't You Please Come Home,** Frankie Trumbauer and His Orch., 2s. 6d. **PARLO R1978**

Super hot! Trumbauer is a marvellous trumpeter. Worth every penny of its price. This is not one of those modern discs of the ear-splitting variety.

★(*a*) **Smoke Gets In Your Eyes** (slow f.), (*b*) **My Old Flame** (f.), Ambrose and His Orch., 1s. 6d. **DECCA F5293**

Ambrose plays the smoky one as a slow job and makes a perfect job of it. This, I believe, is Ambrose's first recording on the 1s. 6d. Decca; and it is one of the best records he has ever produced.



Photopress photo
This unusual-looking aerial is to be found on the roof of Electra House, London. It is a parabolic reflector for wavelengths as low as 75 centimetres

Aerial Design

By MALCOLM HARVEY

This article has been written in response to numerous requests from readers for a comprehensive survey of short-wave aerials for both reception and transmitting. All the more usual types and systems in use today have been dealt with in a concise way, and the article will prove of great value to short-wave users

A LONG length of wire fixed horizontally with a downlead from one end kept well away from the house is the average amateur's formula for an efficient aerial. If it is too long and causes poor selectivity a pre-set condenser in the downlead has to remedy the evil.

That may be all very well if you only want to receive the local station, but don't blame me if you cannot hear all of those short-wave stations

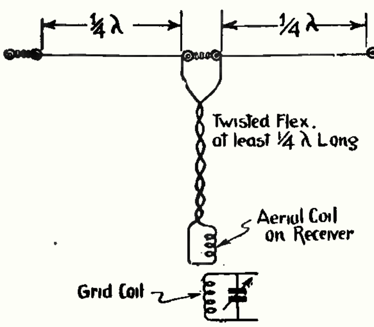


Fig. 1.—A doublet-system aerial which uses lamp flex for lead-in wires

that abound in every corner of the universe.

How do you imagine that amateur transmitters go about the erection of an aerial? They know that their apparatus, although it may be very efficient, will be almost useless if the aerial to which it is connected has not been designed in a satisfactory way.

Although this article deals principally with the fundamental principles of transmitting aerials, the same remarks apply, in a measure, to short-wave receiving aerials if you intend to get the absolute maximum from your equipment.

I do agree that almost any type of aerial will bring in the powerful short-wave stations, but if you intend to pick up some of those 10-watt D.X.'ers then your first consideration must be the erection of an aerial of a suitable type.

One of the most efficient aerials for reception is a variation of the tuned transmitting type, or perhaps a modified doublet.

This doublet is shown in Fig. 1. You will see it is a double aerial,

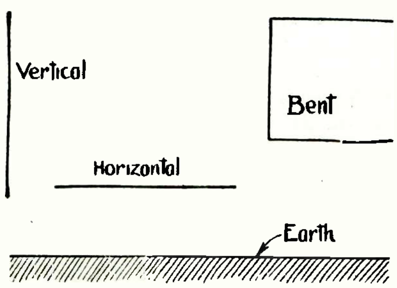


Fig. 2.—Hertz aerials are split up into these three different systems. No direct earth connection is made

each side quarter wavelength, the two centres being coupled to the aerial coil of the receiver by twisted lamp flex. The coupling coil can either be tuned or not, as you wish. It is advisable to tune it if you intend to use the aerial on several wavelengths.

Two Systems

Before we really go into the design of aerials it is as well to point out that all the different types of aerials boil down to two systems.

Those in which a direct earth connection or counterpoise earth is necessary are known as the Marconi aerials. The second type is the Hertz aerial in which an earth connection is not used.

The Hertz aerial with its artificial earth is in its simplest form a single wire suspended as high above the ground as possible so that it has a minute capacity to earth. Incidentally, the Hertz aerial is used almost exclusively for short-wave working.

Hertz Aerial

A Hertz aerial, whether it is upright, horizontal, or bent, such as shown in Fig. 2, has a certain capacity, inductance and resistance, in much the same way as an ordinary tuning coil, the difference being that whereas the tuning coil, being a closed circuit, has a small field, the aerial is an efficient means of radiation.

The aerial should then be considered as a simple oscillating circuit having a natural frequency of its own that can be tuned to the frequency of your receiver or transmitter as the case may be.

Complicated Formula

In order to calculate the natural frequency of a tuning coil or oscillatory circuit one has to use a very complicated formula. In an open oscillating circuit such as an aerial there exists a relationship between the natural period and the length of wire.

The natural wavelength of the wire (the highest wavelength at which it will oscillate) will be its length in metres, multiplied by a figure that varies between 2.1 and 2.07.

Natural Frequency

If the speed of a wireless wave was always 300,000,000 metres per second in free space, the natural frequency of the wire would be exactly twice the length of the wire in metres. The speed of a wireless wave, however, is slightly less than this, when on wire, so that the natural wavelength is slightly greater

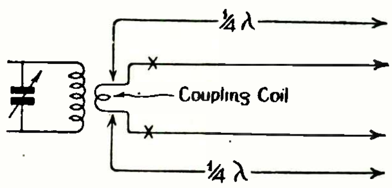


Fig. 3.—A half-wave system with both sections of the aerial having a total length of half wavelength

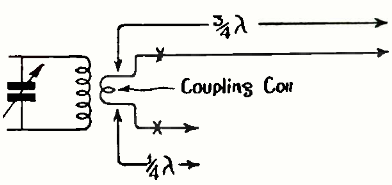


Fig. 4.—A full-wave arrangement with one side of the radiator quarter wavelength, and the other side, three-quarter wavelength

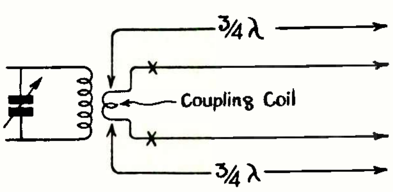


Fig. 5.—A third-harmonic system with each section of the radiator three-quarter wavelength

than twice the length of the aerial.

You will see from this that the highest wavelength to which a Hertz aerial can tune—its natural wavelength—is approximately twice its length in metres. In other words, the length of the aerial is about half the wavelength to which it will tune.

This simple means of calculation makes it advisable to refer to wavelengths rather than frequencies. Let me give you one or two examples of how to calculate the length of wire required.

An aerial having a natural frequency of 160 metres will oscillate on all of its harmonics, that is, it will be efficient on 80, 40, 20 metres, etc. My own particular aerial has a fundamental wavelength of 84.46 metres (3,550 kilocycles). But it also works on 42.23 metres and 21.165 metres. The same aerial would also oscillate on 10.55 metres.

I have just mentioned to you that

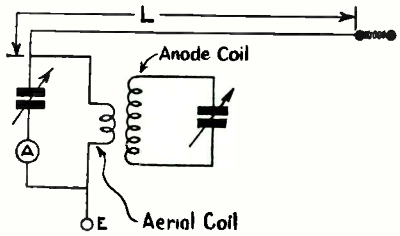


Fig. 7 A very simple type of aerial, the radiating portion of which is tapped direct.ly on to the coupling coil

the natural wavelength of the Hertz aerial is 2.1 to 2.07 times its actual length, instead of being twice its length. The reason for this is that the aerial has effective distributive capacity and inductance which is influenced by various factors, such as nearby conductors, gauge of wire; all become more noticeable as the wavelength decreases.

At a frequency of 28 megacycles, that is below 10 metres, the ratio of natural wavelength to actual aerial length is even greater than 2.1 times.

The length of the aerial is not critical, because the aerial itself is really only a broadly tuned circuit. I have a simple formula for calculating these wavelengths, and it is suitable for either transmitting or receiving aerials. This formula is:

Length (in feet) equal 1.56 times the required natural wavelength in metres, or

Length (in metres) equals 0.475 times the required natural wavelength in metres.

If this is defined in terms of frequency we get:

$$L \text{ (in feet)} = \frac{468{,}000}{f \text{ (kc.)}} = \frac{468}{f \text{ (mc.)}} \quad \text{or}$$

$$L \text{ (in metres)} = \frac{142{,}500}{f \text{ (kc.)}} = \frac{142.5}{f \text{ (mc.)}}$$

This formula is based on a 2.1 : 1 ratio of natural wavelength to actual length. If it is expressed another way, the actual length is approxi-

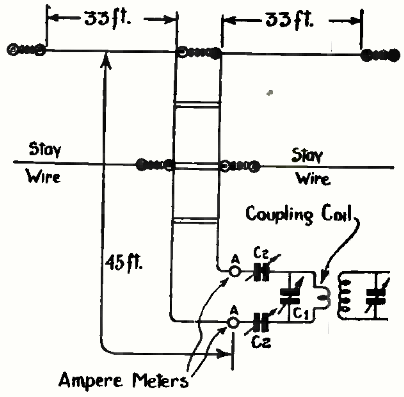


Fig. 6.—A flexible current-fed aerial with non-radiating feeders. These feeders must be 45 ft. long

mately 95 per cent of one-half the natural wavelength. Unfortunately it is not possible to tell which is the best aerial, for this depends so much on the locality, your own particular requirements, and so on.

"Fed" Aerials

There are two types of "fed" aerials used by amateurs. One employs a tuned non-radiating feeder between the transmitter and the aerial and the other uses an untuned feed circuit, the characteristic impedance being matched at the aerial end by a suitable coupling arrangement.

The tuned-feeder systems are usually called current or voltage-fed, while the matched-impedance systems are of two types, single and two-wire. The tuned-feeder arrangements are simpler.

Half-wave Circuit

In Figs. 3, 4 and 5 you will see that it is not necessary to have the two actual sections of the aerial of similar length where you are restricted as regards space. In Fig. 3, for example, you will see the conventional half-wave circuit where each half of the aerial is exactly quarter-wavelength.

The length between the extreme ends of the aerial, excluding the coil, should be half wavelength. Fig. 4 is a simple variation where one section of the aerial is approximately one quarter-wavelength.

Then there is the third harmonic

system, Fig. 5, where each side of the aerial is .75 of the wavelength required. All of these lengths, of course, exclude the coil. Where you are restricted for space make one side of the aerial .25 wavelength and the other $\frac{5}{4}$ of the wavelength required.

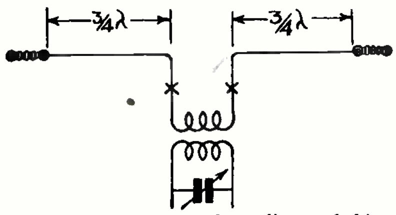


Fig. 8.—Each side of the radiator of this type is three-quarter wavelength. Slight losses are introduced by part of the radiator section being inside the house

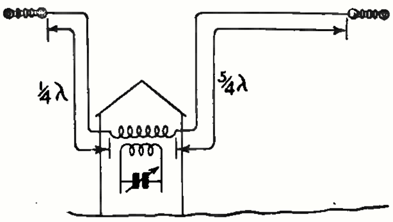


Fig. 9.—In this arrangement one side of the radiator is a quarter wavelength, the other being five-fourths

Of these systems Fig. 4 is the best for one does not get the aerial doubling back on itself, so decreasing the effective radiation. All these systems make it necessary for the actual aerials themselves to be taken inside the house, so that a portion of the aerial which might be effectively radiating is lost.

Current-fed Aerial

To overcome this it is quite a good idea to erect an aerial with the entire radiating section high above the ground and coupled to the receiver or transmitter through spaced feeders.

In Fig. 6 you will see how an aerial of this type is constructed. The actual length of the aerial can be calculated from the previous formula given, while the feeders should be approximately 10 in. to 12 in. apart, so as to prevent radiation. The feeder wires can also be erected with the aid of the same formula.

A current-fed aerial of this kind is suitable for many wavebands. For example, if it is constructed to the length given, that is, with each half being 33 ft. and the feeders 45 ft. in length, the approximate fundamental frequency will be 7,100 kilocycles.

From this you will see that it will also oscillate on 14,200 and 28,400 kilocycles, being the second and fourth harmonics respectively.

Parallel tuning is used on the fundamental frequency, series tuning for 14,200-kilocycle working and parallel tuning again on 28,400 kilocycles, that is the 10-metre band. This aerial works as a two-voltage fed Hertz in parallel on the two top frequencies.

This system will also work quite well on the 80-metre band, and it is then approximately a half-wave aerial. It would, however, be much better if it had a fundamental frequency of 3,500 kilocycles, that is a total length of 133 ft.

The condensers C_1 and C_2 have a capacity of .0001 and .00016 microfarads. If the length between the aerial and receiver is less than 45 ft.

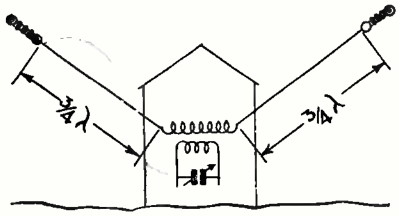


Fig. 10.—Both radiators are at an angle to the earth and are three-quarter wavelength

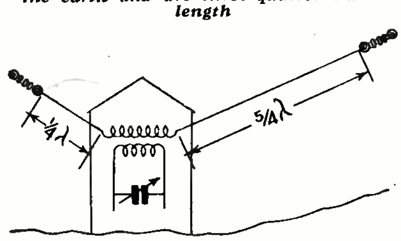


Fig. 11.—A variation of Fig. 10 has one radiator a quarter wavelength and the other five-fourths

the feeders can be pulled back by means of stay wires so as to give the required length.

In Figs. 8, 9, 10 and 11 are four other satisfactory current-fed aerial systems. Notice how each section of the aerial can be split up so that one side is .25 wavelength and the other .75, while the second is .25 wavelength on one side and $\frac{5}{4}$ on the other, and so on.

Zeppelin aerials or two-wire voltage-fed systems, which they should be called, are very commonly used. They actually utilise two-wire feeders (tuned) with one feeder attached to the Hertz-type aerial at one end, the other one being effectively dead.

The length of the aerial is determined by the original formula again, while the feeders should be equivalent to an odd multiple of .25 wavelength.

A simple voltage-fed system is shown in Fig. 7. You will see that here the radiating portion is fed directly on to the coil. This aerial is particularly useful, for it is very flexible. With an aerial length of 264 ft. it can be operated on any of the amateur bands by merely tuning the two coils to the required wavelength.

Half-wave Type

If you make the aerial length 132 ft., so that it has a fundamental frequency of 3,550 kilocycles, or 84.64 metres, it will work as a half-wave aerial when used on 160 metres.

For normal use 66 ft. will be more convenient, when the aerial will have a fundamental frequency of 42.32 metres. You will see from this that it cannot be effectively worked above its natural wavelength without some external means, such as a variable tuning condenser.

Conventional Marconi

On the other hand it will work on the harmonics of its fundamental frequency without any such artificial means. By connecting a good earth at the point marked E in Fig. 7 the aerial is then converted into the conventional Marconi, when it will be suitable for operation at half the fundamental frequency of the aerial.

Therefore if it is 132 ft. long, that is having a fundamental

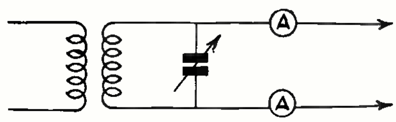


Fig. 12.—A very simple circuit with parallel tuning. Suitable for those who are cramped for space

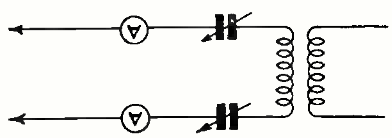


Fig. 13.—A series-tuned circuit suitable for wavelengths of the order of 20 metres

frequency of 3,550 kilocycles, it will be satisfactory on a 1,715-kilocycle frequency.

An interesting aerial, shown in Fig. 14, has the impedance of the feeders matched by the impedance of the section marked C between the actual radiating portions. The aerial length L, the feeder clearance E, the spacing between the feeders at D, and the coupling length C are all fairly critical and can be obtained from the formula given.

Difficult to Erect

The system must be designed for exact impedance values, as well as frequency values, so that it makes the system a little more difficult to erect. The length of the aerial can be calculated from the following formula:

$$L \text{ (feet)} = \frac{492{,}000}{F} \times K$$

$$\text{or } L \text{ (metres)} = \frac{150{,}000}{F} \times K.$$

In this formula L is the aerial length in feet or metres for the desired frequency, F and K are constants depending on the frequency required. For wavelengths above 3,000 kilocycles, K = 0.96, for frequencies between 3,000 and 28,000 kilocycles = 0.95, and for higher frequencies above 28,000 kilocycles K = 0.94. F is the frequency in kilocycles.

Aerial-coupling Valve

The value of the aerial-coupling dimension is obtained from this formula.

$$C \text{ (feet)} = \frac{492{,}000}{F} \times K_1, \text{ or}$$

$$C \text{ (metres)} = \frac{150{,}000}{F} \times K_1.$$

$K_1 = 0.25$ for frequencies below 3,000 kilocycles, 0.24 for frequencies between 3,000 and 28,000 kilocycles, and 0.23 for frequencies above 28,000 kilocycles. F is the fundamental frequency in kilocycles.

The feeder clearance E between the aerial and the beginning of the feeder is obtained from this simple equation.

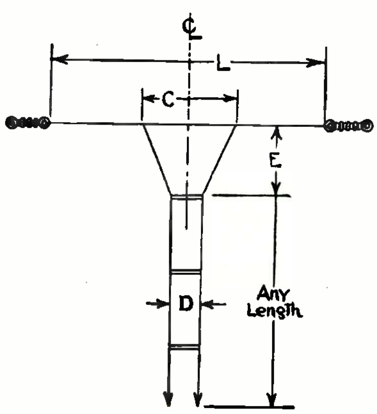


Fig. 14.—This aerial has feeders with a surge impedance of 600 ohms. It must be carefully erected

$$E \text{ (feet)} = \frac{492{,}000}{F} \times K_2 \text{ or}$$

$$E \text{ (metres)} = \frac{150{,}000}{F} \times K_2.$$

K_2 is 0.30 for all wavebands, while F is the frequency in kilocycles. These equations work out correctly for feeders having a surge impedance of 600 ohms, but they do not apply

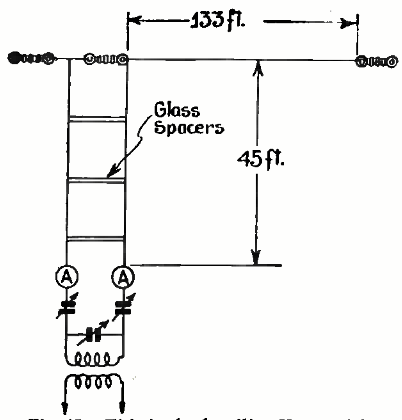


Fig. 15.—This is the familiar Hertz with a 133-ft. top and 45 ft. feeders. It is series and parallel tuned

to feeders of any other impedance.

The proper spacing for a 600-ohm transmission line is obtained from the following formula.

D (the spacing) = 75 × d. D being the spacing and d the diameter of the wire. If the wire diameter is in inches the spacing will be in inches, but on the other hand if the wire

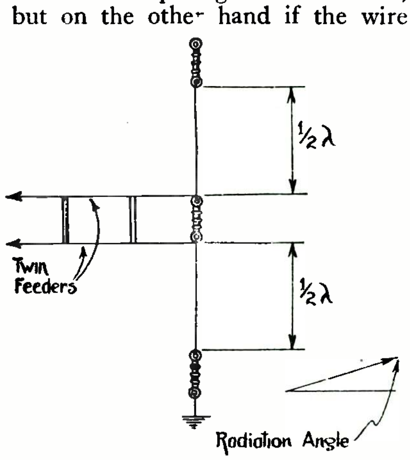


Fig. 17.—The vertical di-pole type for ultra short-wave reception. If used horizontally the earth should be disconnected at A

diameter is in millimetres the spacing will be in millimetres.

The length of the feeders is immaterial. Anything up to 500 ft. or 600 ft. is satisfactory. This system is really effective if you wish to erect the actual aerial at a distance from the receiver to overcome pick-up from local interference, etc.

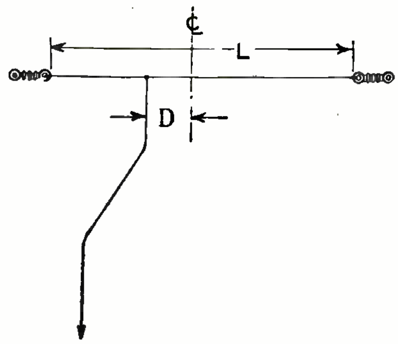


Fig. 16.—The Windom aerial is not very often used in this country. The downlead must be curved

An aerial that is not very often used in this country is the Windom. You can see how it is erected from Fig. 16. The distance between the downlead and the centre line is approximately 9 ft., while the total length of the horizontal portion can be obtained from the original formula. Make a very special note that the downlead has to be curved in the manner shown and not brought down with a right-angle bend.

Vertical Di-pole Type

The vertical di-pole is popular for ultra short-wave working. It is shown in Fig. 17, and here again the dimensions are obtained from the original formula. The current in the two aerials is in phase, and radiation is at all directions of the compass, but at a low angle to the earth's surface.

This same aerial can be erected horizontally, in which case one end is not earthed.

About the only type of aerial that has not been discussed is the kite arrangement. Several amateurs have been using kites of about 10 ft. diameter and have obtained especially good results using the simplest types of sets. I have in mind some experiments on Dunstable Downs where a doublet aerial was obtained by using two kites flying at approximately 600 ft. and about 66 ft. apart. With a two-valver American stations were heard on a loud-speaker in the early afternoon. Next month I hope to give you a short article describing this rather unusual aerial.

You will see from this that an aerial, or rather the aerial system, is not quite so simple as you imagine, but next time you begin to wonder just why you are not hearing all those out of the way amateur stations, just consider if your aerial is of the right type.

In Tune with the Trade

FETTER LANE'S Review of the Latest Catalogues

SEND TO US FOR THESE CATALOGUES!

Here we review the newest booklets and folders issued by six manufacturers. If you want copies of any or all of them, just cut out this coupon and send it to us. We will see that you get all the literature you desire.

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Send this coupon in an unsealed envelope, bearing ½d. stamp, to "Catalogue Service," WIRELESS MAGAZINE, 58-61 Fetter Lane, E.C.4. ***Valid till Jan.* 31.**

GOLTONE WHISTLE SUPPRESSOR

IN addition to the splendid catalogue issued by Ward and Goldstone, a leaflet is available giving full details of their second-channel whistle suppressor. For those experiencing this form of interference this unit should prove of great assistance.

When a super-het is used near a powerful station it may suffer from certain forms of interference, among which the above will no doubt be present and show itself by objectionable whistles.

The Goltone unit is fitted between the aerial and the receiver, and when used in conjunction with two variable condensers, it forms, in effect, two wavetraps. These can be adjusted in such a manner that the second-channel interference is eliminated. **432**

ACCUMULATOR CHARGING

HOW often have you switched on the radio to hear some particular item and found, much to your annoyance, that the low-tension hasn't a spot of juice left in it? How often have you been let down by the charging station not delivering your battery? This always seems to happen when you are expecting friends or when you need the radio.

These irritating snags, together with many others, are mentioned in the latest leaflet we have received from T. W. Thompson, of Greenwich, makers of A.C. chargers. They point out how easy it is to remove all the troubles connected with accumulators and their nasty habit of running down, by using one of the many types of chargers they produce.

A popular model capable of charging a 2-volt cell at .5 ampere is priced at the low figure of 19s. 6d., while a larger type suitable for 6-volt cells, charging at 1 to 1.5 amperes, is available at 35s.

These chargers are soundly engineered, free from frills, and employ Westinghouse metal rectifiers, while the transformer is such that a generous factor of safety is provided. All battery users should make a point of studying this interesting leaflet. **433**

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KINVA RADIO PRODUCTS

INTERESTING details of the latest heterodyne-whistle and sideband filters are given in the new folder to hand from the makers of these components.

Owing to the present crowded state of the ether reception is often subject to various forms of heterodyne interference, particularly if a powerful set is being used near a powerful station. It is possible by using suitable filters to remove, or at least reduce to a negligible extent, these annoying whistles.

Postlethwaite Bros., the makers of Kinva products, have specialised in the design and production of such filters, together with various forms of high-frequency chokes and allied components. The leaflet gives full technical details, while diagrams showing the necessary connections are included with each component. **434**

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VOIGT LOUD-SPEAKERS

THE illustrated folder issued by Voigt Patents, Ltd., contains most comprehensive details of their range of moving-coil loud-speakers. The units are designed to operate in conjunction with the special wooden or metal horns which form a feature of the complete assembly.

Those interested in high-quality reproduction and/or public-address work should not fail to secure a copy of this most interesting leaflet. Frequency-response curves are given showing the amazing capabilities of these loud-speakers and the advantages obtained with the twin diaphragm. **435**

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MAINS INTERFERENCE

NEWS for those suffering from interference troubles comes to hand with the special leaflet from the Telegraph Condenser Co., Ltd., describing two units for interference suppression.

Unit No. 1, which costs 10s. 6d., will be found quite satisfactory in the majority of cases, but where the trouble is of a severe nature then Unit No. 2 is recommended.

The makers state that the investigations made by the Post Office authorities indicate that 90 per cent of the cases of interference with radio reception are caused by disturbances travelling along the electric supply wires, as a result of which the house wiring acts as a transmitting aerial and the disturbances are picked up on the aerial system of the set.

Diagrams are provided with each unit and they can be fitted by novices quite easily. **346**

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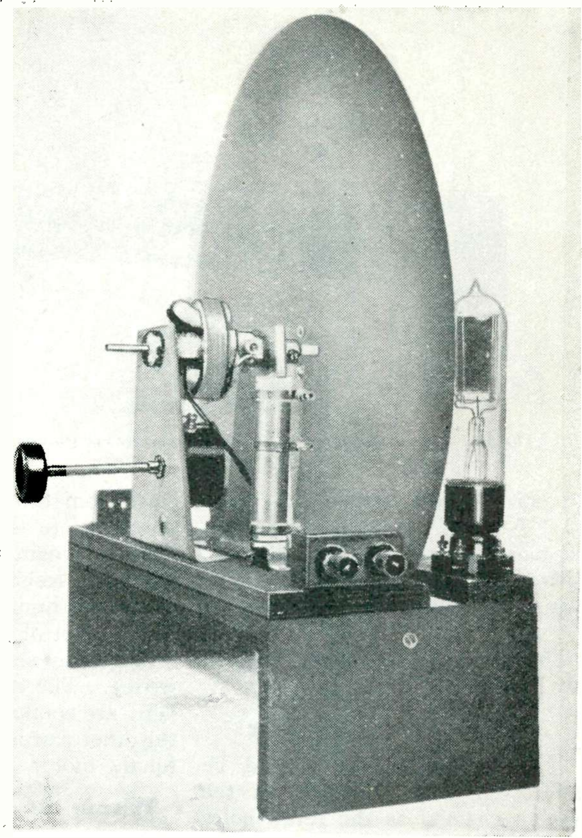
RADIO CABINETS

A VERY neat and profusely illustrated catalogue has just been received from Osborn. It contains thirty-two pages packed full of details and pictures of all the numerous types and styles of cabinets produced by this firm. The various models can be obtained in kit form; assembled but not polished; or completely assembled and polished ready for the receiver.

Individual designs can be made, and we understand that an estimate for work of this kind will be supplied by return of post. Those interested in providing an artistic and well-finished cabinet for their radio or radiogram will be well advised to secure a copy of this booklet. **347**

It Is Easy to Build A Television Receiver

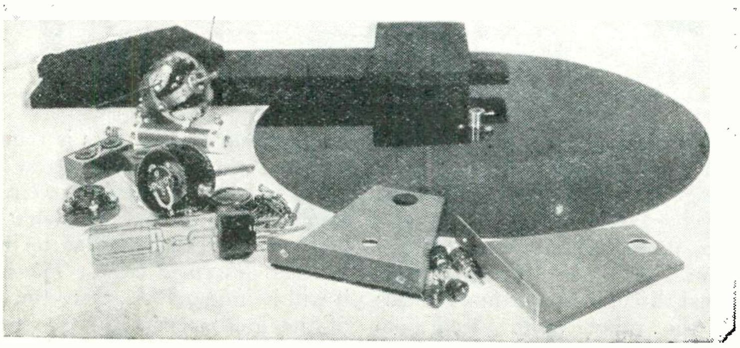


This article gives full instructions for building and operating a simple television receiver of the disc type. Your ordinary wireless set will be quite suitable for receiving the vision transmissions and the apparatus described is all that is necessary in addition

THERE are now a number of kits of parts available for the construction of simple television receivers of the disc type. These have been so designed that anyone, even without any previous knowledge of television, will have no difficulty in assembling the parts and, what is equally important, getting good results almost immediately.

At the outset it will be as well to explain exactly what the requirements are for the successful operation of a receiver of this type. We will assume, of course, the possession of a kit of parts for the mechanical part of the apparatus, and these are shown by the photograph. It will be observed that included in these parts is a motor for driving the scanning disc. Well, naturally this will require current, and the best way is to supply this from the mains, though six-volt motors can be obtained which can be driven from an accumulator.

Next there is the necessity of receiving the vision signals which are broadcast from London National. For this most ordinary three-valve receivers are quite suitable when a little modification has been made in the way of extra high-tension supply. The question is often asked at what distances from the transmitter (Brookmans Park) is it possible to receive the signals at sufficient strength. Successful reception can be obtained up to about three hundred miles, and in special circumstances even more, but it will be understood that at long distances it is possible that a more powerful receiver will be required. Good loud-speaker strength is a good criterion by which range can be judged; there may, of course, be noticeable fading at fairly long distances, and the picture will suffer in consequence, but this will not prevent a great deal of entertainment being obtained.



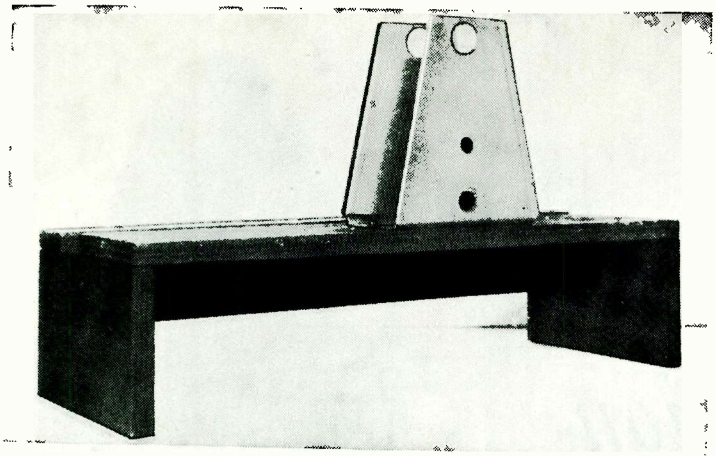
This photograph shows all the parts necessary for the assembly of the receiver

Moderate Requirements

It will be clear then that the requirements are very moderate and do not entail much more trouble than the operation of an ordinary broadcast receiver.

The kit of parts shown in the accompanying photographs are made by the Mervyn Sound and Vision Co., Ltd., and comprises :—

1 Mervyn BM3 motor.
1 Mervyn 15½ in. BD4 scanning disc.
1 variable motor control.
1 fixed series mains resistance with adjustable link.



The first stage in the construction is to assemble the stand and the motor mount

1 pair of motor supports.
1 " Nu-glo " 16 lamp and holder.
2 pairs of terminals with mounts.
Motor chassis parts.
Sundry screws and connecting wire.

The whole is sold for the remarkably low price of 60s.

Assembling the Receiver

The first work that should be undertaken is the assembly of the wooden chassis; as the screw-holes are already made this is quite a simple matter and does not necessitate any measurements being made. The chassis is made of 5-ply wood and care must be taken when inserting the screws into the edges of this that the ply is not split apart. This can be avoided by making holes in the edges before the screws are put in.

Motor Stand

The motor stand serves the dual purpose of holding the motor and the motor control resistance, so before screwing the stand on the chassis the variable resistance should be fixed in position on the front member of the stand. One screw should then be inserted in each motor upright and the motor put into position. To do this it is necessary to remove the grease caps at each end of the motor spindle; these can easily be prised off with a screwdriver. Note that the commutator end of the motor is nearest the slot in the chassis baseboard.

A special type of neon lamp which has a wire grid is supplied with this kit, and the lamp holder must be so placed that the wire grid faces the disc. This will be clear from the photograph showing the complete assembly.

The remaining components are the fixed resistance for the motor, and the terminals. The positions of these is not of consequence, but the arrangement shown makes for simple wiring. The two terminals near the lamp are connected to the lamp, and the other pair is for the mains supply for the motor.

Wiring the Lamp and Motor

To wire the lamp, join the lamp-holder terminal (corresponding to the plate connection in a normal 4-pin valve holder) to the positive; the negative is connected to either terminal on the lamp-holder corresponding to the filament connection on a valve holder.

The motor connections are as follows: Take a wire from one mains terminal directly to one motor lead; from the other motor lead join up to one terminal on the variable control; from the other terminal of this control take a flexible lead to the centre link of the fixed series resistance; the bottom link of the fixed resistance connect directly to the other mains terminal.

The motor speed is roughly set by adjustment of the fixed resistance and fine control carried out by the variable motor control.

The value of the fixed resistance is 700 ohms, and the following scale will give the approximate position at which to set the movable connection on the fixed resistance for trial.

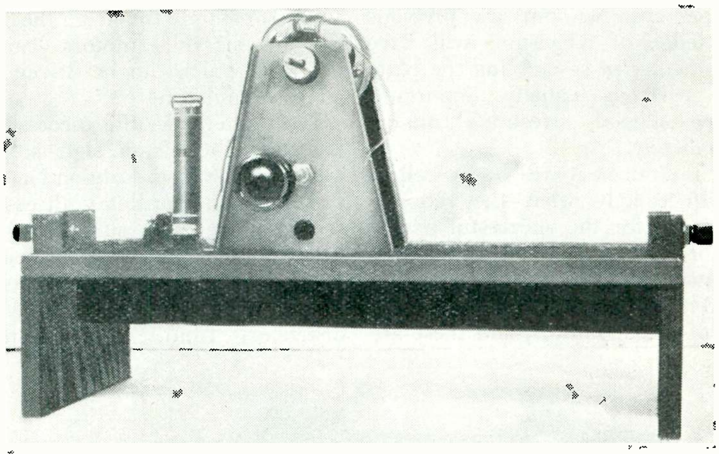
Final Adjustment

Final adjustment should be made under actual receiving conditions, and once the correct value is found the connection can be permanently fixed.

D.C. Mains.	*Values, Ohms.*	*A.C. Mains.*	*Values, Ohms.*
250	700	240	650
220	550	220	550
200	530	200	450

The scanning disc should be placed on the motor spindle with the polished side facing the lamp, and a test should be made to see that it runs quite freely and clear of either side of the slot in the chassis.

This completes the assembly, and there remains the connecting of the lamp to the wireless receiver. A minimum of 185 volts is required to cause the lamp to " strike " or light, and if under ordinary circumstances this is not available the high tension can be added to in the manner described later. The lamp, it will be understood, takes the place of the loud-speaker, and there are many methods of connecting it to

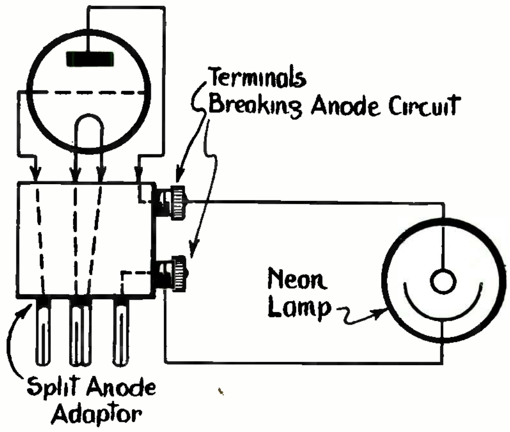


This photograph shows the motor and the central resistances fitted the receiver. If the receiver is a commercial type the use of a split anode adaptor is recommended as shown by the diagrams.

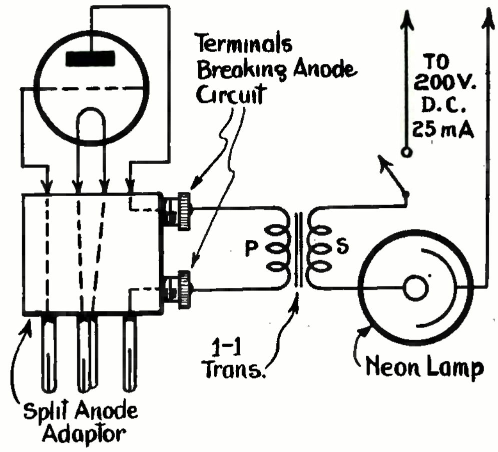
With this method the lamp is either used directly in the anode circuit of the last valve, or it can be coupled by means of a 1—1 transformer. As will be seen, the top terminal of the adaptor is connected to one side of the lamp or transformer and the other side of the transformer is connected to maximum high-tension positive. This is one of the leads on the loud-speaker transformer and can be found by connecting one side of a voltmeter to the chassis of the receiver and trying the other on the transformer connections until the highest reading is obtained.

If a voltmeter is not available, tune the set to a station broadcasting music, and then place the free lead from the lamp (or 1—1 transformer) on each terminal of the loud-speaker transformer in turn. The terminal required is that which when contact is made the set becomes silent. This connection cuts out the speaker, and in addition any filters which have been installed for obtaining good reproduction and are not desirable for television.

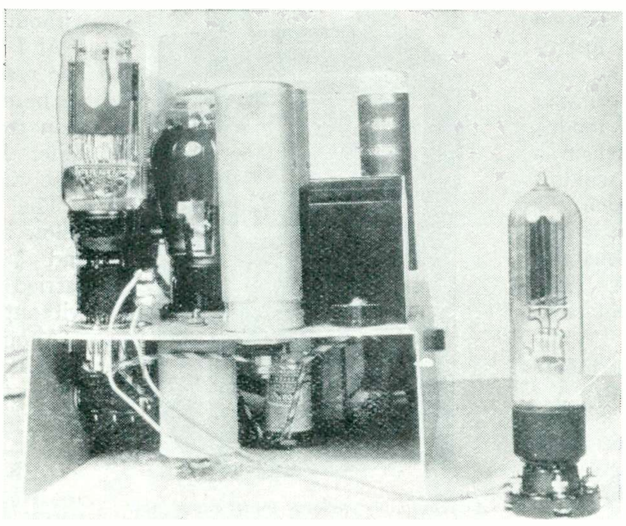
Other schemes of connections are shown by the diagrams which with the text below are self-explanatory. Two of these, it will be observed, allow for the addition of high-tension should the ordinary supply not be a sufficiently high voltage.



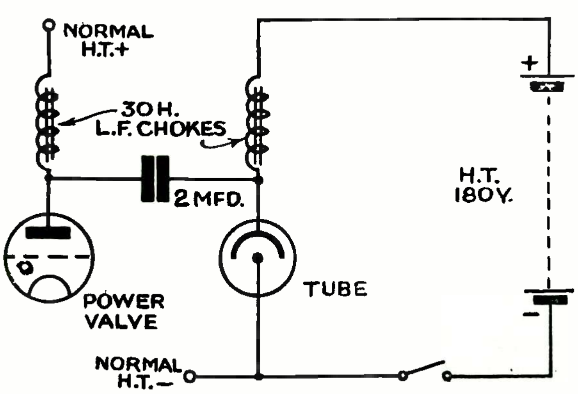
A simple method of connecting the neon lamp to the receiver is by means of a split-anode adaptor



When a mains eliminator is used it is necessary to use a 1-1 transformer as shown in this diagram



This photograph shows the neon lamp connected by means of a split anode adaptor as in the first circuit

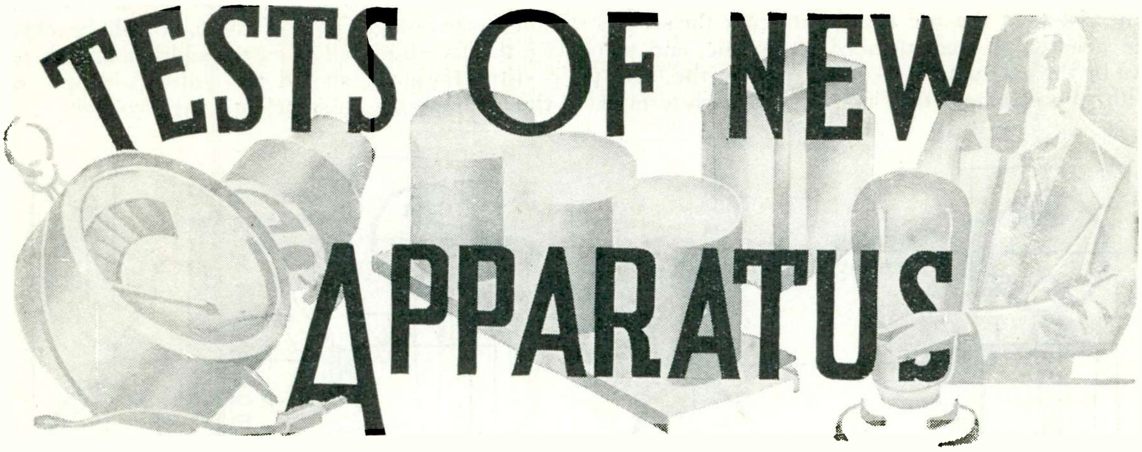


The connections of the neon lamp when the set has a choke output circuit

Providing that suitable connections have been made from the receiver to the lamp, when the set is switched on the latter should glow irrespective of whether any transmission is being received.

Now if the motor is set running and a broadcast is tuned in, a field of light will appear which is constantly changing in appearance due to the light being modulated by the signals which are being received. If this condition is obtained then everything is in order for the reception of a television broadcast and the resolving of a picture will merely depend upon obtaining the correct speed of the scanner. This is exactly 750 revolutions per minute, and the simplest way of checking it is to paint a circle of eight dots on the disc; if these are viewed by the light of a lamp (preferably a neon lamp) fed from 50-cycle A.C. mains they will appear to stand still when exactly this speed has been attained.

Control of speed is a little difficult at first but there are indications in the image formed which after a little practice soon enable the speed to be gauged and adjustment made accordingly. After a little practice it is easy to resolve a picture almost at once.



TESTS OF NEW APPARATUS

Pifco Rotameter :: Amplion Fixed Resistances :: Ferranti Droitwich Wavetrap :: Regular Chemical Earth Tube

PIFCO ROTAMETER

APPARATUS: Multi-range test meter.
MAKERS: Pifco, Ltd.
PRICE: £2 2s.

THE new Pifco moving-coil Rotameter is a de-luxe edition of the well-known eight-range instrument introduced by this firm some time ago. This latest type is similar in appearance to the earlier model.

The instrument is housed in a black bakelite case with a window at the bottom through which the indications appear. A knob at the side changes the connections for the various ranges and at the same time alters the scale to the new readings.

The resistance of the instrument is 500 ohms per volt, so that the full scale deflection is only 2 milliamperes, which is a very desirable feature. The actual ranges are 0-5, 0-20, 0-100, and 0-400 volts; 0-10, 0-50, and 0-250 milliamperes; and a resistance scale operated by an internal battery which gives readable measurements on resistances from a few ohms up to about 10,000 ohms.

There is a four-pin valve socket on the top for testing the continuity of filaments and heaters; adapters are supplied for other valves.

On test we found that the instrument was accurate to within a few per cent. On the 10-milliampere range, for example, the reading for 5 milliamperes was 5.2, and for 10 milliamperes it was 9.85.

Other ranges were checked in the same way, and were found to be of the same order of accuracy, the maximum error being 5 per cent.

At the low price of two guineas this instrument must be considered an attractive proposition. The convenience of having the correct scale on each range is a very real one.

A reasonably priced multi-range test meter, the moving-coil Rotameter is ideal for amateur requirements

AMPLION FIXED RESISTANCES

APPARATUS: Wire-wound resistors.
MAKERS: Amplion (1932), Ltd.
PRICE: 1-watt type, 22 valves from 50 to 100,000 ohms. 1s.; 3-watt type, 2s.

AMPLION has recently introduced a line of wire-wound resistors. These are very neatly made, being wound on glass tubes with very fine wire. The usual thick wire terminations are used, and the resistances are colour coded to indicate their value in the usual manner.

We received for test a 20,000 and a 50,000 1-watt type and a 100,000 3-watt type. The 1-watt type are 1-in. long and are wound on a $\frac{5}{16}$-in. diameter tube. They were found to be approximately 4 per cent low in resistance, which is quite a satisfactory tolerance, while they actually carried over 3 watts without getting unduly hot.

At 1 watt they are quite cool, and one resistor carried 5 watts for half an hour without any damage other than the burning off of the colour code. Its resistance at the end of the time was the same as before.

The 3-watt type was 5 per cent below in value, and was $1\frac{5}{8}$ in. long and $\frac{3}{8}$ in. wide. This resistor carried over twice its rated wattage without any distress.

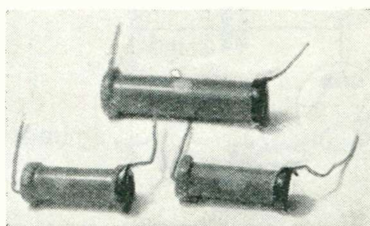
Altogether these Amplion resistors can be considered very creditable products from all points of view.

FERRANTI WAVETRAP

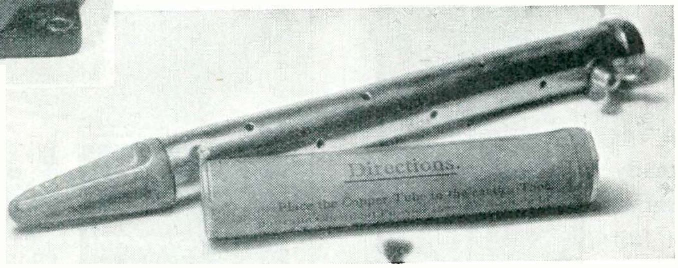
APPARATUS: 1,000-2,000-metre wavetrap.
MAKERS: Ferranti, Ltd.
PRICE: 7s. 6d.

WE have received from Ferranti, Ltd., a particularly effective wavetrap intended for use by those troubled with interference from the new long-wave station at Droitwich.

The device consists of a single layer coil wound on a ribbed former some $2\frac{3}{4}$ in. in diameter tuned with



Showing the three Amplion fixed resistances tested by "W.M."



(Above) The Ferranti wavetrap is a boon for those in the Droitwich swamp area. (Right) The Regular chemical earth tube, an efficient earthing device that is easy to install

a pre-set condenser to the required frequency. The coil is housed in a circular bakelite moulding, in the top of which is the knob operating the condenser, together with three sockets.

A connection is taken from one of these to the aerial terminal on the set, while the aerial itself is tapped into either one or other of the remaining two, which cuts the rejector in or out as required.

On test we found that the device was very good, possibly because the ratio of capacity to inductance is large, giving a selective circuit.

As a test we took an ordinary long-wave tuning coil and supplied it from a signal generator through an artificial aerial. The circuit and the rejector were tuned exactly to 1,500 metres, and then the frequency from the generator was varied by 5 kilocycles. The voltage across the coil in this slightly mistuned condition was .8 volt with the rejector out, and .01 volt with the rejector in circuit.

This, of course, is the practical condition, for one uses the rejector to cut out the signal from Droitwich a few kilocycles off-tune and so clear the air for foreign stations.

The test shows that only 5 kilocycles off tune the strength of Droitwich is reduced to $^1/_{80}$ of its normal value. At 10 kilocycles off tune the reduction was too large to be measured.

Many rejectors have an unpleasar action on the normal tuning of th circuit. Therefore we made some further tests to find what proportion of the normal voltage was developed with the rejector in circuit at frequencies some way away from the tuning point.

Results are shown in the curve below and it will be seen that the disturbance of the tuning introduced by the rejector is only quite small.

This is a well-designed component and one which can be thoroughly recommended.

◆ ◆ ◆

REGULAR EARTH TUBE

APPARATUS: Earth Tube.
MAKERS: Polchar's Wireless, Ltd.
PRICE: 2s. 0d.

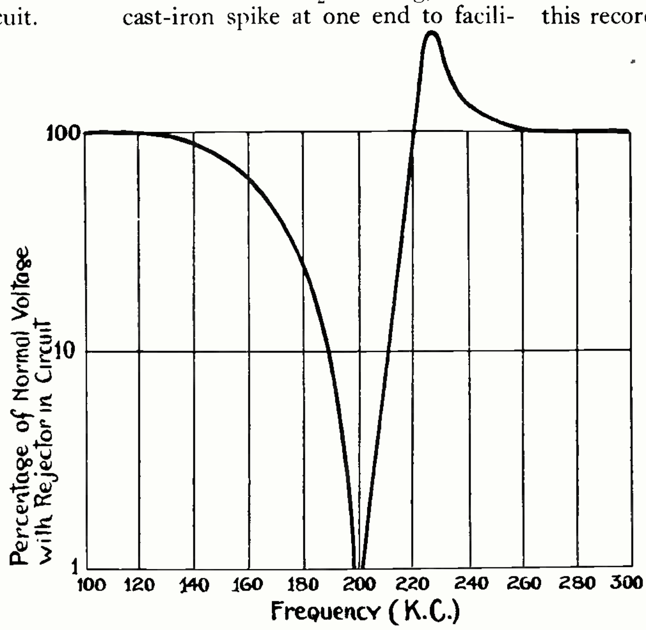
THE Regular earth tube is of the chemical variety. It consists of a short tube $7\frac{1}{2}$ in. long, with a cast-iron spike at one end to facilitate driving the rod into the ground. The top of the tube is capped with a brass ferrule to avoid damaging the tube when hammering it.

At intervals down the tube perforations are provided, and the procedure is to fill the inside of the tube with a chemical powder after it is in position, and then to introduce water from time to time through the hole in the top.

The chemicals dissolved by the water filter through the holes into the surrounding soil and ensure a good contact.

It is difficult to carry out any exact test on a device of this nature, but the principle is sound and the tube will give good results if properly used.

Manufacturers are invited to send apparatus for test and report in these pages.



A curve taken showing the effect on a circuit's efficiency at various frequencies by the Ferranti wavetrap

ROYAL WEDDING RECORD

AN interesting new record has been released by Decca of the anthem, *Alleluya*, which was specially written for the Abbey wedding of the Duke of Kent and Princess Marina.

The record was made in Westminster Abbey by the Westminster Abbey Choir under Dr. Ernest Bullock with O. H. Peasgood at the organ.

All the proceeds from the sale of this record will be given to charities nominated by their Royal Highnesses. Each record bears the signatures, too, of the Duke and Duchess.

The number is Decca R001 and the price is 2s. 6d.

From a recording point of view the disc is excellent for testing out the capabilities of a gramophone amplifier. Most noticeable in this record is the fine bass recording of the Abbey organ and the high voices of the boys in the choir.

The name and address of the makers is the Decca Record Co., Ltd., 1-3 Brixton Road, London, S.W.9.

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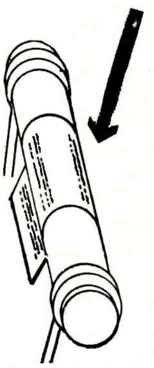

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You know these two favourite broadcasters. Jack Jackson, leader of the Dorchester Hotel band, is discussing a knotty problem with Peggy Cochrane before the mike

News from All Quarters

IT is interesting to note that the Central Council for School Broadcasting has approved the following Ferranti products for school use: the type M1 Plus permanent-magnet moving-coil loud-speaker, Lancastria, Arcadia and Gloria super-het receivers.

The M1 Plus loud-speaker, in addition to being approved for use in schools by itself, has also been approved as an extension instrument for use with any of these sets.

It will be appreciated that this indicates a very high standard of performance as the requirements, particularly as regards good and clear reproduction and large volume, are specially exacting in the case of radio apparatus for school use.

◆ ◆ ◆

Radio Instruments, Ltd., has also received the approval of the Council for the use of its three-valve A.C. receiver with separate 9-in. permanent-magnet moving-coil loud-speaker mounted on a baffle-board.

A similar set chassis supplied as a radio gramophone with separate loud-speaker has also been approved for use in schools.

These sets have been specially designed for this particular work and are so arranged that the controls are covered by doors fitted with a lock and key. A two-position tone control is also provided.

On the recommendation of the Central Council for School Broadcasting the sets were designed for use with external loud-speakers mounted on a 30-in. baffle, as this method is considered to be more suitable for school use than a set with self-contained reproducer.

◆ ◆ ◆

The manufacture and distribution of Epoch loud-speakers has now been taken over by the Radio Development Co., of Bush House, Aldwych, London, W.C.1. We understand that exactly the same method of distribution is being employed, and all the various Epoch models will be continued.

A very neat illustrated folder is now available which contains full details of all loud-speakers together with a description of the Epoch moving-coil microphone.

◆ ◆ ◆

In the article by Alan Hunter, "The B.B.C. Plans a New Regional Scheme," which appeared in the December issue, there is a slight error at the end of the first column. The last line should read "alternative through an experimental 5GB," and not "5CE," as printed.

◆ ◆ ◆

One of the most novel wedding presents received by the Duke of Kent and Princess Marina was a set of the gramophone records of the works of Sibelius.

Three volumes containing the greatest works of the Finnish composer, and which he himself recommends as "the only perfect performance of my music," were the gift from the Viscountess Cholmondley, who selected them on the advice of Mrs. Alfred Imhof.

◆ ◆ ◆

A rejector unit, neatly housed in an aluminium case, has now been placed on the market by Berclif, Ltd. It is suitable, according to the makers' claims, for use on medium or long waves, and should prove of great assistance in cutting out Droitwich. It is priced at 3s. 9d.

◆ ◆ ◆

A new permanent-magnet moving-coil loud-speaker has been introduced by the Triotron Radio Co., Ltd. It is fitted with an input transformer designed to match up with valves having impedances between 8,000 and 12,000 ohms.

A circular magnet is employed providing a flux density of 5,500 lines, while the cone has a diameter of 8 in., and is formed from moulded buckram.

A dust cover is fitted, and the whole assembly finished in matt copper. The retail price is 30s.

◆ ◆ ◆

We understand that Tungsram are shortly to release a new octode-frequency-changer suitable for operation in mains receivers. The type number is MO465, but at the time of going to press no details are available as to the price.

The heater, indirectly heated, takes .75 ampere at 4 volts, while the anode rating is 250 volts, the screen needing 70 volts maximum. A standard English 7-pin base is fitted.

◆ ◆ ◆

The makers of the Milnes high-tension supply unit have now released a new three-valve battery receiver employing Q.P.P. output and iron-core coils.

The receiver is housed in an attractive figured walnut and macassar-ebony cabinet, space being provided for high- and low-tension batteries.

The price is £10 10s., complete with valves, or if supplied with a 150-volt Milnes high-tension unit and low-tension accumulator, £17 18s. 6d.

Modern Acoustics

AN interesting technical publication is a book called "Modern Acoustics," by A. H. Davis, D.Sc., published by G. Bell & Sons, Ltd., price £1 6s.

It is not strange that a book on modern acoustics should contain a very large proportion of matter devoted to the application of electricity to acoustics and sound engineering. Accordingly, "Modern Acoustics" should appeal particularly to anyone who is connected in any way with sound reproduction.

In dealing with the subject, which has an almost unlimited field, the author has very wisely treated everything basically. In order fully to understand the reasoning and proofs of many of the statements it is essential for the reader to have a knowledge of calculus and ordinary mathematics. At the same time, however, the book is so written that a non-mathematical reader can obtain a thorough understanding of the whole subject, and nowhere does the author take for granted any steps in scientific reasoning.

Chapter by Chapter

The first four chapters, which occupy some 70 pages, deal essentially with fundamentals. Then follows some exceptionally useful information on the subject of electro-acoustical relations and audio-frequency electrical apparatus in general.

Consideration is next given to various methods of measurement of intensity, loudness and frequency. This is followed by two chapters which again deal with the subject fundamentally and relate to sound transmission, acoustic impedance and absorption.

Chapter 14 is particularly useful and deals with the ear and human hearing. The remainder of the book is devoted to the measurement and suppression of noise, the acoustics of buildings, and sound recording and reproduction systems.

Finally, some eighteen pages are devoted in the form of appendices to various electric and acoustic formulæ, which should prove invaluable for reference purposes.

The book is undoubtedly an extremely useful addition to existing works on acoustic problems, and its wide scope and basic method of treatment makes it an ideal volume of reference.—*P. D. T.*

INDEX TO ADVERTISERS

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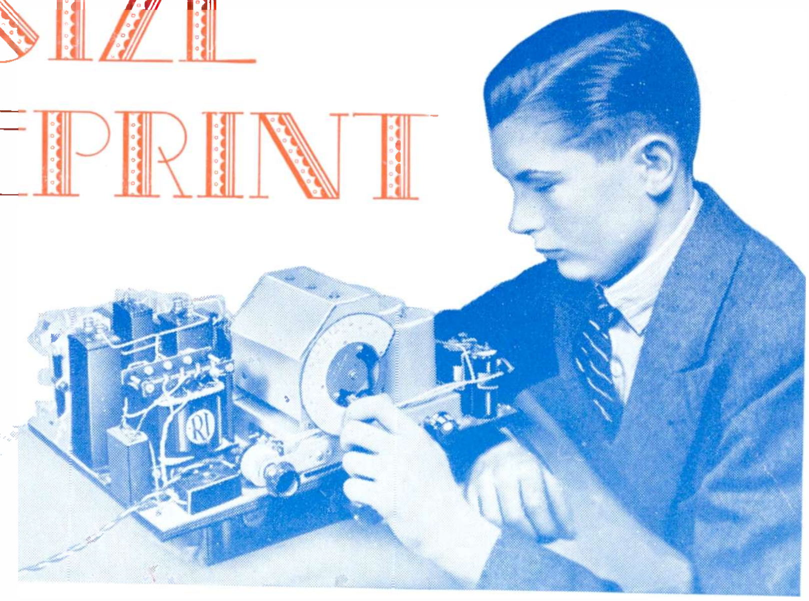

Each blueprint shows the position of each component and every wire and makes construction a simple matter. Copies of "Wireless Magazine" and of "Amateur Wireless" containing descriptions of most of these sets can be obtained at 1s. 3d. and 4d., respectively, post paid. Index letters "A.W." refer to "Amateur Wireless" sets and "W.M." to "Wireless Magazine" sets. Send, preferably, a postal order (stamps over sixpence unacceptable) to "Wireless Magazine," Blueprint Dept., 58-61 Fetter Lane, London, E.C.4.

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Melody Ranger Two (D, Trans)	13.5.33	AW388
Full-volume Two (SG, Det, Pen)	17.6.33	AW392
Iron-core Two (D, Trans) ...	29.7.33	AW395
Iron-core Two (D, QPP) ...	12.8.33	AW396
B.B.C. National Two with Lucerne Coil (D, Trans) ...	17.2.34	AW377A
Big-power Melody Two with Lucerne Coil (SG, Trans) ...	17.2.34	AW338A
Lucerne Minor (D, Pen) ...	24.3.34	AW426

Three-valvers: Blueprints, 1s. each.

Transportable Three (SG, D, Pen)	Feb. '32	WM271
Multi-mag Three (D, 2 Trans)...	June '32	WM288
Percy Harris Radiogram (HF, D, Trans)	Aug. '32	WM294
£6 6s. Radiogram (D, RC, Trans)	Apr. '33	WM318
Simple-tune Three (SG, D, Pen)	June '33	WM327
Tyers Iron-core Three (SG, D, Pen)	July '33	WM330
C.-B. Three (D, LF, Class B) ...	Sep. 33	WM333
Economy-pentode Three (SG, D, Pen)	Oct. '33	WM337
All-wave Three (D, 2LF) ...	Jan. '34	WM348
"W.M." 1934 Standard Three 5G, D, Pen)	Feb. '34	WM351
£3 3s. Three (SG, D, Trans) ...	Mar. '34	WM354
Iron-core Band-pass Three (SG D, QP21)	June '34	WM362
1935 £6 6s. Battery Three (SG, D, Pen)	Oct. '34	WM371
£8 Radiogram (D, RC, Trans)...	21.5.32	AW343
New Regional Three (D, RC, Trans)	25.6.32	AW349
Class-B Three (D, Trans, Class B)	22.4.33	AW386
New Britain's Favourite Three (D, Trans, Class B)	15.7.33	AW394
Home-built Coil Three (SG, D, Trans)	14.10.33	AW404
Fan and Family Three (D, Trans, Class B)	25.11.33	AW410
£5 5s. S.G.3 (SG, D, Trans) ...	2.12.33	AW412
1934 Ether Searcher: Baseboard Model (SG, D, Pen)	20.1.34	AW417
1934 Ether Searcher: Chassis Model (SG, D, Pen)	3.2.34	AW419
Lucerne Ranger (SG, D, Trans)	3.3.34	AW422
Cossor Melody Maker with Lucerne Coils	17.3.34	AW423
P.W.H. Mascot with Lucerne Coils (Det, R.C., Trans) ...	17.3.34	AW337A
Mullard Master Three with Lucerne Coils	24.3.34	AW424
Pentaquester (HF, Pen, D, Pen)	14.4.34	AW431
£5 5s. Three: De-luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	9.6.34	AW437
All-Britain Three (HF Pen, D, Pen)	6.9.34	AW448
"Wireless League" Three (HF Pen, D, Pen)	3.10.34	AW451

Four-valvers: Blueprints, 1s. 6d. each.

Quadradyne (2 SG, D, Pen) ...	Feb. '32	WM273
Calibrator (SG, D, RC, Trans)	Oct. '32	WM300
Table Quad (SG, D, RC, Trans)	Nov. '32	WM303
Calibrator de Luxe (SG, D, RC, Trans)	Apr. '33	WM316
Self-contained Four (SG, D, LF, Class-B)	Aug. '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	Feb. '34	WM350
65/- Four (SG, D, RC, Trans)	17.12.32	AW370
"A.W." Ideal Four (2 SG, D, Pen)	16.9.33	AW202
2 H.F. Four (2 SG, D, Pen) ...	17.2.34	AW421
Crusaders' A.V.C. 4 (2 HF, D, QP21)	18.8.34	AW445
(Pentode and Class-B outputs for above; blueprints 6d. each)	25.8.34	AW445A

SPECIAL HALF-PRICE OFFER

Blueprints of the following "Wireless Magazine" sets described in this issue are obtainable at the special price, given below, if the coupon on last page is used before Jan. 31, 1935.

Graduating to a Low-frequency Stage (D.2LF) WM378	6d.
1935 Super Five (Five-valve battery superhet) WM379	9d.
"W.M." Long-wave Converter (Det.-osc. unit) WM380	6d.

Five-valvers: Blueprints, 1s. 6d. each.

Super-quality Five (2 HF, D, RC, Trans)	May '33	WM320
New Class-B Five (SG, D, LF, Class B)	Nov. '33	WM340
Class-B Quadradyne (2 SG, D, LF, Class B)	Dec. '33	WM344

Mains Operated

Two-valvers: Blueprints, 1s. each.

Economy A.C. Two (D, Trans) A.C.	June '32	WM286
Consolectric Two (D, Pen) A.C.	23.9.33	AW403

Three-valvers: Blueprints, 1s. each.

D.C. Calibrator (SG, D, Push-pull Pen) D.C.	July '33	WM328
Simplicity A.C. Radiogram (SG, D, Pen) A.C.	Oct. '33	WM338
Six-guinea AC/DC Three (HF Pen, D, Trans) A.C./D.C. ...	July '34	WM364
Mantovani A.C. Three (HF Pen, D, Pen) A.C.	Nov. '34	WM374
Home-lovers' New All-electric Three (SG, D, Trans) A.C. ...	25.3.33	AW383
S.G. Three (SG, D, Pen) A.C....	3 6 33	AW390
A.C. Triodyne (SG, D, Pen) A.C.	19.8.33	AW399
A.C. Pentaquester (HF Pen, D, Pen) A.C.	26.6.34	AW439

Four-valvers: Blueprints, 1s. 6d. each.

A.C. Quadradyne (2 SG, D, Trans) A.C.	Apr. '32	WM279
All Metal Four (2 SG, D, Pen) A.C.	July '33	WM329
A.C. Melody Ranger (SG, DC, RC, Trans) A.C.	4.3.33	AW330
AC/DC Straight A.V.C. 4 (2 HF, D, Pen) A.C./D.C. ...	8.9.34	AW446

SUPER-HETS

Battery Sets: Blueprints, 1s. 6d. each.

Super Senior	Oct. '31	WM256
1932 Super 60	Jan. '32	WM269
Q.P.P. Super 60...	Apr. '33	WM319
"W.M." Stenode	Oct. '34	WM373
Modern Super Senior	Nov. '34	WM375
1934 Century Super	9.12.23	AW413

Mains Sets: Blueprints, 1s. 6d. each.

1932 A.C. Super 60, A.C. ...	Feb. '32	WM272
Seventy-seven Super, A.C. ...	Dec. '32	WM305
"W.M." D.C. Super, D.C. ...	May, '33	WM321
Merrymaker Super, A.C. ...	Dec. '33	WM345
Heptode Super Three, A.C. ...	May '34	WM359
"W.M." Radiogram Super, A.C.	July '34	WM366
"W.M." Stenode, A.C. ...	Sep. '34	WM370
1934 A.C. Century Super, A.C.	10.3.34	AW425